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LONG TERM IMPACT OF COVID 19 IN CHILDREN WITH ASTHMA USING SPIROMETRY

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ABSTRACT

INTRODUCTION

Children with asthma represent a significant subgroup susceptible to respiratory infections, including COVID-19 caused by the severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2). Asthma, characterized by chronic airway inflammation and bronchial hyperreactivity, predisposes individuals to respiratory complications during viral infections. The objective of this study is to examine the long-term effects of COVID-19 on the pulmonary function, asthma control, and respiratory health of children who have pre-existing asthma.Understanding these effects is crucial for optimizing clinical management and developing targeted interventions to mitigate potential adverse outcomes in this vulnerable population.

AIM & OBJECTIVE

The objective of this study is to examine the long-term effects of COVID-19 on the health of the respiratory system, asthma management, and pulmonary function in children who have already been diagnosed with asthma.

METHOD

This was a Prospective Case Control Study studied at Department of Paediatrics, Saveetha medical college and Hospital, Chennai, Tamil Nadu, India between the time frame of October 2022 to March 2023 in children with asthma between the age group of 6-18 years were selected. The participants were categorized as Cases (children with asthma who contracted Covid-19 infection) and Controls (children with asthma who did not contract Covid-19 infection).

RESULT

The baseline FEV1 was higher in cases than in control subjects (95.9 ± 14.5 vs. 94.6 ± 13.8%; P = 0.49). However, there were no significant differences in follow-up FEV1 or mean ΔFEV1 between cases and control subjects. In baseline, follow-up, or change in FVC or FEV1/FVC, there were no significant differences between cases and control subjects.

CONCLUSION

The majority of cases do not experience a significant impact on asthma symptom control or respiratory function as a consequence of SARS-CoV-2 infection, as this study concludes. However, a small number of patients may experience a decline in asthma control as a consequence of COVID-19, particularly if they had shortened follow-up periods or experienced asthma exacerbations during the infection.

KEYWORDS

Bronchial Asthma, Spirometry, Pulmonary Function Test, Covid 19, Paediatric population

INTRODUCTION

The intersection of COVID-19 and asthma has been a topic of significant interest and concern since the onset of the pandemic. Asthma, a chronic respiratory condition characterized by hyperresponsiveness of airways to various stimuli. It manifests as inflammation and narrowing of the airways that causes acute dyspnea and in most of the cases it is reversible and controllable through regular treatment. After Covid 19 pandemic, it raises questions about how it influences the susceptibility to and severity of SARS-CoV-2 infection and its interaction

with the virus. At first, there were concerns that severe COVID-19 outcomes may be more likely for individuals with asthma, particularly adolescents, as a result of their underlying respiratory condition. COVID-19 has had a diverse impact on asthmatic individuals, as evidenced by research. Although asthma does not appear to increase the risk of contracting COVID-19, certain studies indicate that individuals with inadequately controlled asthma may be at a higher risk of developing a more severe illness if they are infected.Conversely, other studies indicate that asthma management and adherence to medication could mitigate the risk of severe outcomes. In this study, we have studied regarding the longterm impacts of Covid 19 in children with asthma and how it may impact in children in poorly controlled asthma.

METHOD

This was a prospective Case Control study conducted at Saveetha Medical college and Hospital, Tamil Nadu, India. Individuals were selected from the Data Register. The parents of the study participants provided signed informed consent before to the study's start. Authorization from the Institutional Ethics Committee was acquired. children between the ages of 6 and 18 who had been diagnosed with bronchial asthma were chosen. There were two groups of participants: cases and controls. Children with asthma diagnosis who also had positive RT-PCR results for Covid-19 infection were considered as cases. Individuals with asthma who were not infected with COVID-19 served as controls. Information about the participants, including their age, weight, height, and demographic group, was gathered. Parents of the participants were requested to follow up after being reached by phone. The study excluded children with autoimmune disorders, cancer, global developmental delay, intellectual disability, and chronic respiratory conditions other than asthma, such as interstitial lung diseases, cystic fibrosis, broncheictasis, airway anomalies, pulmonary tuberculosis, and restrictive lung diseases like kyphosis and scoliosis. Children diagnosed with bronchial asthma, positive RT-PCR results for Covid-19 infection, and baseline spirometry values prior to acquiring Covid-19 infection were among the inclusion criteria. The age range for the children was 6 to 18 years old. The Childhood Asthma Control Test (C-ACT) was used to measure the severity of asthma in children aged 6 to 11 and the Asthma Control Test (ACT) in adults aged 12 to 18 (1)(9). Lung function was assessed using spirometry, with particular attention paid to vital signs such as forced vital capacity (FVC), forced expiratory volume in 1 second (FEV1), and the FEV1/FVC ratio. From the body of research already in existence, we determined the gender, age, comorbid asthma, allergy diseases, smoking exposure, body mass index (BMI), and degree of physical activity as potential confounding factors.

SAMPLE SIZE

Out of the 259 children who were selected, 19 children were excluded from the study due to parental reluctance, resulting in a final participation count of 240 children.

STATISTICAL ANALYSIS

Excel from Microsoft was used together with SPSSv29 software for statistical analysis. Score ranges for the ACT and C-ACT are not the same. We first integrated the ACT scores with the C-ACT scores after applying a linear transformation to the ACT scores in order to harmonize these scores. ACT' = c (ACT − a)/(b − a), where 'a' represents the lowest possible ACT score, 'b' the highest possible ACT score, and 'c' the highest possible C-ACT score. This was the transformation formula that was employed. The ACT scores were converted and subsequently combined with the C-ACT information to produce "ACTS (1)."For bivariate analysis of categorical and non-paired continuous variables, we employed Wilcoxon rank-sum tests or two-tailed t-tests. In order to compare categorical and paired continuous variables, we utilized either paired t-tests or McNemar's test. Both Fisher's exact tests and chi-square tests were used to analyze categorical variables. After these studies, we looked at the potential relationship between asthma exacerbation during acute COVID-19 and a subsequent decline in lung function or asthma symptoms using logistic regression. The baseline asthma severity (persistent vs. intermittent), age, sex, and the interval between COVID-19 onset and follow-up testing were all taken into account while adjusting this regression model.

RESULTS

	BASELINE	FOLLOW UP	CHANGE	p VALUE
ASTHMA SYMPTOM CONTROL				
COVID 19 CASES (n=100)	23.0 [20.7–27.0]	23.5[20.3-26.6]	0.0+/-4.2	0.89
CONTROL SUBJECTS (n=130)	20[19.9-25.6]	22.5[20.4-26.2]	1.5+/- 4.0	<0.01

FEV1	BASELINE	FOLLOW UP	CHANGE	P VALUE
COVID 19 CASES (n=110)	95.9 ± 14.5	94.6 ± 13.8	0.4+/-8.5	0.49
CONTROL SUBJECTS (n=130)	94.0 ± 16.8	93.6 ± 14.7	1.0+/-9.0	0.21

FVC	BASELINE	FOLLOW UP	CHANGE	P VALUE
COVID 19 CASES (n=110)	104.2+/- 14.6	103.8 +/-14.9	-0.6+/-8.6	0.44
CONTROL SUBJECTS (n=130)	102.3+/- 14.8	103.6+/-14.6	0.6+/-13.1	0.59

FEV1/FVC	BASELINE	FOLLOW UP	CHANGE	P VALUE
COVID 19 CASES (n=110)	83.2+/-7.8	82.8+/-7.4	-0.6+/-6.2	0.44
CONTROL SUBJECTS (n=130)	81.5+/-10.0	8.7+/-8.0	0.4+/-7.9	0.52

Asthma Symptom Control:
COVID-19 cases: The median baseline score for controlling asthma symptoms was 23.0 [20.7–27.0], and it did not change during the follow-up 23.5 [20.3-26.6]. The p-value between cases and controls was not significant (0.89), and the difference in symptom control was negligible (0.5).
Control subjects: The median baseline asthma symptom control score was 20[19.9-25.6] which improved to a median of 22.5[20.4-26.2] at follow-up. When compared to cases, the shift in symptom management was statistically significant ($p < 0.01$).
Spirometry:

- **FEV1%pred (Percentage of predicted Forced Expiratory Volume in 1 second):**
  COVID-19 cases: The mean baseline FEV1%pred was 95.9 ± 14.5, and at follow-up, it declined to 94.6 ± 13.8. FEV1%pred is a measure of percentage of expected forced expiratory volume in one second. At $p = 0.49$, the change was not statistically significant.

Control subjects: At follow-up, the mean baseline FEV1%pred was 93.6 ± 14.7, up from 94.0 ± 16.8 at baseline. Additionally, the change did not reach statistical significance (p = 0.21).

FVC%pred (Percentage of predicted Forced Vital Capacity):

- **COVID-19 cases:**At follow-up, the mean baseline FVC%pred was 103.8 +/-14.9, a small drop from 104.2 +/- 14.6 at baseline. 0.6+/-8.6, p = 0.44, indicates that the change was not statistically significant.
- **Control subjects:**The mean FVC%pred at baseline was 102.3+/- 14.8; at follow-up, it had slightly increased to 103.6+/-14.6. At 0.6+/-13.1 and p = 0.59, the change was not statistically significant.

Interpretation:

- **Asthma Symptom Control:** In contrast to controls, who experienced a substantial improvement in asthma symptom control over time, children with COVID-19 did not demonstrate any significant alterations insymptom control.
- **Spirometry (FEV1%pred and FVC%pred):**FEV1%pred and FVC%pred, two lung function parameters, did not significantly alter in either case or control group during the course of the study. Neither case nor control group differed significantly at baseline, follow-up, or in terms of changes over time.
- Overall, children with COVID-19 did not significantly change their ability to regulate their asthma symptoms or their lung function parameters as determined by spirometry during the trial period, but control individuals' ability to do so improved.

DISCUSSION

In the study done by Kristina et.al, there were no statistically significant differences observed in asthma symptom control or various spirometry parameters between children who had experienced SARS-CoV-2 infection (cases) and those who did not (control subjects). Specifically, measures such as forced expiratory volume in 1 second (FEV1), forced vital capacity (FVC), FEV1/FVC ratio, and forced expiratory flow in the midexpiratory phase did not show significant changes after COVID-19 infection.Comparing follow-up data between cases and control subjects revealed similar proportions experiencing poorer asthma symptom control or worsened lung function. Although there was a trend towards poorer asthma symptom control in cases compared to controls, this difference did not reach statistical significance.Additionally, the investigation determined that children who encountered an asthma exacerbation during their COVID-19 illness and whose asthma control deteriorated post-COVID-19 had a shorter follow-up interval. These results emphasize the necessity of closely monitoring asthma patients following COVID-19 infection, particularly those who experience exacerbations during the acute phase, in order to manage and mitigate potential long-term effects on asthma control and lung function (1).

In contrary, the study conducted by Sharanya et.al involving 40 children, primarily adolescents, among whom a notable proportion exhibited abnormal spirometry results indicating reduced forced vital capacity (FVC) and forced expiratory volume in one second (FEV1). The study underscores the importance of assessing lung function in children following COVID-19 infection, given the high prevalence (30%) of abnormal spirometry findings in the sample.Interestingly, being underweight emerged as a significant risk factor for abnormal spirometry, with underweight children showing more than five times higher odds of having impaired lung function compared to those with normal weight. This association underscores the potential impact of nutritional status on respiratory health outcomes following COVID-19 infection in children.Contrary to expectations, the study did not find significant associations between abnormal spirometry and other factors such as age, sex, severity of initial COVID-19 infection, or the need for oxygen therapy during the acute phase(4).

In similar study conducted by Sansone et al.,on children with Long-COVID syndrome (LCS), and they were compared to controls. The results of their study indicated that children with LCS were on average older than controls (mean (SD) 12 (4.1) vs. 9.7 (2.6); p = .04). In addition, Sansone et al. reported a higher prevalence of symptoms, including fatigue, congestion, exercise intolerance, and dyspnea, among children with LCS, which is consistent with our findings.. Despite these symptom differences, both our study and that of Sansone et al. found no significant differences in lung function parameters between children with LCS and controls. Additionally, the frequency of lung ultrasound (LUS) abnormalities did not differ significantly between LCS cases and controls in either study (43.3% vs. 56.7%, p = .436 in our study. Sansone et al. also observed that fractional exhaled nitric oxide (FeNO) values were lower in children with LCS, which is consistent with our findings of lower FeNO values (log difference −0.30 (CI 95% −0.50, −0.10)). This suggests a potential commonality in inflammatory responses or airway function among children with Long-COVID syndrome across different cohorts(6).

CONCLUSION

According to the findings of the investigation that compared individuals with COVID-19 to control subjects: Controlling Asthma Symptoms: Children with COVID-19 did not demonstrate any significant changes in asthma symptom control scores when contrasted with controls.The scores for COVID-19 cases remained relatively stable, despite the fact that controls exhibited a statistically significant improvement in symptom management over time.
Spirometry (FEV1%pred and FVC%pred): Neither group experienced a significant change in FEV1%pred or FVC%pred, which are indicators of lung function, during the study period. These spirometry parameters did not exhibit any substantial differences between COVID-19 cases and control subjects at baseline, follow-up, or in terms of variations over time.This study concludes that the lung function parameters of children with COVID-19 did not experience substantial changes in their ability to manage asthma symptoms or in their spirometry results. Conversely, control subjects demonstrated an enhancement in asthma symptom management. These results indicate that COVID-19 infection in children, at least within the scope of this study, did not have a substantial long-term impact on lung function or asthma control in comparison to children who did not have COVID-19.In conclusion, control subjects experienced enhanced asthma symptom management over time; however, children with COVID-19 did not demonstrate comparable improvements or adverse effects in asthma symptom control or lung function parameters during the trial period.

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