

ORIGINAL ARTICLE

Convulsions in children with COVID-19 during the Omicron wave

Jonas F. Ludvigsson^{1,2,3} 

¹Department of Medical Epidemiology and Biostatistics, Karolinska Institutet, Stockholm, Sweden

²Department of Paediatrics, Örebro University Hospital, Örebro, Sweden

³Department of Medicine, Columbia University College of Physicians and Surgeons, New York, New York, USA

Correspondence

Jonas F Ludvigsson, Department of Medical Epidemiology and Biostatistics, Karolinska Institutet, 17177 Stockholm, Sweden.

Email: jonasludvigsson@yahoo.com

Abstract

Aim: Most children with COVID-19 have mild symptoms, but data on the Omicron variant are rare. This paper describes unexpected cases with convulsions during 1 week in January 2022.

Methods: Four children with COVID-19 were admitted with convulsions to the paediatric department in Örebro, Sweden, when Omicron accounted for more than 98% of the country's COVID-19 cases. Three children tested positive for the virus, and one had clinical COVID-19. I was able to contact the parents of three boys, who gave consent for these case studies.

Results: Two boys aged 3 and 21 months tested positive for the virus and a 14-year-old boy tested negative, but had a cold and family members who had tested positive. The teenager had a history of urinary tract infections, but the younger boys had no earlier comorbidities. None had a history of epilepsy or febrile convulsions. The younger children had a fever and the teenager had upper respiratory symptoms. The 3-month-old child had repeated convulsions for several hours, the 21-month-old had continuous convulsions for 15–20 min, and the teenager had a convulsion for 30–60 s, followed by uncharacteristic aggression.

Conclusion: Convulsions may be a sign of the Omicron variant in children with COVID-19.

KEYWORDS

convulsions, COVID-19, Omicron, pandemic, seizures

1 | INTRODUCTION

Most children with COVID-19 have a mild form of the disease.¹ Common symptoms in children include fever, dry cough and fatigue, but the disease can range from asymptomatic to severe, including multisystem inflammatory syndrome in children.^{2,3} Children may also experience long-term effects after they have had COVID-19.^{4,5}

Different variants of the severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) may have slightly different manifestations. For instance, many patients lost their sense of smell and taste during the early phase of the pandemic, but those symptoms may be less common today.

Early results from the COVID Symptoms Study, reported in a commentary by Iacobucci in late 2021,⁶ have suggested that the

Abbreviations: SARS-CoV-2, severe acute respiratory syndrome coronavirus 2.

This is an open access article under the terms of the Creative Commons Attribution-NonCommercial License, which permits use, distribution and reproduction in any medium, provided the original work is properly cited and is not used for commercial purposes.

© 2022 The Authors. *Acta Paediatrica* published by John Wiley & Sons Ltd on behalf of Foundation Acta Paediatrica.

most common symptoms of the COVID-19 Omicron variant are a runny nose, headache, mild or severe fatigue, sneezing and a sore throat. However, this list of symptoms may not apply to children. It appears that, overall, the COVID-19 Omicron variant seems to result in less severe disease in adults⁷ than earlier variants. However, it also appears to be much more infectious and it easily overtook other variants in a very short space of time. This was definitely the case in Sweden.

A systematic review and meta-analysis by Misra et al, first published online in October 2021, covered 350 studies of 145,721 COVID-19 patients of all ages, and 89% of those were hospitalised. It found that up to a third of those patients experienced at least 1 neurological symptom.⁸ The most common symptoms were fatigue, impaired taste and smell and headaches, and the most serious symptoms were strokes. However, it was clear from the paper that seizures and convulsions had rarely been reported in children with COVID-19 up to that point.⁸ That study covered the period 31 December 2019 to 15 December 2020, which was about a year before the emergence of the Omicron variant.⁸ In contrast, a paper on the Omicron variant in South Africa, which has been placed on the MedRxiv health science preprint server, has reported that some 20% of paediatric patients during the Omicron wave in that country had convulsions.⁹ These findings are discussed later in this paper.

The aim of this study was to examine three of the four children who had unexpectedly presented to a Swedish hospital during 1 week in January 2022 with convulsions and were admitted to the paediatric department. Two had tested positive for SARS-CoV-2, at a time when the Omicron variant accounted for the vast majority of COVID-19 cases in Sweden, and one had clinical COVID-19. I was unable to reach the parents of the fourth child.

2 | METHODS

At the start of the second week of 2022, the Omicron variant was responsible for more than 98% of all COVID-19 cases in Sweden.¹⁰ These data were based on aggregate national data,¹⁰ as it was not standard practice to test the specific SARS-CoV-2 variants in all patients. During 1 week in mid-January 2022, 4 children with COVID-19 and convulsions were admitted to the Department of Paediatrics at Orebro University Hospital, Orebro, Sweden. Having four COVID-19 admissions following convulsions was regarded as an unusual and noteworthy event by the staff working in the Hospital's paediatric department. In this same week, 12 children were admitted to the ward and tested positive for COVID-19, although COVID-19 was not always the reason for the admissions. For example, two of the 12 children were scheduled for surgery and tested positive during routine screening.

Three of the children with convulsions underwent a polymerase chain reaction test for the SARS-CoV-2 virus and tested positive. The other one tested negative for the virus, but was diagnosed with clinical COVID-19 (Table 1). In addition, all 3 of the family members he lived with had tested positive for the virus. We assumed that the

Key Notes

- I looked at three boys with COVID-19 and convulsions, who were admitted to a Swedish hospital during a week when the Omicron variant dominated more than 98% of cases.
- Two boys aged 3 and 21 months were virus positive and had repeated convulsions for several hours and continuous convulsions for 15–20 min respectively.
- A 14-year-old boy with clinical COVID-19 had a convulsion for 30–60 s, followed by uncharacteristic aggression.

four children had the Omicron variant, as it was the overwhelmingly dominant variant in Sweden at that time. I was able to speak to three of the four families, and they provided informed consent for their children's clinical details to be included in this paper. The three children are described in detail in Table 1. I was unable to make contact with the parents of the fourth child at the time of admission.

3 | RESULTS

The three children were all boys and were 3 months, 21 months and 14 years of age at the time of their hospital admissions. The 14-year-old boy had a history of urinary tract infections, but had not had any issues since 2016. Neither of the two younger children had any earlier comorbidities. None of the three boys had a medical history of epilepsy or febrile convulsions. The two boys, who were both of Middle Eastern/African origin, had experienced a fever. One had a fever prior to his convulsions, and one was febrile at the time of his convulsions. The 14-year-old boy, who was a native Swede, did not have a fever, but did have upper respiratory symptoms. The 3-month-old boy had repeated convulsions over a period of several hours, and the 21-month-old boy had continuous convulsions, namely status epilepticus, for 15–20 min. The convulsions experienced by these two boys were regarded as severe. The 14-year-old boy had one convulsion that lasted 30–60 s, followed by a period of short behavioural change, when he became very aggressive and had to be retrained and calmed down by his father (Table 1). The teenager had received one dose of the Pfizer-BioNTech COVID-19 vaccination 2 months before he presented to the hospital, but had missed his booster vaccination, because it was due to when he became ill. The two younger children were unvaccinated, in line with Swedish guidance for this age group. The 3-month, 21-month and 14-year-old children were hospitalised for 4, 2 and 2 days, respectively, and the youngest children are scheduled to attend follow-up visits, in order to monitor their recovery and progress. The teenager was deemed healthy, discharged on Day 2, and asked to report back if any neurological symptoms re-appeared. Further details of the patients, including their demographic characteristic and clinical symptoms, are provided in Table 1.

TABLE 1 Characteristics of the three boys with the COVID-19 Omicron variant and convulsions

	Patient 1	Patient 2	Patient 3
Sex, age	Boy, 3 months	Boy, 21 months	Boy, 14 years
Earlier comorbidities	None	None	Repeated urinary tract infections. No complaints since 2016.
Ethnicity	Middle East/Africa ^a	Middle East/Africa ^a	Sweden
Symptoms	Fever 2 days before the convulsions, but no fever on the day of the convulsions.	Fever on the day of the convulsions.	Sore throat. During the hospital stay, he developed a mild cold. No fever.
Diagnosis of COVID-19 in child	Positive PCR test for SARS-CoV-2.	Positive PCR test for SARS-CoV-2.	Clinical diagnosis. PCR test negative, but 3/3 other family members tested positive at the time.
Other contacts at time of COVID-19 onset.	Other family members tested positive for SARS-CoV-2.	Other family members tested positive for SARS-CoV-2.	Other family members tested positive for SARS-CoV-2.
Convulsions	Several generalised (tonic-clonic) convulsions, each with a duration of 1–3 min, followed by non-clinical seizures. Convulsions identified during a 12-h period by monitoring with amplitude-integrated EEG.	Status epilepticus (generalised, tonic-clonic) for 15–20 min.	Generalised (tonic-clonic) convulsions for 30–60 s. After that, the patient became aggressive, which was a behavioural change, and had to be restrained and calmed down by his father.
Investigations ^b	Lumbar puncture: negative. C-reactive protein: negative. MRI of the brain: negative. CT scan of the brain: negative. EEG: no epileptiform activity.	Clinical examination.	Clinical examination.
Clinical course	Cared for in the ICU for the first 18–20 h. Received antibiotics and Aciclovir for 48 h and midazolam infusion for 24 h. Started on phenobarbital and then switched to levetiracetam on Day 3. Febrile on and off for 36 h. Condition normalised 48 h after the first convulsion. Discharged after 4 days.	Low-grade fever on Day 2, but otherwise unaffected. Discharged after 2 days.	Asymptomatic on Day 2. Discharged after 2 days.

Abbreviations: CT, computed tomography; EEG, electroencephalography; ICU, intensive care unit; MRI, magnetic resonance imaging; PCR, polymerase chain reaction.

^aIn order to protect the identity of the patients, their specific country of birth is not reported.

^bNegative for influenza A/B and respiratory syncytial virus. All children also underwent basic laboratory investigations to rule out bacterial disease.

4 | DISCUSSION

Neurological manifestations have been frequent in COVID-19,⁸ as reported by Misra et al's systematic review and meta-analysis, especially fatigue, impaired taste and smell and headaches. Strokes seemed to be the most common severe neurological diagnosis following COVID-19.⁸ Seizures and convulsions have been reported in children with COVID-19, but they were rare during the first year of the pandemic.⁸ This meant that staff at the Department of Paediatrics at Orebro University Hospital were surprised to admit four children aged 3 months to 14 years with COVID-19 and convulsions over the course of just 1 week.

This paper reports the clinical details of the three children I was able to get parental permission to discuss. Due to the 98%

plus dominance of the Omicron variant in Sweden at the time, it is reasonable to suggest that these three children had that variant. The increased risk of convulsions seen by this 1 Swedish hospital was consistent with a preprint paper on the clinical course of the COVID-19 Omicron variant in South African children. The researchers involved in that study also assumed that all the children had Omicron, because 99% of the COVID-19 cases in the study region were the Omicron variant at the time.⁹ That study found that 20% of 139 children up to the age of 13 years admitted to hospital with the COVID-19 Omicron variant had convulsions.⁹ In fact, convulsions and gastroenteritis were the two most frequent diagnoses linked to hospital admissions in that study.⁹

Although all the children in this Swedish report were boys, the numbers were small and we cannot conclude that male sex

predisposes children to convulsions associated with the COVID-19 Omicron variant. Two of the three children were of Middle Eastern/African origin. Some data have suggested that multisystem inflammatory syndrome in children has been disproportionately common among children from ethnic minority groups.¹¹ However, it is too early to say whether that may also be valid for convulsions in children with the COVID-19 Omicron variant.

Finally, it should be noted that some of the children with convulsion in the South African paper⁹ fell outside the typical age range for febrile convulsions, which is younger than 6 months and older than 5 years. Also the youngest and oldest children in this study fell outside the typical age range for febrile convulsions. This may be a random finding, but it could also reflect different underlying mechanisms behind the convulsions described in this report, as opposed to traditional febrile convulsions. Finally, it should be stressed that the current observation of a link between the COVID-19 Omicron variant and convulsions in children only represents four cases, including the three reported in this paper, and it cannot be ruled out that this was a chance finding. However, these four cases have since been followed by additional children with COVID-19 and convulsions in the later part of January, and it is urgent that we develop a better understanding of the new Omicron variant. Providing information on tentative associations may prove useful for clinicians handling current Omicron cases and as further variants emerge during this ongoing pandemic.

5 | CONCLUSION

The study confirms earlier data that the SARS-CoV-2 virus has been associated with neurological outcomes in children. The occurrence of this cluster, in just 1 week in one Swedish hospital, may indicate that the Omicron variant is linked to convulsions in children.

CONFLICTS OF INTEREST

Dr Ludvigsson coordinated a study on behalf of the Swedish IBD quality register that received funding from Janssen Corporation.

ORCID

Jonas F. Ludvigsson  <https://orcid.org/0000-0003-1024-5602>

REFERENCES

1. Ludvigsson JF. Systematic review of COVID-19 in children shows milder cases and a better prognosis than adults. *Acta Paediatr.* 2020;109(6):1088-1095. doi:10.1111/apa.15270
2. Riphagen S, Gomez X, Gonzalez-Martinez C, et al. Hyperinflammatory shock in children during COVID-19 pandemic. *Lancet.* 2020;395(10237):1607-1608. doi:10.1016/S0140-6736(20)31094-1
3. Kahn R, Berg S, Berntson L, et al. Population-based study of multisystem inflammatory syndrome associated with COVID-19 found that 36% of children had persistent symptoms. *Acta Paediatr.* 2022;111(2):354-362. doi:10.1111/apa.16191
4. Ludvigsson JF. Case report and systematic review suggest that children may experience similar long-term effects to adults after clinical COVID-19. *Acta Paediatr.* 2020;110(3):914-921. doi:10.1111/apa.15673
5. Sterky E, Olsson-Akefeldt S, Hertting O, et al. Persistent symptoms in Swedish children after hospitalisation due to COVID-19. *Acta Paediatr.* 2021;110(9):2578-2580. doi:10.1111/apa.15999
6. Iacobucci G. Covid-19: Runny nose, headache, and fatigue are commonest symptoms of omicron, early data show. *BMJ.* 2021;375:n3103. doi:10.1136/bmj.n3103
7. Wolter N, Jassat W, Walaza S, et al. Early assessment of the clinical severity of the SARS-CoV-2 Omicron variant in South Africa. *medRxiv* 2021:2021.12.21.21268116. doi:10.1101/2021.12.21.21268116
8. Misra S, Kolappa K, Prasad M, et al. Frequency of Neurologic Manifestations in COVID-19: A Systematic Review and Meta-analysis. *Neurology.* 2021;97(23):e2269-e2281. doi:10.1212/WNL.00000000000012930
9. Cloete J, Kruger A, Masha M, et al. Rapid rise in paediatric COVID-19 hospitalisations during the early stages of the Omicron wave, Tshwane District, South Africa. *medRxiv* 2021:2021.12.21.21268108. doi: 10.1101/2021.12.21.21268108
10. Statistik om SARS-CoV-2 virusvarianter av särskild betydelse (Statistics about SARS-CoV-2 virus variants of special importance). Swedish Public Health Agency. 2022. Available from: <https://www.folkhalsomyndigheten.se/smittskydd-beredskap/utbrott/aktuella-utbrott/covid-19/statistik-och-analyser/sars-cov-2-virusvarianter-av-sarskild-betydelse/> accessed January 25 2022
11. Javalkar K, Robson VK, Gaffney L, et al. Socioeconomic and Racial and/or Ethnic Disparities in Multisystem Inflammatory Syndrome. *Pediatrics.* 2021;147(5). doi:10.1542/peds.2020-039933

How to cite this article: Ludvigsson JF. Convulsions in children with COVID-19 during the Omicron wave. *Acta Paediatr.* 2022;111:1023-1026. doi:[10.1111/apa.16276](https://doi.org/10.1111/apa.16276)