

The impact of COVID-19 lockdown measures on the behaviour and morbidity of children with asthma: a narrative review

Marios Lemonaris¹, Panayiotis Kouis², and Panayiotis Yiallourous²

¹University of Nicosia Medical School

²Respiratory Physiology Laboratory University of Cyprus Medical School Nicosia Cyprus

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Abstract

The spread of COVID-19 and the worldwide implementation of restrictive measures for the containment of SARS-CoV-2 led to drastic population behavioural changes. The aim of this review is to summarize the behavioural changes observed in asthmatic children during this period, present the concurrent changes in childhood asthma morbidity and discuss possible implications of these observations for public health and clinical practice in the post-COVID-19 era. Studies published from November 2021 to February 2022 were identified from PubMed® and Google Scholar databases using appropriate search terms. Numerous studies have assessed the morbidity of children with asthma during lockdown periods and associated these changes with reduced exposure to environmental triggers and respiratory viral infections, while a lockdown-independent increase in patient compliance to treatment was also observed. Within this context, asthmatic children demonstrated reduced asthma-related emergency department visits, less usage of systemic steroids and in general an improved disease control, with some data suggesting a positive association of asthma control and lockdown stringency. In summary, this narrative review examines the behavioural changes brought by lockdowns, their cumulative beneficial effect on paediatric asthmatic morbidity, and triggers a debate on how public health measures may be taken to benefit children with asthma in a post-COVID-19 era.

1 Introduction

Environmental exposures such as maternal smoking, socio-economic status, family structures, mode of delivery, diet, air pollutants and allergens are well-known risk factors for childhood asthma.^{1,2} A strong risk factor for increased asthma incidence and severity are also frequent lower respiratory tract infections and multiple-trigger wheezing during early life, which are significant predictors for the subsequent development of asthma later in life.^{3,4}

The relationship between asthma and respiratory infections has made asthma an empirical risk factor for severe COVID-19 disease since the beginning of the pandemic. Although this relationship remains to date inconclusive with some reports suggesting that childhood asthma may be even protective against COVID-19,⁵ at least during the first months of the pandemic, COVID-19 control strategies characterised asthmatic adults and children as potentially vulnerable subpopulations.⁶

COVID-19 control strategies focused on containment of the spread of COVID-19 and involved national lockdowns, social distancing, compulsory use of masks and, following the roll-out of SARS-Cov-2 vaccines, campaigns and assessment of vaccination status upon entering indoor micro-environments. Not surprisingly, these strategies, combined with concerns of contracting the virus, have resulted in behavioural changes in the population, that, in turn, may have affected the epidemiology of common chronic diseases such as childhood asthma.⁷ Decreased time spent outdoors, leading to reduced exposure to ambient environmental triggers such as allergens, pollutants and dust-related particulate matter,⁸ as well as reduction of social interactions that led to decreased exposure to communicable pathogens such as the influenza virus, respiratory syncytial virus

(RSV) and rhinoviruses (RV) are the most relevant behavioural alterations that may have affected asthma morbidity.⁹ In addition, other COVID-19 control strategies also included stricter hand hygiene, while during peak periods of the pandemic waves access to hospital or primary care practitioners was restricted or avoided. In the case of children with asthma, national containment strategies also involved school closures,¹⁰ as well as restriction of after school (mostly outdoor) activities.⁸ Published evidence over the last two years has consistently documented a marked reduction of asthma morbidity during the COVID-19 period, mainly in terms of reduced exacerbation-related hospital and emergency department (ED) encounters.¹¹⁻¹⁶

The aim of this review is to summarize the behavioural changes observed in asthmatic children during the implementation of COVID-19 containment strategies, present the concurrent improvement of childhood asthma morbidity and discuss the possible implications of these observations for public health and clinical practice in the post-COVID-19 era.

2 Methods

Studies published from November 2021 to February 2022 were identified from PubMed[®] and Google Scholar databases using the search terms ‘lockdown’, ‘COVID-19’, ‘asthma morbidity’, ‘asthma control’, ‘asthma exacerbations’, ‘behavioural changes’, ‘treatment compliance’, ‘pollution’ and ‘respiratory viral infections’. Studies were selected if the target population was asthmatic children and the outcomes were changes in morbidity and control, or changes in any behaviour affecting their exposure to asthma triggers, during the COVID-19 lockdown periods. Studies observing alterations in pollution and implementation of restrictive measures were also included.

3 Results

3.1 Behavioural Changes

3.1.1 Changes in Environmental Exposure

National lockdowns aimed to limit social interactions. In parallel, restraining the population indoors decreased exposure to environmental stressors such as respiratory infections, airborne allergens, particulate matter (PM₁₀, PM_{2.5}) and other air pollutants.^{17,18} These stressors are well-established inducers of airway inflammation, asthma exacerbations and worsening disease control.¹⁹⁻²² Consistent reports from across different countries documented decreased physical activity of children during lockdowns and increased time spent in front of screens, as a result of the increased time spent indoors.²³⁻²⁵ One study, using wearable sensors, objectively measured time spent outdoors and levels of physical activity in asthmatic children before and during lockdown periods and also confirmed a marked reduction of both during lockdown.⁸

Besides decreased outdoor exposure, there was also a notable decrease in anthropogenic pollutants emissions during lockdowns as a result of the reduced traffic volume and economic activity, which reversed following the lifting of the restriction measures.²⁶ Greenhouse gases, specifically nitrogen dioxide (NO₂), carbon monoxide (CO) and emissions of PM₁₀, PM_{2.5} were substantially decreased compared to previous years.²⁶⁻²⁸ NO₂ reductions were consistently low compared to non-lockdown periods across European countries, while levels of PMs were reduced but at different levels, possibly due to their source variability, such as the natural origin particulate matter from environmental dusts.²⁹ Few studies showed no significant decreases in area-specific PM_{2.5}, PM₁₀, NO₂ and ground-level ozone, despite reporting dramatic reductions in vehicular traffic, implying that possible reductions in pollutants were not adequately measured.¹³

3.1.2 Changes in Social Interactions

School and university closures across the world have affected more than 1.5 billion students during 2020.³⁰ Asthmatic children may have benefited from this intervention, as exposure to other respiratory viruses such as influenza, RSV and RV was also reduced. Even though the relationship between influenza and asthma is still ambiguous³¹, respiratory viruses such as RSV and RV are known risk factors for initiating and exacerbating paediatric asthma^{21,22}. Although it is difficult to quantify changes in social interactions at the community level, a reduction was inevitable following the imposition of social distancing measures in

many countries, contributing to the decreased prevalence of influenza, RSV and RV infections during the implementation of these containment strategies^{9,32,33}, and the reduced morbidity of children with asthma. However, the reported lower incidence of other viral infections may have been amplified by reduced health seeking behaviours as a result of fears to visit healthcare services created by the pandemic.

3.1.3 Changes in Treatment Compliance and Hospital Visits

The pandemic has repelled patients from attending many healthcare settings, especially visits for routine or minor care.³⁴ Patients also delayed admissions to hospitals even for major incidents, such as seizures and diabetic ketoacidosis, risking the development of worse outcomes than those of COVID-19.³⁵ Hospital visits were further reduced by policies for avoidance of physical appointments and encouragement of remote consultations when appropriate.³⁶ On the other hand, the pandemic may have increased chronic respiratory patients' concerns for keeping their disease under control, thus increasing their compliance to treatment. In this context, a study assessed the compliance of 297 asthmatic children using parental questionnaires, and demonstrated a relative increase in compliance to spacer and medication use in 65% of the children during the pandemic.³⁷ Similarly, another report in 1054 asthmatic children from different areas of the world showed a general improvement in treatment compliance during the pandemic.³⁶

3.2 Changes in Morbidity

The implementation of containment strategies for the spread of the pandemic appears to have caused an improvement in paediatric asthma control. A hospital study in the US reported a significant decrease in asthma-related emergency department (ED) visits and hospitalisations, which were below the seasonal variation seen in previous years. This observation was seen days after the implementation of a 'stay-at-home' and 'home-schooling' strategies.¹² Interestingly, this change was observed during the spring season where cases of allergy-induced attacks and respiratory viral infections normally peak in incidence. Other studies from the USA, Slovenia and Italy reported decreased asthma-related emergency visits and hospitalisations in children, while data from Philadelphia also reported less use of systemic steroids and a reduction in rhinovirus infections during lockdowns.¹³⁻¹⁵ Similar trends were observed in nationwide studies. A large-scale study in Japan conducted a nationwide observation of asthma-related ED visits and hospitalisations during 2020 and compared it to previous years in 272 hospitals across the country, yielding similar trends.¹⁶ In South America, a study conducted in three Ecuadorian cities found an 89% decrease of ED visits in asthmatic children during lockdowns, but interestingly observed an unchanged use of inhaled corticosteroids and number of exacerbations, and an increased use of β -agonists.³⁸ On the other hand, a study involving three tertiary care hospitals in Madrid observed a rise in the number of well-controlled asthmatic children, a decrease in the use of control medications and overall exacerbations, but an increase in exacerbations related to animal dander, exercise, stress and COVID-19.³⁹ Finally, following the implementation of lockdowns in Greece and Cyprus, a community-based study documented in both countries a significant improvement in asthma control test (c-ACT) score, a decrease in asthma-related hospital ED visits, decrease in the use of systemic treatment such as oral corticosteroids and a lower infection incidence compared to previous years.¹¹ In this study, greater improvements in c-ACT scores were observed in asthmatics with more severe disease. In line with the above, another study also found significant improvements of c-ACT scores in severe asthmatics taking biological agents after the lockdown, compared to before.⁴⁰ Interestingly, some of these studies also confirmed a positive correlation between lockdown stringency and improvement in asthma control and exacerbations.^{11,25}

4 Discussion

During the lockdown period, a consistent improvement in asthma morbidity has been observed across several studies, attributed to behavioural changes that led to decreased exposure to environmental and infectious triggers and improved treatment compliance. It is difficult to quantify the contribution of each specific behavioural change towards the reduction of asthma morbidity, although respiratory viral infections have been proposed as one of the most important and well-established causes of asthma exacerbations and hospitalisations.^{21,22} Lockdowns were directly aiming to decrease the spread of COVID-19 through social

distancing, leading to an inevitable decrease in other infections from common respiratory viruses. Indeed, many studies showed a reduction in the spread of common respiratory viruses, which partly explain the reduction in asthma-related ED visits and hospitalisations across the globe.

However, as Dondi A, et al have pointed out, the improvement in clinical picture was most probably due to synergistic effects of many behavioural changes brought by lockdowns, with the most important being the reductions in pollution exposure and respiratory infections.¹⁵ Other contributing factors may well be the reduction in allergen exposure due to less time spent outdoors and the increased treatment compliance. The relationship between environmental triggers and asthma exacerbations is well-established and there are ongoing studies on mitigation strategies focusing on reduction of exposures to environmental hazards, aiming to reduce morbidity of vulnerable groups such as children with asthma.⁴¹ Furthermore, poor compliance and poor inhaler technique are known major preventable causes of poor asthma control.⁴² The pandemic fear and the concerns for association of asthma with worse COVID-19 outcomes have improved compliance,³⁶ possibly the treatment technique and the vigilance for recognition of signs of poorly controlled asthma.

The findings of this review raise questions on how public health measures may improve asthma control after the pandemic has ended. School-based interventions are a good example of a strategy that can reduce the exposure of children with asthma to respiratory viruses. A national-level study in Italy aiming to improve health behaviours in schools examined raising awareness on disease spreading, teaching promotion of hygienic behaviours and access to antiseptics. During the pandemic, infection incidence of SARS-CoV-2 was 14% lower in schools participating in the intervention compared to regional incidence.⁴³ Mask wearing and social distancing were also shown to reduce SARS-CoV-2 spread,⁴⁴ and may benefit asthmatic children after the pandemic in a similar manner. However, public acceptability and attitudes towards each intervention should be considered, especially in the case of mask wearing and social distancing, as these involve trade-offs between preserving children's physical health versus mental health and social development.^{45,46} Other strategies could focus on air quality by improving school infrastructures aiming to maintain a better indoor air-quality in areas affected by anthropogenic or non-anthropogenic emissions, or during high pollen seasons, and encourage indoor activities for vulnerable children. Design of more efficient buildings with better window and door sealing, or installation of air purifiers in classrooms and houses are such potential measures. Furthermore, timely population alerts on days with high environmental pollution along with dissemination of recommendations on minimising transport, time spent outdoors and instructions on how to maintain a better indoor air quality are also relevant.⁴¹ Finally, better compliance and patient teaching on asthma treatment should continue to be important aspects of primary care.

Some of the presented studies were limited by the small size and isolated sources of their data, such as data from ED visits reported from single hospitals. However, the consistency and robustness of the findings across these studies suggest a real effect of lockdowns on asthma morbidity. Another limitation is the administrative nature of the data in several studies, as they emerged from hospital encounters which may have been affected by pandemic-related hospital avoidance. However, a similar strong trend of improved asthma control was also reported by the few prospective and community-based studies.^{11,38,40}

5 Conclusion

Behavioural changes observed during the lockdown periods may explain the significant reductions in asthma morbidity that were consistently seen across many studies. After the pandemic, public health measures can be developed aiming to produce a similar cumulative beneficial effect on asthma control, as the one produced by the behavioural changes brought by the interventions to control SARS-Cov-2. Further research and careful consideration is needed on the acceptability of such measures by the population and the potential trade-offs.

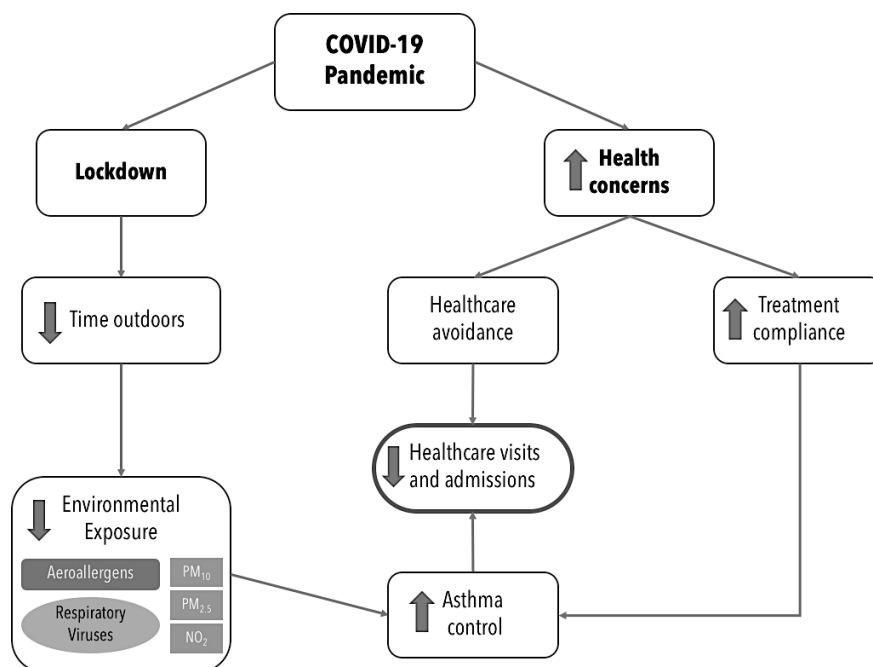
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