



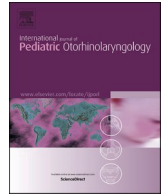
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Contents lists available at ScienceDirect

International Journal of Pediatric Otorhinology

journal homepage: www.elsevier.com/locate/ijporl

COVID-19: Effects of lockdown on adenotonsillar hypertrophy and related diseases in children

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ARTICLE INFO

Keywords:

COVID-19
Lockdown
OSAS
URTIs
Adenotonsillar hypertrophy
Therapy

ABSTRACT

Background: In response to the coronavirus pandemic 2019 (COVID-19), Italy established the national school closings from March 5, 2020. It has been shown that during school closures, there are significant decreases in the diagnoses of the respiratory infections. This has brought as well to a reduction in all those symptoms related to adenotonsillar hypertrophy.

Methods: The study included 162 children, aged between 3 and 13 years, waiting for adenoidectomy and/or tonsillectomy, eventually combined with tympanocentesis or tube insertion. Parents have been called to answer a telephone interview aimed at detecting how the symptoms related to adenotonsillar hypertrophy were changing during lockdown.

Results: There was an improvement in the overall symptomatology of children during the lockdown period. The value attributed by parents to the children's general assessment during the lockdown period decreased significantly during the quarantine ($p = 0,0000$).

Conclusions: The present study demonstrates that lockdown can have a positive impact on those specific diseases derived from precocious socialization and that it results to be particularly effective for the most vulnerable children. Indeed, lockdown has resulted to be so efficient that it has caused a modification in a medical and surgical therapeutic indication.

1. Introduction

The adenoids and palatine tonsils are lymphoid structures respectively located in the nasopharynx and oropharynx and are part of the Waldeyer's ring. They represent the body's first line of defense against external pathogens [1]. The hypertrophy of these lymphoid structures may occur as a consequence of repeated viral and bacterial infections [2]. Adenotonsillar hypertrophy is particularly common in children between 3 and 6 years and causes different symptoms such as nasal obstruction, habitual mouth breathing and snoring up to obstructive sleep apnea. Moreover, it can cause mechanical obstruction of the Eustachian tube orifices leading to recurrent Otitis Media with Effusion (OME). These elements can influence patients' quality of life, as well as interfere with their psychophysical development. It has been shown that during school closures, there are significant decreases not only in the diagnoses of respiratory infections but also in the number of medical examinations, need and usage of the emergency departments and

medication purchases [3]; however, it is still unknown if this improved health status is linked to seasonality or to the reduced circulation of the viruses or, eventually, to the reduced frequency of school communities. In response to the coronavirus pandemic 2019 (COVID-19), Italy established the national school closings from March 5, 2020. Therefore, a study model, which we never wanted to draw or experiment, has been created. This could support one of the most accredited hypotheses, represented by the correlation between upper respiratory tract infections (URTIs) and school attendance. The aim of our study is to evaluate any children's symptomatic improvement related to the restrictive social distancing policies of this period.

2. Material and methods

The parents of the 162 children waiting for adenoidectomy and/or tonsillectomy, eventually combined with tympanocentesis or tube insertion to be performed at the Department of Otolaryngology of the

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<https://doi.org/10.1016/j.ijporl.2020.110284>

Received 4 June 2020; Received in revised form 27 July 2020; Accepted 27 July 2020

Available online 9 August 2020

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University Hospital of Foggia, were informed about the study and received a telephonic interview 60 days after the start of the lockdown period. Inclusion criteria were arranged as follows: age range: 3–13; genders: both; pathology: adenoid hypertrophy and/or tonsil hypertrophy eventually associated with otitis media. Specific exclusion criteria were anatomic sinonasal disorders and cystic fibrosis. Parents were asked to answer a questionnaire about children. The questionnaire included questions related to the degree of adenoid hypertrophy [4] and/or presence of tonsillar hypertrophy. In addition, it investigated specific symptoms linked to these diseases. In particular, it analysed the symptoms related to the ear (frequency in otitis, earache, otorrhea, hearing loss occurrence), breathing (nasal obstruction, mouth breathing, rinorrhea, nasal voice) and snoring (regularity of snoring, observed apneas and behavioural changes) (Fig. 1). In addition, patient's global assessment was evaluated using a scale ranging from 0 (remission) to 10 (maximum symptomatology). Each item was investigated before and during the lockdown period. A detailed form was filled for each child. The differences in the scores attributed to patient's global assessment before and after social distancing were evaluated using the Student's *t*-test.

3. Results

A total of 162 parents were contacted. 37 did not answer the phone, 5 had already undergone surgery elsewhere. Therefore, the final study sample was of 120 children. Of these, 70 were males and 50 were females. The average age was 5.68 (range 2–13 years). Children enrolled had different adenoid hypertrophy grade [4]: 4 (3,33%) grade I, 4 (3,33%) grade II, 43 (35,83%) grade III, 69 (57,50%) grade IV. Moreover, 71 (59,1%) children had tonsillar hypertrophy. Among these patients, 67(55,83%) were candidates for adenotonsillectomy, 35 (29,17%) for adenoidectomy, 10 (8,33%) for adenoidectomy combined with

tympanocentesis/Grommet, 5 (4,17%) for tonsillectomy, 2 (1,67%) adenotonsillectomy combined with tympanocentesis/Grommet, 1 (0,83%) tympanocentesis (Fig. 2). We analysed the symptoms related to the ear, breathing and snoring before and during lockdown period. Fig. 3 shows percentages of symptoms before the lockdown period. Fig. 4 shows how symptoms, if found, varied during the social distancing period. Moreover, parents attributed an average score of 6,7 to children's general assessment before the lockdown period. This value decreased significantly during the quarantine, reducing from 6,7 to 4,1 ($p = 0,0000$) (Fig. 5).

4. Discussion

World Health Organization (WHO) declared the coronavirus disease 2019 (COVID-19) outbreak, caused by severe acute respiratory

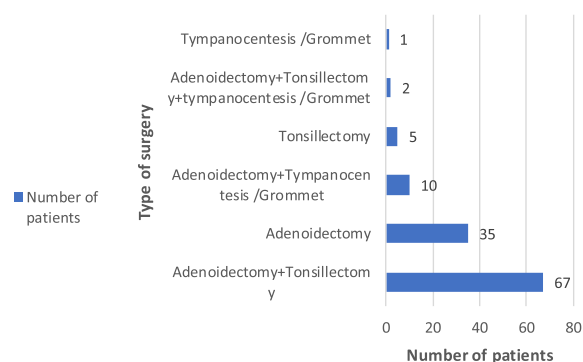


Fig. 2. Bar chart of the number of patients included in the study divided by type of surgery they were waiting for.

OTITIS												
Has the child ever suffered from otitis?	YES	NO										
If yes, from March 5 otitis are	Improved	Unchanged	Got worse									
Has the child ever suffered from earache?	YES	NO										
If yes, from March 5 earache is	Improved	Unchanged	Got worse									
Has the child ever suffered from otorrhea?	YES	NO										
If yes, from March 5 otorrhea is	Improved	Unchanged	Got worse									
Is the child's hearing good?	YES	No										
If no, from March 5 hearing is	Improved	Unchanged	Got worse									
BREATHING												
Has the child ever suffered from nasal obstruction?	YES	NO										
If yes, from March 5 nasal obstruction is	Improved	Unchanged	Got worse									
Does the child have oral breathing?	YES	NO										
If yes, from March 5 oral breathing	Improved	Unchanged	Got worse									
Has the child ever suffered from nasal secretions?	YES	NO										
If yes, from March 5 nasal secretions are	Improved	Unchanged	Got worse									
Has the child ever suffered from nasal voice?	YES	No										
If yes, from March 5 nasal voice is	Improved	Unchanged	Got worse									
SNORING												
Has the child ever snored?	YES	NO										
If yes, from March 5 snoring is	Improved	Unchanged	Got worse									
Has the child ever suffered from sleep apneas?	YES	NO										
If yes, from March 5 sleep apneas are	Improved	Unchanged	Got worse									
Is the child irritated during the day?	YES	NO										
If yes, from March 5 behaviour is	Improved	Unchanged	Got worse									
Has the child ever suffered from concentration problems?	YES	No										
If yes, from March 5 concentration is	Improved	Unchanged	Got worse									
What value would you assign to the child's global assessment before lockdown period?												
Remission	0	1	2	3	4	5	6	7	8	9	10	Maximum symptomatology
What value would you assign to the child's global assessment during lockdown period?												
Remission	0	1	2	3	4	5	6	7	8	9	10	Maximum symptomatology

Fig. 1. Telephone questionnaire submitted to children's parents.

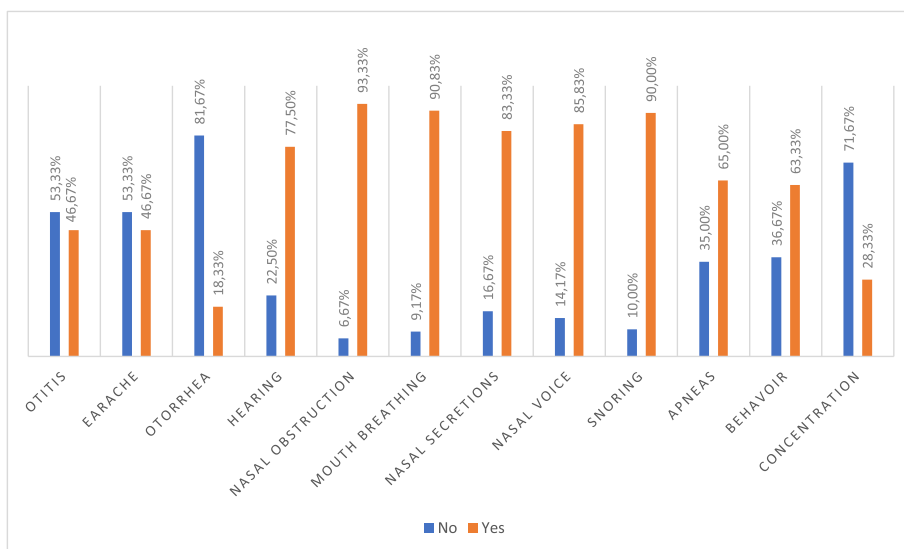


Fig. 3. The histogram shows percentages of symptoms before lockdown period.

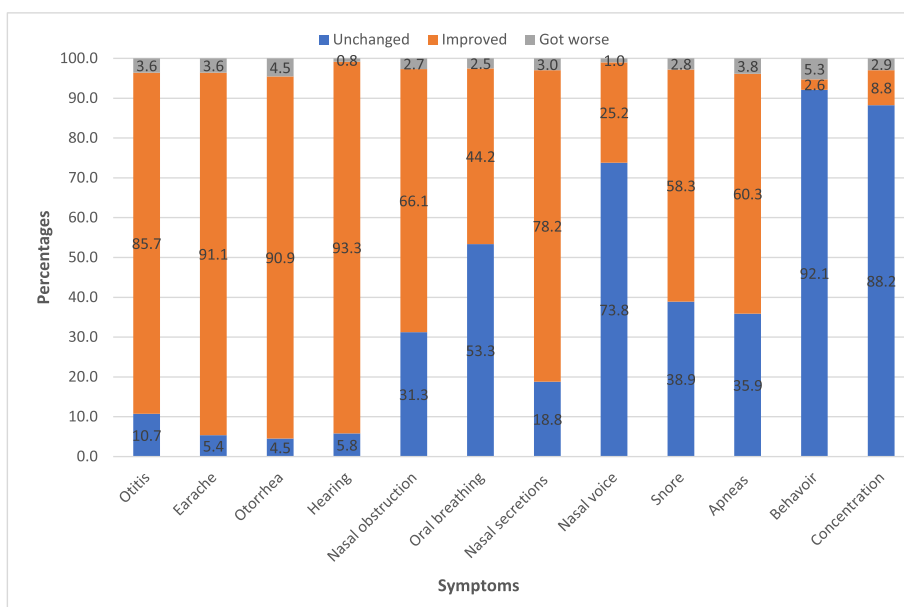


Fig. 4. The stacked bars chart shows how symptoms, if found before lockdown period, varied during the social distancing period.

syndrome coronavirus 2 (SARS-CoV-2), as a “public health emergency of international concern” on January 31, 2020. Within the first two months of the outbreak, the epidemic spread rapidly around the world [5]. In the absence of any pharmaceutical intervention, it has been supposed that the only strategy against COVID-19 was to reduce mixing of susceptible and infectious people through early ascertainment of cases and social distancing interventions [6]. To reduce the spread of SARS-CoV-2, Italy implemented national school closings by March 5, 2020. Indeed, it has been evaluated that school closure can have a substantial impact on the spread of an emerging infectious disease that is transmitted via close (non sexual) contacts [7]. In this context, we hypothesized that social distancing and the closure of schools could improve symptoms and quality of life of children with adenoid and/or tonsillar hypertrophy eventually with OME. Infact, the excessive lymphoid tissue enlargement is due to various isolated or recurrent bacterial or viral infections as well as exposure to environmental irritants such as allergens, cigarette smoke and air pollution [8]. So, we decided to investigate whether and how symptoms of children awaiting surgery at the Department of

Otolaryngology at the University Hospital of Foggia, had changed during the lockdown period. Therefore, we assessed whether symptoms related to adenotonsillar hypertrophy had improved, worsened or remained unchanged after 5 March, 2020. In particular, adenoid hypertrophy in children is considered a risk factor for OME, which can result in hearing loss [9]. As shown in Fig. 4, during the lockdown we found a reduction in the frequency of the otitis with improvement in otalgia, otorrhea and hearing loss. Infact, as demonstrated by Belski et al. [10], children who attend child care arrangements with more than 6 children have an increased risk of OME. This agrees with the theory of Paradise et al. [11] according to which there is a strong positive relationship between days with middle ear effusion and the degree of exposure to other children. Infact, children attending day-care centers have a higher risk of acute respiratory infections compared with children cared at home [12]. This can led to adenoid hypertrophy that may compress or obstruct the Eustachian tube ostium, thereby causing pressure in the middle ear and subsequent effusion formation [13]. We also found a significant improvement in nasal obstruction as well as

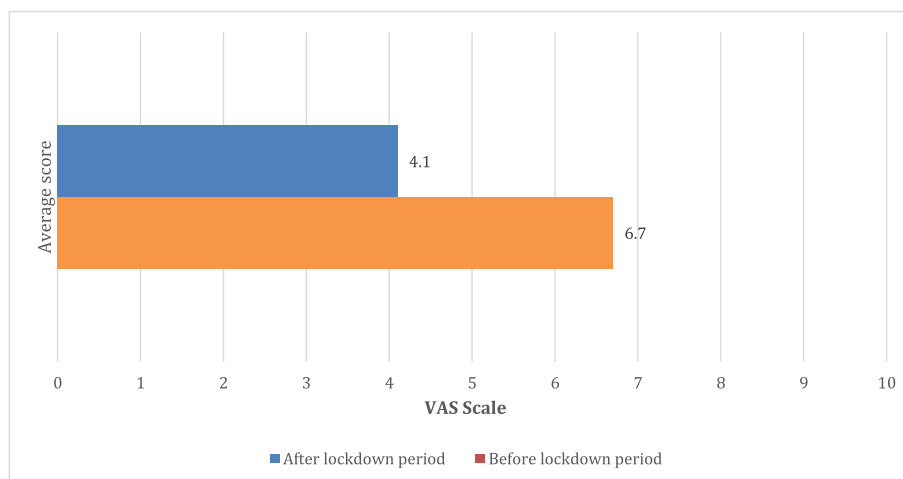


Fig. 5. The bar chart shows how the average score attributed by parents to children's general assessment before the lockdown period decreased significantly during the quarantine.

nasal secretions. However, more than half of the children continued to present mainly mouth breathing and nasal voice. It is well known that substitute mouth respiration is associated with adenotonsillar hypertrophy [14], which causes mechanical obstruction of air passage through the upper airways. This change in the respiratory pattern may provide facial deformities and alterations from the stomatognathic system in the functioning of swallowing and speech [15]. After surgical intervention, it is possible to observe changes in the previous adopted respiratory mode, becoming in most cases the nasal mode, which is physiologically expected. This is associated with improvement of the vocal and swallowing patterns and readjustment of stomatognathic system structures [16]. However, most children need to attend a speech therapy after adenotonsillectomy for readapting stomatognathic structures and the assessed functions. This explains why only 44,2% of children found an improvement in oral respiration and only 25,2% in nasal voice. We believe this may also be related to the habit that children acquired over time to breathe in this substituted way, therefore telephone counselling is recommended to invite parents to get their children used to nasal breathing. Snoring and apneas improved by 58,3% and 60,3% respectively. This can be explained by hypothesizing that during the lockdown period there was a slight reduction of the adenoid hypertrophy but not such as to completely resolve the obstructive symptoms. Children's behaviour remained unchanged in almost all cases. Probably the stress condition associated with social distancing did not allow an improvement in the agitation of the children despite the enhancement of the remaining symptoms. The overall improvement in symptoms reported by patients was reflected in parents' overall satisfaction. In fact, we asked them to score children's general assessment before and during the lockdown period and the value they expressed decreased significantly during quarantine, with significant reduction in symptoms. Although our study has confirmed the correlation between school attendance and recurrence of URTIs, it is certainly not possible to implement this strategy, preventing socialization, which could be recommended for short periods only and in subjects at risk. In this case, the aid policies addressed to the family, such as work permits in the first years of the child's life, are essential for the normal psycho-physical growth of the little patient.

The main limitation of our study is related to the total stop of non-urgent procedures and surgeries across all specialities in Italy: for this reason children were evaluated by their parents and not by the ENT specialist. Nevertheless we would emphasize that parents first notice their children's symptoms and understand when it is appropriate to take them to an ENT specialist. Therefore, we felt that they were able to provide accurate answers to our questions. Another limitation could be represented by the fact that we did not consider variables such as age,

seasonality and allergies. However, the time frame considered was too short to evaluate the influence of these factors on the variations in symptoms. Moreover, other studies have shown that there is no correlation between the season and snoring in children with adenotonsillar hypertrophy nor between season and OME [17,18].

5. Conclusions

The closure of schools as a means of prevention for the spread of SARS-CoV-2 is an exceptional event that has never happened in history. To the present days, we cannot find data in literature about the effects of social distancing on the general conditions of children with adenotonsillar hypertrophy. It is known that the exposure of children to the pathogens present in schools causes recurrent infections of the upper airways, with consequent excessive lymphoid tissue enlargement. With the present study we have shown how preventing children from coming into contact with other people and visiting places that expose them most to infectious risk, greatly improves the child's symptoms and the overall satisfaction of the parents with regard to the health of their children. However, further studies should be conducted in order to understand how much other factors, involved in the etiopathogenesis of adenotonsillar hypertrophy, contributed to the improvement of symptoms.

Disclosure of potential conflicts of interest

All authors certify that they have no affiliations with or involvement in any organization or entity with any financial interest (such as honoraria; educational grants; participation in speakers' bureaus; membership, employment, consultancies, stock ownership, or other equity interest; and expert testimony or patent-licensing arrangements), or non-financial interest (such as personal or professional relationships, affiliations, knowledge or beliefs) in the subject matter or materials discussed in this manuscript.

Ethical approval

This retrospective study was approved by Institutional Review Board OF University of Foggia, Foggia, Italy, Via Luigi Pinto 1-71122 Foggia (FG).

Informed consent

All patients and/or their parents/guardians included in the study signed informed consent.

Declaration of competing interest

The authors have no conflicts of interest to declare.

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