

ORIGINAL ARTICLE

Impact of COVID-19 on paediatric care in Japan: Analysis of national health insurance claims data

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Abstract

Aim: To quantify the impact of the COVID-19 pandemic on paediatric care use compared to adult care and identify affected subdomains.**Methods:** Data from the National Database of Health Insurance Claims and Specific Health Checkups of Japan (NDB) for six fiscal years (FY2016–2021) were analysed. Pre-pandemic (FY2016–FY2019) and pandemic years (FY2020, FY2021) were compared to delineate changes in medical services for paediatric and adult patients. Virtually all individuals who received medical care in Japan during this period were included.**Results:** In FY2019, healthcare utilisation by the paediatric population (under 15 years) accounted for 24% of 245 million first outpatient visits, 7% of 1.2 billion follow-up visits, and 2.6% of 297 million patient-days hospitalisations. In FY2020, outpatient visits of those aged 0–4 years decreased by 44% (first visit) and 24% (follow-up visit) compared to FY2019, and hospitalisations decreased by 47%, with the largest declines observed in community medical institutions across all age groups.**Conclusion:** The COVID-19 pandemic led to a substantial reduction in paediatric healthcare utilisation in Japan, varying by age and type of care. These findings may inform the rational allocation of healthcare resources during public health emergencies.

KEYWORDS

paediatrics, COVID-19, insurance claim review, pandemics, universal health insurance

1 | INTRODUCTION

The Coronavirus Disease 2019 (COVID-19) pandemic impacted lives worldwide. Japan has experienced several COVID-19 outbreaks since January 2020. The Japanese government declared a state of emergency for the entire country from 7 April 2020 to 25 May 2020, and for 11 prefectures from 8 January 2021 to 21 March 2021. These measures included stay-at-home orders, mobility restrictions, schools and public facility closures, bans on large-scale events and encouragement of remote work.

Decreases in hospitalisations during the COVID-19 pandemic have been reported in several countries.^{1,2} In Brazil, research found a significant decrease of 27% in adult hospitalisations for chronic non-communicable diseases, including cancer, diabetes mellitus, cardiovascular diseases and chronic respiratory diseases, during the pandemic period compared to the pre-pandemic period.¹ In the United States, an analysis of data from 286 hospitals revealed a 21% decrease in all-cause hospitalisations between March and April 2020.² Furthermore, not only inpatients but also outpatients decreased during the pandemic. During the early pandemic period, the total number of emergency

Abbreviations: COVID-19, coronavirus disease 2019; FY, fiscal year; NDB, National Database of Health Insurance Claims and Specific Health Checkups of Japan;

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department visits in the United States was 42% lower than during the same period a year earlier, with the largest declines in visits in persons aged ≤ 14 years.³ Declines in the number of paediatric outpatients have been reported in other countries as well. A study in Italy showed a 73%–88% decrease in paediatric emergency room visits during 1–27 March 2020 compared to 2018–2019, attributing this to caregivers' fear of COVID-19 infection.⁴ This trend continued after the early pandemic period; in the United States overall paediatric emergency department visits decreased by 51%, 22% and 23% during 2020, 2021 and January 2022, compared with 2019.⁵ In addition to a decrease in seeking medical attention, a decrease in the reported numbers of respiratory tract infections other than COVID-19 has been reported,^{5–8} suggesting changes in the epidemiology of infectious diseases as a result of public health efforts.

In Japan, the impact of COVID-19 on healthcare supply and demand has also been reported. Compared to the pre-pandemic period, the total number of outpatient visits during the pandemic decreased by about 10% according to the comprehensive national health insurance claims data.⁹ Hospitalisations of individuals aged 1–17 years in 272 acute care hospitals in Japan (representing 12.4% of acute care hospitals) decreased by 38% from February to May of 2020.¹⁰ However, details on how paediatric care was affected compared to adult care remain unknown, as no age-specific analysis has been conducted.

In this study, we examined the impact of the COVID-19 pandemic on paediatric care in Japan using comprehensive national health insurance claims data that cover more than 98% of all insurance claims in Japan. We specifically examined differences in the magnitude of impact between adult and paediatric care, as well as across several subdomains (e.g. inpatient, outpatient) within paediatric care.

2 | METHODS

2.1 | Study design and population

We analysed data derived from the National Database of Health Insurance Claims and Specific Health Checkups of Japan (NDB). NDB includes comprehensive health insurance claims and specific health check-up data. The data collection process involves gathering information from medical institutions across Japan, which submit health insurance claims for various medical services such as outpatient care, inpatient treatment, prescriptions and diagnostic tests. To ensure privacy, the collected data are anonymised, removing personal identifiers to prevent individual identification. The anonymised data are then aggregated and made available as NDB Open Data Japan, and as of May 2024, data are available up to fiscal year (FY) 2021. NDB contains more than 98% of the national health insurance claims data, reflecting national healthcare trends.

The FY in Japan starts in April and ends in March. In this study, we defined data from those aged 0–14 years as paediatric and from those aged over 15 years as adult. NDB Open Data Japan provides the number of health insurance claims (counts) for each FY by age group in 5 years increments.

Key notes

- This study demonstrates the impact of the COVID-19 pandemic on healthcare utilisation.
- An analysis of near-complete national health insurance claims data revealed that, among all age groups, the pandemic had the greatest impact on healthcare utilisation in those aged 0–4 years, particularly concerning first outpatient visits and hospitalisations in community medical institutions.
- This suggests major factors to be considered for the appropriate allocation of healthcare resources in future pandemics.

2.2 | Outpatients

NDB Open Data Japan provides the number of claims for outpatient care, including 'First Visit Fee' and 'Repeat Visit Fee', claimed for each first visit and follow-up visit, respectively.

2.3 | Hospitalisations

NDB Open Data Japan provides the number of claims for inpatient management fees, which are determined by age, severity of illness, and type of medical institution. Since a specific fee is counted once a day for each patient, the total number of claims corresponds to the total number of hospitalisations expressed as patient-days.

To perform a subgroup analysis of paediatric inpatient care, we extracted specific hospitalisation fees, including 'Paediatric Inpatients' and 'Neonatal Inpatients'. Paediatric Inpatients are divided into five categories based on the scale of the paediatric department at each institution (see Appendix S1). In brief, 'Tertiary Department Fee' applies to admissions to tertiary paediatric institutions (i.e. children's hospitals and university hospitals) that provide advanced paediatric care. Large, Medium, Small and Basic Department Fees apply to admissions to community hospitals with at least nine, five, three and one full-time paediatrician, respectively. Hospitals that primarily treat adult patients or lack dedicated paediatricians do not meet the criteria for specific hospitalisation fee as 'Paediatric Inpatients'. As a result, hospital admissions for children under 15 years of age at these facilities are not included in this subgroup analysis.

2.4 | Statistical analysis

To quantify the impact of the COVID-19 pandemic on total hospitalisations (patient-days) and total outpatient visits (counts), these numbers for FY2020 and FY2021 are presented as percentages relative to FY2019. Percentages from FY2016 to FY2018 are also shown to illustrate secular trends unrelated to the COVID-19 pandemic. Data

TABLE 1 Numbers of outpatient visits and hospitalisations.

		FY2016	FY2017	FY2018	FY2019	FY2020	FY2021
Total outpatient visit (counts)	Children	161 181 045	158 014 488	153 888 738	146 251 295	98 259 578	107 067 256
	Adults	1 340 446 327	1 339 624 928	1 333 916 175	1 322 199 928	1 212 982 514	1 261 928 481
First visits (counts)	Children	66 953 287	65 218 994	62 713 819	58 761 685	36 910 830	40 764 343
	Adults	192 260 500	193 803 586	193 215 430	186 873 843	151 625 822	162 650 982
Follow-up visits (counts)	Children	94 227 758	92 795 494	91 174 890	87 489 548	61 348 087	66 302 388
	Adults	1 148 185 827	1 145 821 342	1 140 699 769	1 135 324 013	1 061 347 555	1 099 270 298
Total hospitalisations (patient-days)	Children	7 992 593	7 975 856	7 971 397	7 845 502	6 188 537	6 581 584
	Adults	286 079 795	289 926 249	288 470 907	289 077 603	276 922 887	276 367 450

Note: Children are defined as those aged 0–14 years. Adults are defined as those aged 15 years and older.
Abbreviation: FY, fiscal year.

for individuals age 20 years or older were grouped into 10 years age groups. Additionally, percentages from FY2016 to FY2021 for each size of paediatric department are shown by age categories: 0–4, 5–9 and 10–14 years.

3 | RESULTS

3.1 | Summary statistics

The numbers of outpatient visits are summarised in Table 1, which shows the total, first visits and follow-up visits for paediatric (0–14 years) and adult (over 15 years) patients. In FY2019, there were 245 million first visits, with paediatric patients accounting for 24% (59 million visits). Follow-up visits in FY2019 totalled 1.22 billion, with paediatric patients accounting for 7.2% (87 million visits).

The numbers of hospitalisations (patient-days) are shown in Tables 1 and 2. In FY2019, the total number of hospitalisations was 297 million patient-days, with paediatric patients accounting for 2.6% (7.8 million patient-days) (Table 1). The number of hospitalisations under 'Paediatric Inpatients' in FY2019 was 5.0 million patient-days, while 'Neonatal Inpatients' accounted for 1.1 million patient-days (Table 2).

3.2 | Outpatients

Figure 1A shows Japan's trend in the number of outpatient first visits from FY2016 to FY2021, expressed as percentages relative to FY2019. In FY2020, when the COVID-19 epidemic began, the number of outpatient visits decreased in most age groups, with a slight recovery observed in many age groups in FY2021. Notably, the age groups of 0–4 and 5–9 years exhibited a steeper decline compared to the other age groups. Although we classified the 10–14 year-old age group as paediatric, the trend was similar to those of adults. Figure 1B depicts the trend in the number of outpatient follow-up visits showing similar trends as those observed for first visits. Among young adults, the decrease was greater for follow-up visits than for first visits, but among those aged 0–4 years, the decrease was smaller for follow-up visits than for first visits.

3.3 | Hospitalisations

Figure 2A illustrates Japan's trend in the numbers of hospitalisations from FY2016 to FY2021, expressed as percentages relative to FY2019. After the COVID-19 pandemic, hospitalisations declined in most age groups, and recovered slightly in FY2021. The age groups of 0–4 and 5–9 years exhibited a more substantial decrease compared to other age groups. Figure 2B represents the trend in the numbers of hospitalisations classified by Paediatric Inpatients and Neonatal Inpatients. The number of neonatal hospitalisations remained stable over the course of 6 years, apparently showing no change after the COVID-19 pandemic.

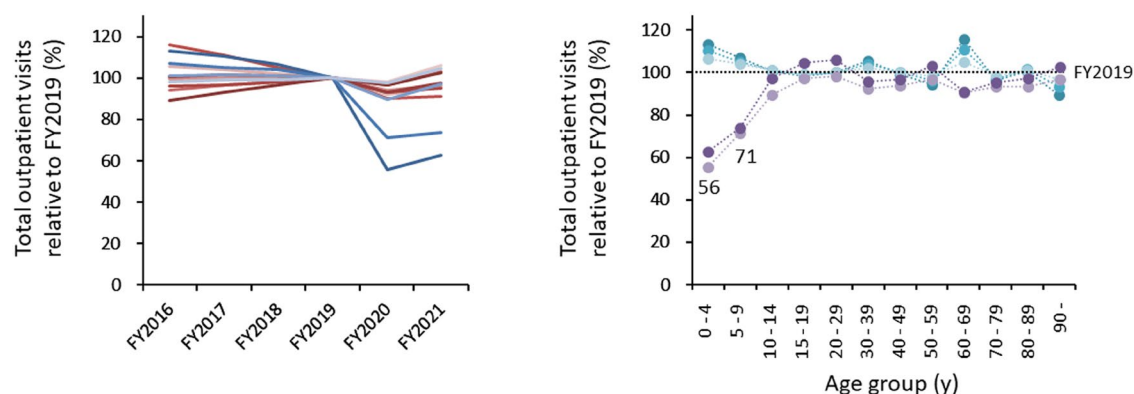
TABLE 2 Number of hospitalisations for specific paediatric inpatient care.

		FY2016	FY2017	FY2018	FY2019	FY2020	FY2021
Paediatric Inpatients	Total (patient-days)	5 111 135	5 088 686	5 125 645	5 002 799	3 510 019	3 794 858
	Tertiary Department Fee (patient-days)	1 292 269	1 322 326	1 407 945	1 453 795	1 225 167	1 291 706
	Large Department Fee (patient-days)	1 662 657	1 652 245	1 647 295	1 556 515	1 068 065	1 147 005
	Medium Department Fee (patient-days)	586 008	614 783	573 112	556 135	318 883	297 635
	Small Department Fee (patient-days)	1 327 073	1 247 358	1 256 762	1 208 683	740 311	890 102
	Basic Department Fee (patient-days)	243 128	251 974	240 531	227 671	157 593	168 410
Neonatal Inpatients	Total (patient-days)	1 054 278	1 073 966	1 083 591	1 091 322	1 054 494	1 078 034

Note: Large, Medium, Small and Basic Department include community hospitals with at least nine, five, three and one full-time paediatrician, respectively.

Abbreviations: FY, fiscal year.

(A) Outpatient (First visit)



(B) Outpatient (Follow-up visit)

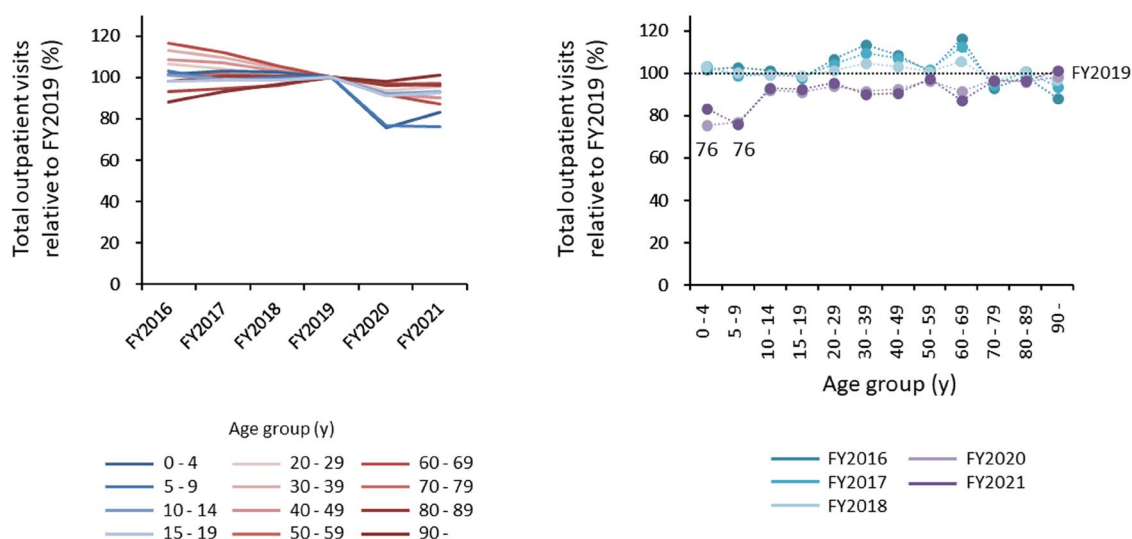


FIGURE 1 Trends in outpatient visits from FY2016 to FY2021 relative to FY2019. (A) Graphs show changes in the number of first outpatient visits (count) by FY (left panel) or by age group (right panel). (B) Graphs show changes in the number of follow-up visits by FY (left panel) or by age group (right panel).

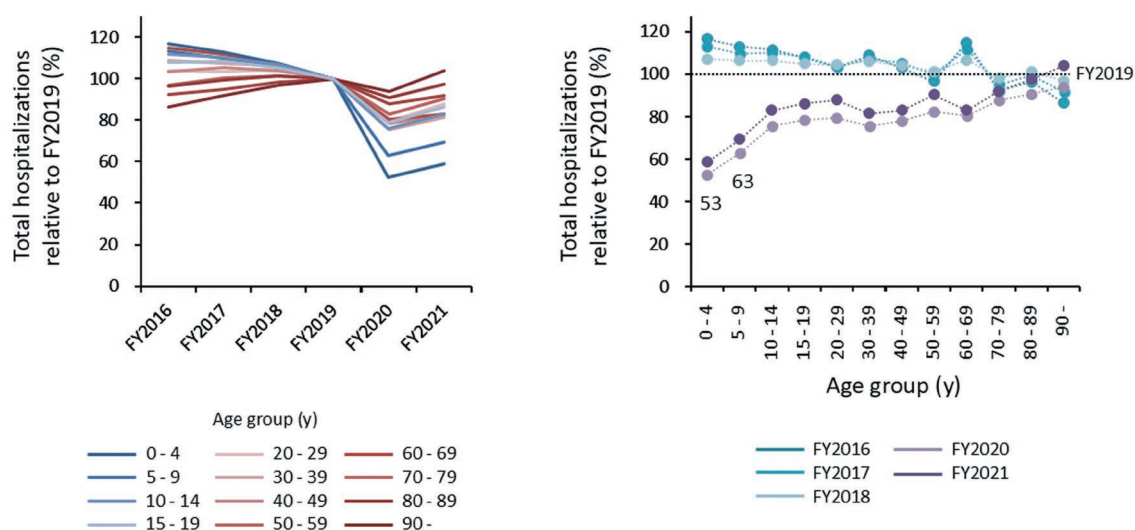
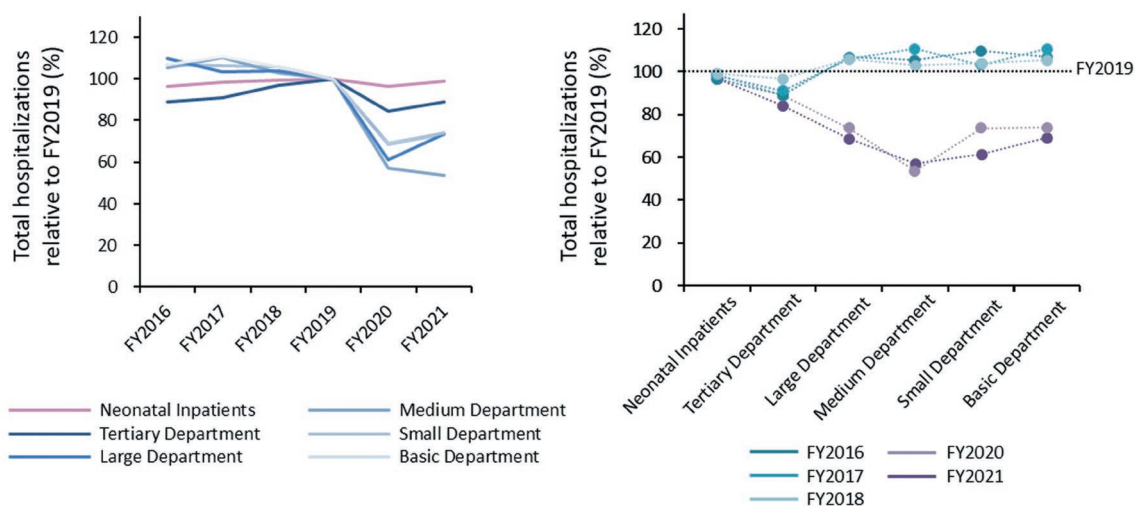
(A) Hospitalization**(B) Pediatric Inpatients**

FIGURE 2 Trends in hospitalisations from FY2016 to FY2021 relative to FY2019. (A) Graphs show changes in the number of hospitalisations (patient-days) by FY (left panel) and by age group (right panel). (B) Trends in hospitalisations for 'Neonatal Inpatients' and 'Paediatric Inpatients' from FY2016 to FY2021. Graphs show changes in the number of hospitalisations by FY (left panel) and by type of Paediatric Inpatients departments (right panel).

When comparing the impact of the decline in hospitalisations by the type of Paediatric Inpatient departments, we observed that tertiary paediatric institutions (i.e. children's hospitals and university hospitals) experienced a smaller decline in hospitalisations compared to smaller institutions (i.e. community medical institutions).

In Figure 3, examining paediatric inpatients by hospital size shows that the decrease in hospitalisations for children aged 10–14 years was less than 10% in Tertiary and Large hospitals. However, in Medium and Small hospitals, although the decrease was not as pronounced as for the 0–9 age group, hospitalisations for children aged 10–14 years still showed a significant reduction. Additionally, in Basic hospitals, hospitalisation trends for children aged 10–14 and 5–9 years synchronised after the pandemic.

4 | DISCUSSION

To date, this is the first study to characterise the impact of the COVID-19 pandemic on paediatric care use for an entire nation, taking advantage of Japan's unique universal health insurance system. We found that the numbers of paediatric patients decreased in both outpatient and inpatient settings during the COVID-19 pandemic. We also demonstrated that the largest decrease was observed in paediatric patients younger than 10 years of age.

There are three possible explanations for the substantial decrease in paediatric care during the pandemic. First, when COVID-19 became epidemic in Japan, other infectious diseases, including influenza, adenovirus and RS virus, decreased.^{11–13}

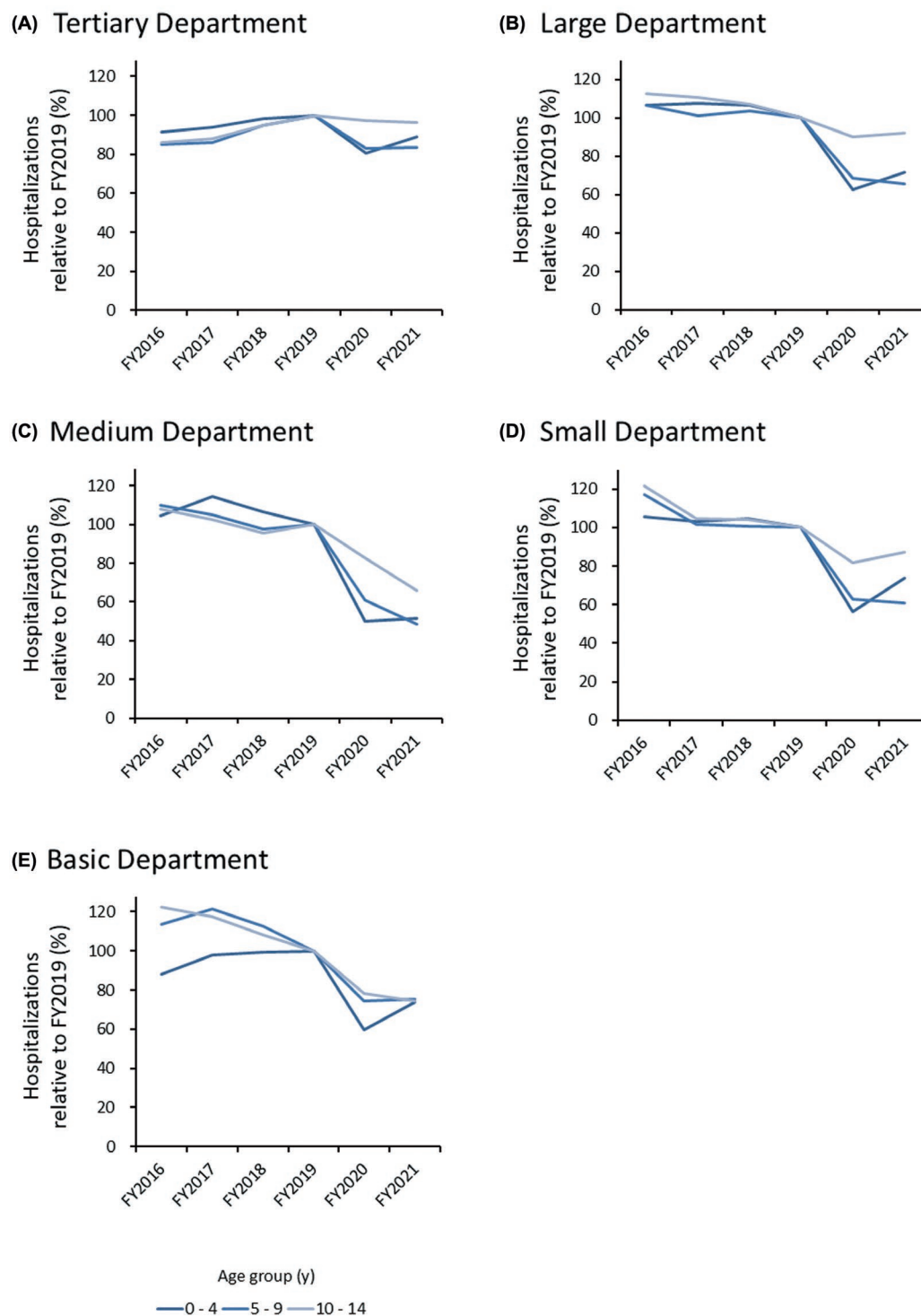


FIGURE 3 Trends in hospitalisations from FY2016 to FY2021 relative to FY 2019 for each size of paediatric department. The Graphs show changes in the number of hospitalisations (patient-days) by FY, categorised by department size: (A) Tertiary Department, (B) Large Department, (C) Medium Department, (D) Small Department and (E) Basic Department.

Efforts by Japanese citizens to control the spread of COVID-19, such as the closure of daycare centres/schools and the implementation of infection control measures (e.g. hand washing and masks) may also have reduced these infections spread primarily through person-to-person contact.¹² Second, patients and caregivers may have refrained from going to the hospitals and clinics because they

did not want to risk being exposed to COVID-19.⁴ Third, the unprecedented situation may have reduced the ability of healthcare providers to treat patients as they have used to. Personnel, supplies and space were allocated to managing infection risks, which forced them to limit medical care, especially for patients with infectious symptoms.

This study revealed decreased healthcare utilisation in both outpatients and hospitalisations, with the most pronounced decrease observed in children younger than 10 years old. This is presumably due to the different nature of diseases in children and adults. For adults, medical demands for non-communicable diseases such as cardiovascular diseases, cerebrovascular diseases and cancers are relatively high. It is assumed that medical needs for these non-communicable diseases remained unchanged or were minimally affected during the pandemic. Contrastingly, demands for medical care of infectious diseases and infection-triggered diseases (e.g. Kawasaki disease, post-streptococcal nephritis, immune thrombocytopenic purpura) are high in children.¹⁴ Treatment for paediatric chronic conditions such as congenital diseases and malignancies is chiefly provided at tertiary paediatric institutions in our subgroup analysis of paediatric inpatient care, there was a relatively small reduction in hospitalisations at these tertiary care institutions. On the other hand, smaller institutions (i.e. community hospitals), where common infections are predominant, showed a marked decrease in total hospitalisations. When inpatient data by the size of paediatric departments are separated by age groups, hospitalisations of children aged 10–14 years in Tertiary and Large departments remained above 90% after the pandemic. This suggests that these hospitalisations were likely for reasons other than infectious or infection-triggered diseases. In contrast, in Basic to Medium departments, hospitalisations of children aged 10–14 years dropped to below 90%, indicating a relatively high proportion of cases related to infectious or infection-triggered diseases in these hospitals. These observations support our speculation about the relationship between the share of communicable diseases in healthcare and the magnitude of the impact of the COVID-19 pandemic. Another possible explanation for the differences across age groups may be related to the varying risk of severe COVID-19.^{15–18} It is known that COVID-19 is much less severe in children than in adults, and as a result, the medical demand associated with COVID-19 may have been relatively lower in children.

This study has two strengths. First, we used the national database that covers more than 98% of all the insured hospitalisations and outpatient visits in Japan. We were able to take advantage of this specific situation in Japan to describe the national healthcare trends during the COVID-19 pandemic with minimal sampling bias. Second, a unique analysis of Paediatric Inpatients claims allowed us to show that the impact of the COVID-19 pandemic likely varied by the type of paediatric care provided.

There are two major limitations. First, the data we extracted show the total numbers of patient-days for inpatients and of patient-visits for outpatients, not the actual number of patients. Patient-days and patient-visits do not provide specific information on the number of unique patients treated. This may affect the interpretation of results by overestimating the number of patients impacted. Second, NDB Open Data Japan does not provide detailed information such as diagnosis, region and month. In particular, if diagnoses of hospitalisations and outpatient visits were available, it would have been possible to analyse the factors affecting the

demand for paediatric care. Since there are seasonal variations in the incidence of most infectious diseases, monthly data may enable high-resolution analysis to identify the yet unidentified factors affecting healthcare demand.

We assessed the impact of the COVID-19 pandemic on paediatric care using Japan's highly comprehensive health insurance claims data, showing that both outpatient and inpatient use of medical care declined substantially, especially among children under 10 years of age. Within paediatric care, there was a particularly large decrease in the use of medical care in community hospitals and clinics. Ultimately, this study provides real-world evidence for rational policy making in future pandemics.

AUTHOR CONTRIBUTIONS

Takuma Ohnishi: Writing – original draft; writing – review and editing; methodology; data curation; investigation; validation; formal analysis. **Mari Kinoshita:** Writing – review and editing; methodology. **Satoshi Narumi:** Conceptualization; writing – original draft; writing – review and editing; supervision; funding acquisition; visualization; project administration.

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CONFLICT OF INTEREST STATEMENT

None.

ETHICS STATEMENT

This study utilized publicly available anonymized data, and therefore, no individual patient information or identifiable data were included. As the data used in this research are open to the public and do not involve direct interaction with human participants, ethical approval was not required in accordance with national and institutional guidelines.

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SUPPORTING INFORMATION

Additional supporting information can be found online in the Supporting Information section at the end of this article.

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