

**Article details:** 2022-0072

**Title:** The impact of the COVID-19 pandemic on pediatric asthma-related emergency department visits and hospitalizations in Montreal, Quebec: a retrospective cohort study

**Authors:** Khadidja Chelabi, Esli Osmanliu, Jocelyn Gravel, Olivier Drouin, Sze Man Tse

**Reviewer 1:** Nicole Maison

**Institution:** Asthma and Allergy, Dr von Haunersches Kinderspital Kinderklinik und Kinderpoliklinik der Ludwig Maximilian Universität München

General comments (author response in bold)

The presented study addresses an important topic in pediatrics by examining the impact of the pandemic on asthma-related hospital visits and clinical characteristics. While an overall decrease in ED visits is described in the first three waves of the pandemic, an increase is observed in June 2021 after relaxation of hygiene measures, such as school closures and others. An important observation is that children presented to the hospital with a higher acuity. However, as described by the authors in "Introduction" section, several other studies have already shown that ED visits occur less frequently and with more severe symptoms. One objective of the study is to illuminate the impact of the pandemic on the biannual peaks of exacerbation rates, but only limited information is available.

Q0) An important observation is certainly the role of the socioeconomic status in relation to asthma, but this is quite limited in this study because no person-specific data are available. Additional data may contribute to more relevance in this important study.

**We thank the reviewer for these comments. While other studies have shown a decrease in asthma-related ED visits in the first wave of the pandemic, they did not evaluate the acuity of the visits (in terms of triage levels and ICU admissions). Thus, our study adds to the current literature by examining the level of acuity of asthma exacerbations requiring ED visits. While the use of administrative data allowed us to have data on a large number of patients (n=22 746), an inherent limitation is that we did not have detailed individual data such as household income to classify socioeconomic status. However, in order to get as much granularity as possible, we used the Canadian Index of Multiple Deprivation as a surrogate measure. This index is based on each patient's 6-character postal code, which offers an indirect measure of socioeconomic status at the patient's neighborhood level.**

Major revisions

# METHODS

Q1: Study inclusion is based on ICD10 code J45. On the basis of which criteria was this diagnosis assigned?

**Given limitations with our databases, we could not retrieve information on the patients' past medical history (ie have confirmation of previous asthma diagnosis). We could only retrieve information on the discharge diagnosis for which we considered asthma exacerbations. This was added as a limitation in the revised manuscript. We included ED visit with a primary discharge diagnosis of asthma or bronchospasm or with an ICD-10-CA code J45 or ICD-9 code 493.XX. These ICD codes are widely used in asthma studies that uses administrative data. As mentioned above (response to comment S7), national guidelines in Canada**

**provide a framework for diagnosing asthma in preschool- and school-aged children and the ICD codes should reflect these guidelines. However, we acknowledge the possibility that a first episode of wheeze may be labelled as asthma and counted as an event in our data. We have added this potential for misclassification in the limitations section of the manuscript.**

Q2: The diagnosis of asthma is difficult to make, especially in preschool children. However, the median age of the children in this study is 2.7 years. The code J45 is often assigned to an episode of obstructive bronchitis at this age. However, a single episode of wheeze should not be equated with a diagnosis of asthma. How was this handled in this study?

**Please see answer to Point S7 and Q6**

Q3: Do the authors have information on patients' pre-existing conditions (allergies, pre-existing asthma)? This would help to classify the admission diagnosis.

**Unfortunately, this was not part of the administrative database and such information could not be retrieved. We have added this to the limitations section of the manuscript.**

Q4: The study aims to examine the impact of the pandemic on the previously observed biannual peaks. As described, both viral and allergen triggers play a role here. Recent data suggest that the worldwide observed surge in RSV infections is the main trigger of increasing asthma exacerbation starting from June 2021. Is there any information on the trigger of exacerbation (for example infection with fever, microbiological data)?

**We agree with the reviewer that microbiological data would be very interesting. However, children presenting with an asthma exacerbation do not routinely get virology studies as this would not change the management of their asthma. Thus, we do not have data on the identification of the viral trigger.**

## # RESULTS

Q5: Table 1 and supplemental table 1 show that patients presenting during the pandemic are significantly older. Is there an explanation or hypothesis for this?

**For preschool-aged children, respiratory viruses are the main triggers for asthma exacerbations and viral respiratory illnesses overall have drastically decreased during the pandemic. Additionally, while we do not have school or daycare attendance data, we hypothesize that while school attendance was mandatory, a higher number of preschool-aged children may have been kept home from daycares. Given these factors, it is possible that the pandemic has disproportionately reduced the risk of asthma exacerbations in younger children, which could explain the older age of children presenting to the ED during the pandemic. We have added this hypothesis to the Discussion.**

Q6: Code J45 may have a different meaning at preschool age than at school age (see Q2). A separate analysis of the age groups 0-5 and 6-17 might help to disentangle cause and effects of the observations.

**As per the reviewer's suggestion, we further analyzed the data with stratification by age (5 years and under vs 6 years and above). For asthma-related ED visits, we found a significant decrease for both age groups, with a larger decrease among children aged 5 years and under. For asthma-related hospitalizations, we found a significant decrease among children aged 5 and under, but not for older children.**

**However, the total number of hospitalizations were small in this subgroup, with only 389 hospitalizations over the study period (75 during the pandemic period), which may have limited our ability to see a statistically significant effect. Since the most common trigger for asthma exacerbations among preschool-aged children are respiratory viruses, we expect that they are the most impacted by the pandemic with the decrease in community transmission of these viruses. However, this decrease in exacerbations was also noted in older children. We have added these findings in the Results and Discussion sections of the manuscript.**

Q7: The analysis of the influence of socioeconomic status on the occurrence of exacerbations is very exciting and the statement that the pandemic does not lead to more inequality is extremely important. However, since no differences are found, a table and a graph may not be necessary.

**While we did not find a difference in the CIMD between the 2 groups of patients, we believe that the figure facilitates the understanding of the results for the readers. Additionally, we wanted to emphasize these findings since measuring an index of socioeconomic status is a novel aspect of our study compared to previous publications.**

## **Reviewer 2**

General comments (author response in bold)

Q8) Overall:

This is a well conducted simple study that aims to identify differences in the frequency of asthma-related acute care visits in children pre pandemic and during the pandemic and correlate these with changes in public health measures aimed to contain the spread of SARS-CoV-2.

While the analyses seem appropriate and the study findings are well represented and described, the biggest drawback of the study is that it does little to add to the existing knowledge or literature on this subject. It is well known that respiratory viruses are the major trigger for asthma exacerbations. We became keenly aware of the effectiveness of public health measures in curbing the spread of all respiratory viruses in the first 4-6 months of the pandemic throughout Canada and abroad (as referenced by the authors in the introduction). I am not sure that studying subsequent waves of the pandemic and how public health measures may have continued to influence respiratory virus/asthma exacerbations provides much more information on this topic.

Nonetheless, the authors did well to see if there were subpopulations that were more severely affected during the pandemic and did not experience the same protection against asthma exacerbations as other children. Despite seeing socioeconomic disparities in sickness related to COVID-illness, it was interesting that this was not demonstrated for asthma exacerbations.

Finally, the small increase in ICU admissions is also an interesting finding, though the magnitude of change was quite small, calling to question the true clinical importance of this finding.

**We thank the reviewer for their thorough review. While other studies have reported on asthma exacerbations during the first wave of the pandemic, we believe that analyzing the incidence of asthma exacerbations during subsequent**

waves is a strength of our study given the distinct school/daycare reopenings in Quebec. While schools and daycares were completely closed for in-person learning during the first 4-6 months of the pandemic, daycares reopened during summer 2020 and in-person school attendance was mandatory in September 2020, with certain public health measures in place such as mask wearing. This differs from several other Canadian provinces. Thus, we wanted to evaluate whether the reopenings of schools and daycares during the fall season, combined with the ongoing pandemic, would have an impact on asthma exacerbations in children.

Minor points:

Q9) Methods: How was the assumption of a 2 week lag time determined? Incubation of many respiratory illnesses is less than 2 weeks. Furthermore, much of the population had already started to change social behaviour on hearing of the emergence of the pandemic in Canada well before March 31. It would have made sense to define the pandemic period as starting in early March (e.g. March 10, March 15), rather than March 31. However, this small change would not likely affect the overall study findings.

**In Quebec, daycare and school closures occurred on March 13, 2020. There were no other public health measures in place at that time. Thus, we assumed that there would be baseline levels of community transmission of respiratory viruses until then. We chose a lag time of 2 weeks to uncover the impact of daycare and school closures. As a sensitivity analysis, we analyzed the data by changing the start date of the pandemic to March 13, 2021 and this did not impact the study findings.**

Q10) Discussion: Another reason for the increased exacerbations seen in May/June of 2021 likely relates to weather phenomenon experienced in this region of Canada at this time. i.e. there was an earlier start and much longer duration of the spring allergy season due to earlier hotter climates in these regions in 2021 compared to previous years. In addition, by 1 year into the pandemic, many providers/families of children with asthma chose to discontinue controller medications after several months of less disease activity. Both of these may have increased the frequency of asthma exacerbations, unrelated to relaxation of public health restrictions.

**Thank you. We acknowledged that medication adherence is a factor that we could not control for given the administrative nature of the data and included this as a study limitation. Unfortunately, we did not have access to environmental data and we acknowledge this in the limitations. Conversely, while it is interesting to note the weather phenomenon, environmental studies suggest that increases in allergens only contribute to a moderate increase in asthma-related ED visits. For example, Héguy et al documented a mean percent increase of 1.73% in asthma-related ED visits among children per increase of 10 grains/m<sup>3</sup> of grass pollen in Montreal (6). Thus, while allergies may have contributed to higher numbers of asthma exacerbations in May/June 2021, it is unlikely to be the sole explanation.**

References:

1. Davies GA, Alsallakh MA, Sivakumaran S, Vasileiou E, Lyons RA, Robertson C, et al. Impact of COVID-19 lockdown on emergency asthma admissions and deaths: national interrupted time series analyses for Scotland and Wales. *Thorax*. 2021 Feb;thoraxjnl-2020-216380.

2. Shah SA, Quint JK, Nwaru BI, Sheikh A. Impact of COVID-19 national lockdown on asthma exacerbations: interrupted time-series analysis of English primary care data. *Thorax*. 2021 Sep;76(9):860–6.
3. Hawley S, Ali MS, Berencsi K, Judge A, Prieto-Alhambra D. Sample size and power considerations for ordinary least squares interrupted time series analysis: a simulation study. *Clin Epidemiol*. 2019 Feb 25;11:197–205.
4. Xi N, Wallace R, Agarwal G, Chan D, Gershon A, Gupta S. Identifying patients with asthma in primary care electronic medical record systems. *Can Fam Physician*. 2015 Oct;61(10):e474–83.
5. Canadian Pediatric Society. Diagnosis and management of asthma in preschoolers: A Canadian Thoracic Society and Canadian Paediatric Society position paper | Canadian Paediatric Society [Internet]. [cited 2022 Mar 12]. Available from: <https://cps.ca/en/documents/position//asthma-in-preschoolers/>
6. Héguy L, Garneau M, Goldberg MS, Raphoz M, Guay F, Valois M-F. Associations between grass and weed pollen and emergency department visits for asthma among children in Montreal. *Environmental Research*. 2008 Feb 1;106(2):203–11.