

## Paracetamol overdose in Danish children and adolescents during the Covid-19 restrictions

Kempf, Oliver Nørholm; Helt, Thora Wesenberg; Johansen, Klaus Birkelund; Rittig, Charlotte; Lundby-Christensen, Louise; Frederiksen, Marianne Sjølin; Mathiesen, Pernille; Boas, Malene; Nielsen, Preben Berg; Ellermann, Annie; Børch, Klaus; Petersen, Jens Jakob; Petersen, Thomas Houmann; Sønderskov, Cæcilie Trier; Andersen, Jesper; Nielsen, Rasmus Gaardskær; Jeppesen, Eva Mosfeldt; Christensen, Vibeke Brix

*Published in:*  
Danish Medical Journal

*DOI:*  
10.61409/A08230494

*Publication date:*  
2024

*Document version:*  
Final published version

*Document license:*  
CC BY-NC-ND

*Citation for pulished version (APA):*

Kempf, O. N., Helt, T. W., Johansen, K. B., Rittig, C., Lundby-Christensen, L., Frederiksen, M. S., Mathiesen, P., Boas, M., Nielsen, P. B., Ellermann, A., Børch, K., Petersen, J. J., Petersen, T. H., Sønderskov, C. T., Andersen, J., Nielsen, R. G., Jeppesen, E. M., & Christensen, V. B. (2024). Paracetamol overdose in Danish children and adolescents during the Covid-19 restrictions. *Danish Medical Journal*, 71(5), Article A08230494. <https://doi.org/10.61409/A08230494>

Go to publication entry in University of Southern Denmark's Research Portal

### Terms of use

This work is brought to you by the University of Southern Denmark.  
Unless otherwise specified it has been shared according to the terms for self-archiving.  
If no other license is stated, these terms apply:

- You may download this work for personal use only.
- You may not further distribute the material or use it for any profit-making activity or commercial gain
- You may freely distribute the URL identifying this open access version

If you believe that this document breaches copyright please contact us providing details and we will investigate your claim.  
Please direct all enquiries to [puresupport@bib.sdu.dk](mailto:puresupport@bib.sdu.dk)

Original Article

# Paracetamol overdose in Danish children and adolescents during the COVID-19 restrictions

Oliver Nørholm Kempf<sup>1\*</sup>, Thora Wesenberg Helt<sup>2\*</sup>, Klaus Birkelund Johansen<sup>3, 4</sup>, Charlotte Rittig<sup>5</sup>, Louise Lundby-Christensen<sup>6</sup>, Marianne Sjølin Frederiksen<sup>7</sup>, Pernille Mathiesen<sup>7</sup>, Malene Boas<sup>8</sup>, Preben Berg Nielsen<sup>9</sup>, Annie Ellermann<sup>10</sup>, Klaus Børch<sup>11</sup>, Jens Jakob Petersen<sup>12</sup>, Thomas Houmann Petersen<sup>13</sup>, Cæcilie Trier Sønderskov<sup>14</sup>, Jesper Andersen<sup>15</sup>, Rasmus Gaardskær Nielsen<sup>16</sup>, Eva Mosfeldt Jeppesen<sup>1</sup> & Vibeke Brix Christensen<sup>1</sup>

1) Department of Paediatrics and Adolescent Medicine, Copenhagen University Hospital – Rigshospitalet, 2) Department of Clinical Physiology and Nuclear Medicine, Copenhagen University Hospital – Rigshospitalet, 3) Department of Paediatrics and Adolescent Medicine, Aarhus University Hospital, 4) Department of Emergency Medicine, Horsens Regional Hospital, 5) Department of Paediatrics, Aalborg University Hospital, 6) Department of Paediatrics and Adolescent Medicine, Slagelse Hospital, 7) Department of Paediatrics and Adolescent Medicine, Copenhagen University Hospital – Herlev Hospital, 8) Department of Paediatrics and Adolescent Medicine, Zealand University Hospital, Roskilde, 9) Department of Paediatrics and Adolescent Medicine, University Hospital of Southern Denmark – Sønderjylland, 10) Department of Paediatrics and Adolescent Medicine, Holbaek Hospital, 11) Department of Paediatrics and Adolescence Medicine, Copenhagen University Hospital – Hvidovre Hospital, 12) Department of Paediatrics and Adolescent Medicine, University Hospital of Southern Denmark – South-West Jutland, 13) Department of Paediatrics and Adolescent Medicine, University Hospital of Southern Denmark – Lillebaelt, 14) Department of Gynaecology, Obstetrics and Paediatrics, Nykøbing Falster Hospital, 15) Department of Paediatrics and Adolescent Medicine, Copenhagen University hospital – North Zealand Hospital, 16) Hans Christian Andersen Children’s Hospital, Odense University Hospital, Denmark

Dan Med J 2024;71(5):A08230494. doi: 10.61409/A08230494

## ABSTRACT

**INTRODUCTION.** To assess the effect of long-term isolation on the mental state of Danish youth. This study aimed to investigate trends in paracetamol overdoses among people under 18 years of age in Denmark during COVID-19 restrictions as an indicator of mental health.

**METHODS.** All patients under the age of 18 years presenting with paracetamol overdose at one of the 18 paediatric departments in Denmark from 2016 to 2021 were included. They were identified in all Danish hospital databases using specific diagnostic codes.

**RESULTS.** From 2016 to 2021, a total of 3,217 people under 18 years of age were admitted for paracetamol overdose. Among these, 86% (n = 2,755) were girls and 14% (n = 462) were boys. During 2020, a slight (7%) decrease in admissions was observed among both boys and girls compared with the preceding four-year mean value. In 2021, the number of overdoses among girls exceeded by 35% the former all-time high from 2016. Furthermore, the number of overdoses among girls exceeded the pre-four-year period mean value by 43%. Among boys, an 8% increase was seen from the highest ever previous value recorded in 2019 and a 23% increase compared with the previous four-year mean value.

**CONCLUSIONS.** During the first year of restrictions, a slight decrease in paracetamol overdoses was observed, possibly associated with limited accessibility. The second year showed a considerable increase in paracetamol overdoses, which may imply an affected mental state among youth during the prolonged lockdown restrictions as seen in previous epidemics. Therefore, further studies are warranted to develop a pandemic preparedness plan to protect general mental health.

**FUNDING.** None.

**TRIAL REGISTRATION.** Not relevant.

The World Health Organization (WHO) declared COVID-19 a global pandemic on 11 March 2020. COVID-19 originated in a zoonotic strain of virus in the Wuhan Region of China and quickly spread across the globe. The virus had a high fatality rate and was very contagious, which led to a widespread focus on containing and limiting the spread of the virus [1, 2]. Danish COVID-19 restrictions were applied by law on 10 March 2020, when public events counting more than 100 people were forbidden. Further restrictions were introduced eight days later, limiting gatherings of people to a maximum of ten. During the next two years, restrictions varied in relation to the current infection numbers and predicted trends. All restrictions were lifted on 1 February 2022 [3]. The consequences of the COVID-19 restrictions on paracetamol overdose in Danish children have not been studied.

Paracetamol is the primary over-the-counter drug in Denmark and across the world owing to its analgetic and antipyretic effects with few to no side effects when administered in therapeutic dosages [4]. Paracetamol is metabolised in the liver. If excessive amounts of the drug are ingested, an accumulation of the toxic metabolite N-acetyl-p-benzoquinone-imine causes severe liver damage and, if left untreated, liver failure [5].

To limit the accessibility of paracetamol in Denmark, two restrictions have been introduced. In 2011, the sale of paracetamol was restricted to people above 18 years of age; in 2013, package restrictions limited the size of over-the-counter packages to 10 × 500 mg. This triggered an immediate decrease in paracetamol overdoses among Danish adolescents [6]. According to the national Danish database eSundhed, this decreasing trend remained in place for the following two years after which paracetamol suicide attempts stabilised. In general, a severe overrepresentation was observed of female-related paracetamol overdoses in Danish hospitals [7]. Similar trends were recorded in Ireland, England and the USA [8-10]. eSundhed had data until 2018, leaving the influence of pandemic restrictions and lockdowns unknown.

This study aimed to investigate trends in paracetamol overdoses among people under 18 years of age in Denmark during the COVID-19 restrictions.

## METHODS

A retrospective observational study was conducted using national hospital databases. Data on paracetamol overdose from January 2015 to December 2021 were retrieved from all paediatric departments in Denmark using codes based on the International Classification of Diseases, version 10. The diagnostic codes related to paracetamol overdose were DT398 and DT398A. The employed hospital databases record all incidents across Denmark and link each incident to a personal identification number (CPR) to obtain the sex of the patient. The total annual incidence of paracetamol overdoses was given for girls and boys separately.

### Inclusion and exclusion criteria

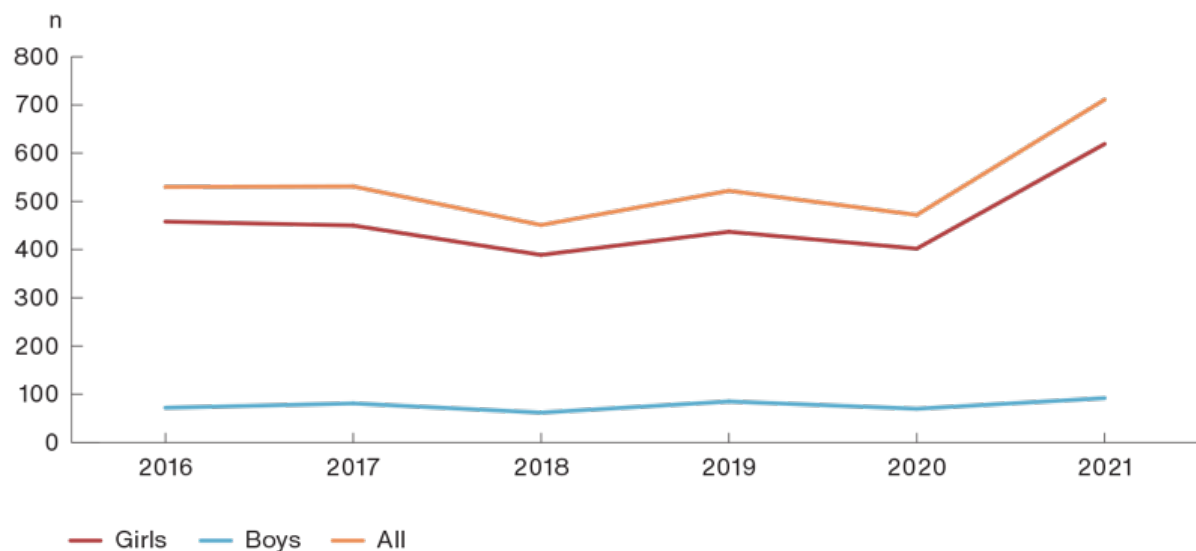
Patients under 18 years of age who presented with the diagnostic code for paracetamol overdoses were included when admitted to the hospital. No distinction was made between accidental overdoses and intentional overdoses; therefore, accidental overdoses were included in the study. The quantity of paracetamol was not available, so all children and adolescents who overdosed on paracetamol were included. An overdose was defined as a dose that exceeded the therapeutic doses. Data from the year 2015 were excluded due to incomplete data related to a change in IT provider. This problem was solved in 2016.

*Trial registration:* not relevant.

## RESULTS

From January 2016 to December 2021, a total of 3,217 children and adolescents with paracetamol overdoses were admitted to Danish hospitals. Among these, 86% were girls (n = 2,755) and 14% (n = 462) boys. The annual incidences and the distribution between boys and girls is presented in **Figure 1**.

**FIGURE 1** Presentation of children and adolescents to Danish hospitals concerning intentional paracetamol poisonings in the 2016-2021 period.



Within the first year of COVID-19 restrictions (2020), a slight decrease (7%) was seen in paracetamol overdoses (n = 472) compared with the mean value for the previous four years (n = 509). However, the incidence was lower in 2018 (n = 451) than in 2020. This was similar for both boys and girls who also recorded a 7% decrease compared

with the mean value for the previous four years. The boys decreased from  $n = 75$  to  $n = 70$  and the girls from  $n = 434$  to  $n = 402$ .

During 2021, the second year of COVID-19 restrictions, the total number of paracetamol overdoses increased by 40% from a mean value of 509 the four years before COVID-19 restrictions to 711 in 2021. The increase was highest in girls: 43% from 434 to 619; and lowest in boys: 23% from 75 to 92. Similarly, the total number of paracetamol overdoses ( $n = 711$ ) was 34% higher than the previous maximum ( $n = 531$ ) recorded in 2017. The girls ( $n = 619$ ) recorded the highest increase (35%) from the previously highest observed value ( $n = 458$ ) in 2016, whereas the boys ( $n = 92$ ) presented with the lowest increase (8%) from the previous maximum ( $n = 85$ ), recorded in 2019.

## DISCUSSION

This study was the first to study hospital admissions for paracetamol overdoses on a national level during the Danish COVID-19 restrictions. In the first year of restrictions, a slight decrease in the number of overdoses was observed among girls and boys. However, this was followed by a large increase in 2021 among girls and boys alike. The increase was primarily driven by a rise among the girls. These surges in paracetamol overdoses among young people are of great concern because this specific overdose is often taken with suicidal intention.

Different containment strategies have been adopted around the world [11]. In Denmark and many other European countries, lockdown was the preferred solution to ensure the containment of SARS-CoV-2. According to an English study, the lockdown strategy even proved to be the most effective way of containing and reducing the fatality of SARS-CoV-2 [12]. The containment strategy may potentially explain why no increase was observed in paracetamol overdoses in 2020 as people tended to stay in their homes, thus limiting their trips to pharmacies and grocery stores to a minimum, resulting in limited access to paracetamol in the homes. England observed a decrease in paracetamol overdoses in the first year of the lockdown [13]. According to Shield et al., this decrease was thought to be related to a combination of limited access and a national shortage of paracetamol. Another reason explaining the decrease may be the early promise of a vaccine, which may have made the restrictions more tolerable, knowing that they would remain in place only for a limited period of time [13].

The isolation period kept being prolonged as new strains of SARS-CoV-2 emerged, and restrictions continued into 2021 even though COVID-19 vaccination was in progress. Despite having vaccinated most of the adult population, the government relied on maintaining the lockdown strategy. During this time, the amount of children and adolescents presenting at the hospital with paracetamol overdose rose progressively. This coinciding correlation between the duration of the isolation and the surge in paracetamol overdoses may potentially imply an affection of the mental health among the Danish children and adolescents. Continued social isolation and loneliness are well-known indicators of developing depressive symptoms [14]. Almeida et al. found a significant relationship between social isolation and suicidal ideation, and the correlation was seen to be increasingly significant when the feeling of loneliness increased [14]. Prolonging lockdown restrictions and thereby social isolation and possibly increased loneliness are all coinciding factors that may potentially explain the observed rise in paracetamol overdoses. Also, it was harder for the professional caregivers (teachers, psychologist, etc.) to identify loneliness and despair in the young people so that the right measures could be taken and the necessary treatment could be initiated in time to avoid paracetamol overdoses.

Isolation strategies like those used during the COVID-19 pandemic were applied during the Ebola epidemic in 2014. The West African governments enforced several laws, which included the closing of schools and non-essential public facilities. Studies investigating the effects of isolation found that enforced isolation seemed to create a fear-related behaviour that predisposes to future harm both physically and mentally [15]. Similar anxiety

tendencies were found during the H1N1 pandemic in 2009. Bults et al. found increasing anxiety among the study participants correlating with the progressive spread of the virus [16]. Anxiety related to isolation was also documented in a study investigating the effects of the SARS-1 epidemic in 2003. This study found increased depression among those isolated, which seemed to be positively correlated with the length of isolation. Variables such as age, education, and family relation had no significant impact [17].

Anxiety and depression were some of the most frequently reported reactions to the COVID-19 epidemic, especially in children and adolescents [18]. An English study showed that children and adolescents were more disposed to anxiety and depression during the COVID-19 pandemic [12].

These studies related to previous viral outbreaks and the restrictions seemed to highlight a tendency towards an affected mental state among the studied participants. It remains unclear whether similar tendencies were found among the Danish youth during the COVID-19 outbreak restrictions. However, the large increase in paracetamol overdoses may potentially imply an affected mental state among Danish adolescents. Follow-up studies exploring this trend are warranted to investigate if the increase was an outlier related to COVID-19 restrictions or if a permanent increase in paracetamol overdoses among the Danish adolescence was seen and, if so, to identify the reasons behind it. Lastly, studies are needed on how to prevent an increase in paracetamol overdoses in case of another viral outbreak that requires restrictions such as a lockdown.

## Limitations

The study had limitations. Firstly, it was not possible to separate the cohort into separate age groups. Therefore, the study included accidental overdoses among babies and children, which did not reflect an affected mental state. Secondly, the study period was too short to conclude whether the increase found in 2021 was related to COVID-19 restrictions or if paracetamol overdoses are on the rise. Thirdly, if the same person was admitted more than once, this would count as multiple overdoses; however, this was also the case for the years leading up to COVID-19, so the data are comparable. Also, the number of admissions are a marker of the problem size even if some persons were hospitalised more than once. Lastly, parallels between an increase in intentional paracetamol overdoses and affected mental state should be drawn with caution. However, paracetamol seems to be the drug of choice for suicide attempts among the Danish youth, which may render it viable as an indicator of mental health.

## CONCLUSIONS

During the first year of restrictions in the COVID-19 pandemic, a slight decrease was observed in paracetamol overdoses, possibly connected to limited accessibility. The second year recorded a considerable increase in paracetamol overdoses, which may imply an affected mental state among children and adolescents during the prolonged lockdown restrictions as seen in previous epidemics. Therefore, further studies are warranted to prevent and protect general mental health in a future epidemic.

**Correspondence** *Vibeke Brix Christensen*. E-mail: [Vibeke.brix.christensen@regionh.dk](mailto:Vibeke.brix.christensen@regionh.dk)

\*) Shared first authorship

**Accepted** 22 February 2024

**Conflicts of interest** none. Disclosure forms provided by the authors are available with the article at [ugeskriftet.dk/dmj](https://ugeskriftet.dk/dmj)

**References** can be found with the article at [ugeskriftet.dk/dmj](https://ugeskriftet.dk/dmj)

**Cite this as** *Dan Med J* 2024;71(5):08230494

doi 10.61409/A08230494

Open Access under Creative Commons License CC BY-NC-ND 4.0

## REFERENCES

1. Cucinotta D, Vanelli M. WHO declares COVID-19 a pandemic. *Acta Biomed.* 2020;91(1):157-60. <https://doi.org/10.23750/abm.v91i1.9397>
2. Pustake M, Tambolkar I, Giri P et al. SARS, MERS and CoVID-19: an overview and comparison of clinical, laboratory and radiological features. *J Family Med Prim Care.* 2022;11(1):10-7. [https://doi.org/10.4103/jfmpe.jfmpe\\_839\\_21](https://doi.org/10.4103/jfmpe.jfmpe_839_21)
3. Statens Serum Institut. Da covid-19 ramte verden og Danmark - se tidslinjen her. 2022. <https://www.ssi.dk/aktuelt/nyheder/2022/da-covid-19-ramte-verden-og-danmark-se-tidslinjen-her> (Feb 2024).
4. Brøsen K, Simonsen U, Kampmann JP, Thirstrup S, eds. Basal og klinisk farmakologi. FADL's Forlag, 2014.
5. Ritter JM, Flower RJ, Henderson G et al. Rang and Dale's pharmacology. 9 ed. Elsevier, 2020.
6. Morthorst BR, Erlangsen S, Chaine M et al. Restriction of non-opioid analgesics sold over-the-counter in Denmark: a national study of impact on poisonings. *J Affect Disord.* 2020;268:61-8. <https://doi.org/10.1016/j.jad.2020.02.043>
7. Hedeland RL, Jørgensen MH, Teilmann G et al. Childhood suicide attempts with acetaminophen in Denmark: characteristics, social behaviour, trends and risk factors. *Scand J Pub Health.* 2013;41(3):240-6. <https://doi.org/10.1177/1403494812474122>
8. Daly C, Griffin E, McMahon E et al. Paracetamol-related intentional drug overdose among young people: a national registry study of characteristics, incidence and trends, 2007-2018. *Soc Psychiatry Psychiatr Epidemiol.* 2021;56(5):773-81. <https://doi.org/10.1007/s00127-020-01981-y>
9. Tyrrell EG, Kendrick D, Sayal K et al. Poisoning substances taken by young people: a population-based cohort study. *Br J Gen Pract.* 2018;68(675):e703-e710. <https://doi.org/10.3399/bjgp18X698897>
10. Sheridan DC, Hendrickson RG, Beauchamp G et al. Adolescent intentional abuse ingestions: overall 10-year trends and regional variation. *Pediatr Emerg Care.* 2019;35(3):176-9. <https://doi.org/10.1097/PEC.0000000000000866>
11. Redlin M. Differences in NPI strategies against COVID-19. *J Regul Econ.* 202;62(1-3):1-23. <https://doi.org/10.1007/s11149-022-09452-9>
12. Henry N, Parthiban S, Farroha A. The effect of COVID-19 lockdown on the incidence of deliberate self-harm injuries presenting to the emergency room. *Int J Psychiat Med.* 2021;56(4):266-77. <https://doi.org/10.1177/0091217420982100>
13. Shields C, Bernard J, Mirza OI et al. Covid-19, lockdown and self-isolation: evaluation of deliberate self-harm admissions. *Front Psychiat.* 2021;12:662885. <https://doi.org/10.3389/fpsy.2021.662885>
14. Almeida lLdL, Rego JF, Teixeira ACG et al. Social isolation and its impact on child and adolescent development: a systematic review. *Rev Paul Pediatr.* 2021;40:e2020385. <https://doi.org/10.1590/1984-0462/2022/40/2020385>
15. Shultz JM, Cooper JL, Baingana F et al. The role of fear-related behaviors in the 2013-2016 West Africa ebola virus disease outbreak. *Curr Psychiat Rep.* 2016;8(11):104. <https://doi.org/10.1007/s11920-016-0741-y>
16. Bults M, Beaujean DJMA, Richardus JH et al. Perceptions and behavioral responses of the general public during the 2009 influenza A (H1N1) pandemic: a systematic review. *Disaster Med Public Health Prep.* 2015;9(2):207-

19. <https://doi.org/10.1017/dmp.2014.160>
17. Hawryluck L, Gold WL, Robinson S et al. SARS control and psychological effects of quarantine, Toronto, Canada. *Emerg Infect Dis.* 2004;10(7):1206-12. <https://doi.org/10.3201/eid1007.030703>
18. Joyce LR, Richardson SK, McCombie A et al. Mental health presentations to Christchurch Hospital Emergency Department during COVID-19 lockdown. *Emerg Med Australas.* 2021;33(2):324-30. <https://doi.org/10.1111/1742-6723.13667>