

Obesity and Asthma: An Intriguing Link in Childhood and Adolescence

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Keywords

Asthma · Obesity · Asthma control · Children · Adolescents

Abstract

Background: Asthma is a chronic disease characterized by airway inflammation. Obesity is common and may be associated with asthma. **Objective:** The objective of this study is to investigate the possible relationship between asthma control and obesity in children. **Methods:** A nationwide study included 462 children and adolescents, 319 (69%) males, mean age 11.3 years. Asthma control grade, asthma control test, body mass index calculated as percentiles, and lung function were evaluated. **Results:** Obesity affected 64 (13.9%) children with asthma. This outcome underlined the high prevalence of obesity in children and adolescents with asthma. On the other hand, obesity did not affect the asthma control as well as lung function. **Conclusion:** This study showed that body weight did not affect asthma control and lung function in a large population of children and adolescents with asthma followed in Italian tertiary allergy/asthma centers and adequately managed.

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Introduction

Asthma is the most common chronic disease in childhood and adolescence and significantly burdens the health-care system worldwide. The goal of asthma management is to control the disease as recommended by the Global Initiative for Asthma (GINA) guidelines [1]. The asthma control level drives the intensity of care. Nevertheless, optimal asthma control is still an objective challenging to reach in all patients despite the guidelines’ implementation [2].

On the other hand, overweight and obesity represent a relevant problem from the first and second decades of life. In this regard, the most recent epidemiological study reported a global prevalence of 29.7% for overweight and obesity in Italian children (www.epicentro.iss.it). Obesity affected 9.4% children; however, it has to be noted that the survey used the criteria by the International Obesity Task Force [3]. Obesity is characterized by low-grade chronic inflammation and represents a relevant risk factor for many diseases, including asthma [4].

Obesity, including overweight, is considered common and relevant comorbidity in patients with asthma that deserves adequate attention. The link between asthma and obesity is complex as it involves different pathogenic mechanisms, mainly concerning genetic profile, immu-

nopathological pathways, psychological aspects, hormonal imbalance, diet, and dysbiosis [5]. Therefore, pediatric obese asthma is a complex disease that remains poorly understood [6].

In this regard, Vezir et al. [7] investigated the effects of obesity on bronchial and systemic inflammation in 153 children with asthma. The outcomes showed no interaction between obesity and asthma about bronchial inflammation, whereas adipokines were associated with obesity. However, the researchers did not evaluate the asthma control. Consequently, we would debate this issue reporting data from a nationwide study (Control'Asma) promoted by the Italian Society of Pediatric Allergy and Immunology.

Materials and Methods

We evaluated the impact of body weight on asthma control assessment and lung function in 462 children and adolescents (319 [69%] males, mean age 11.3 years) consecutively visited across 10 Italian Pediatric Allergy centers. All patients were currently treated according to the GINA guidelines based on the asthma control level. The methodology has been reported in detail elsewhere [2]. The Ethics Committee of the Istituto Giannina Gaslini of Genoa initially approved the procedure (code number: 22253/2017). All the other Review Ethics Committees further approved the study procedure. A written informed consent was obtained from all parents of the children. Clinical data were recorded by an electronic case report form designed expressly for this study.

Kruskal-Wallis test was applied to verify differences in continuous variables among weight groups. Any association between weight groups and categorical variables was tested with χ^2 test. A p value <0.05 was considered statistically significant. The analyses were computed using SPSS Statistics version 21.0 (IBM Corp., Armonk, NY, USA). Body mass index (BMI) was calculated and expressed in percentiles using the BMI Percentile Calculator for Child and Teen provided by the CDC (www.cdc.gov/healthy-weight/bmi/calculator).

Results

Globally, 294 (63.6%) subjects had normal weight, 18 (3.9%) were underweight, 86 (18.6%) were overweight, and 64 (13.9%) had obesity. The asthmatic patients were stratified into 3 subgroups: normal weight, underweight, and overweight/obesity, as reported in Table 1.

There was no significant difference in sex and gender among the 3 subgroups. Also, there was no significant difference in lung function outcomes, including FVC, FEV₁, FEV₁/FVC, and FEF₂₅₋₇₅. The prevalence of bronchial obstruction, defined by FEV₁ $<80\%$ of predicted, was not

statistically different among subgroups. The asthma control level, assessed by the GINA criteria, was not significantly different among subgroups. Consistently, the asthma control test score was not different among subgroups.

There was no difference in asthma control between male and female; also, there was no obesity effect between male and female with asthma. Notably, no difference existed, also considering separately children and adolescents.

Discussion

The current investigation showed that the prevalence of overweight was 18.6% and obesity 13.9% in a nationwide population of children and adolescents with asthma. Comparing with the Italian prevalence of obesity (9.3%), the present study demonstrated that obesity was more prevalent in patients with asthma than in the general population. This outcome is consistent with the literature that evidences an increased prevalence of obesity in children and adolescents with asthma. However, other outcomes would suggest that the body weight, mainly concerning overweight/obesity, did not affect lung function and asthma control. These findings could depend on the management, GINA-oriented, used in the enrolled subjects. Namely, these subjects were followed at tertiary allergy/asthma clinics. Therefore, these outcomes were consistent with the Turkish study, confirming the lack of association among obesity, lung function, and asthma control [7].

As concerned uncontrolled asthma, we investigated the differences between controlled and uncontrolled subjects in a previous study [2]. Patients with uncontrolled asthma experienced more severe symptoms, assessed by VAS, had lower FEV₁ values, had more frequently bronchial obstruction and reversibility to the bronchodilation testing, and used higher dosages of inhaled corticosteroids and more courses of oral corticosteroids [2]. However, there was no significant difference about adherence, inhaler technique, comorbidities, and emotional disorders. Moreover, there was no difference among groups about the asthma duration as the median values were 5 years in all groups.

On the other hand, the current study had some limitations, including a cross-sectional design and the lack of biomarker evaluation. Namely, the lack of biomarkers, investigating the systemic inflammation, may explain the inability of this study to identify a link between lung function and asthma control in children and adolescents with

Table 1. Patient's characteristics (*n* = 462), by BMI percentile

	Normal weight (<i>N</i> = 294) (63.6%)	Underweight (<5th %ile) (<i>N</i> = 18) (3.9%)	Overweight (≥85th %ile)/ obese (≥95th %ile) (<i>N</i> = 150) (32.5%)	<i>p</i> value
Sex, <i>n</i> (%)				
Female	100 (34.0)	3 (16.7)	40 (26.7)	0.14
Male	194 (66.0)	15 (83.3)	110 (73.3)	
Age (mean ± SD), yr	11.4±3.11	11.6±3.25	10.9±2.88	0.18
Age class, <i>n</i> (%)				
Child	156 (53.1)	10 (55.6)	54 (36.0)	0.09
Adolescent	138 (46.9)	8 (44.4)	96 (64.0)	
FVC, % predicted	99.7±13.39	91.8±12.71	98.6±14.07	0.05
FEV ₁ , % predicted	97.6±14.93	91.8±14.59	94.7±15.25	0.14
Bronchial obstruction (FEV ₁ <80%), <i>n</i> (%)				
Subjects	29 (11.0)	2 (11.8)	24 (17.4)	0.19
FEV ₁ /FVC	98.2±10.13	100.2±10.25	96.3±10.71	0.12
FEF _{25–75} , % predicted	85.5±26.79	86.7±30.09	84.0±24.27	0.82
Type 2 high phenotype, <i>n</i> (%)				
Subjects	280 (95.9)	16 (88.9)	139 (93.9)	0.32
Asthma control level (GINA), <i>n</i> (%)				
Well-controlled	162 (55.1)	13 (72.2)	80 (53.3)	0.62
Partly controlled	98 (33.3)	3 (16.7)	51 (34.0)	
Uncontrolled	34 (11.6)	2 (11.1)	19 (12.7)	
Asthma control test (adjusted age)	23.0 (22.0–24.0)	23.0 (17.0–24.0)	22.0 (18.0–24.0)	0.20

BMI, body mass index.

obesity. A mechanistic study should be performed to provide a response to this unmet need. In addition, the use of BMI alone as a measure of excess weight is quite different than directly measuring any excess fat. As a consequence, this drawback could, at least in part, affect the outcomes of this study. The use of bioimpedance gives more precise information about fat excess [8]. Also, plicometry and abdominal circumference may add information on fat distribution [9].

This study did not include the measurement of lung volumes as it was conducted in a clinical setting where this approach was not the daily task. In this regard, a recent review analyzed the literature data concerning the effects of obesity lung volume and capacity in children and adolescents [10]. Four studies consistently demonstrated that obesity had negative effects on lung volume and capacity, such as a reduction of functional residual capacity, expiratory reserve volume, and residual volume. On the other hand, the present study demonstrated that the forced volume capacity was reduced only in underweight patients.

However, the study was conducted in a real-world setting, the number of participants was large, and the nationwide distribution of centers across Italy. These factors

contributed to give outcomes that reflect what occurs in daily pediatric practice. In conclusion, the ControlL'Asma study showed that body weight did not affect asthma control and lung function in a large population of children and adolescents with asthma followed in tertiary allergy/asthma centers and adequately managed.

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Statement of Ethics

The Ethics Committee of the Istituto Giannina Gaslini of Genoa initially approved the procedure (code number: 22253/2017). All other EC approved the study procedure. The authors state that all parents provided a written informed consent. The research was conducted ethically in accordance with the World Medical Association Declaration of Helsinki.

Conflict of Interest Statement

The authors have no conflicts of interest to declare.

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Author Contributions

M.A.T. designed the study, I.S. analyzed the data, and G.C. wrote the paper. All the authors discussed and approved the manuscript.

Data Availability Statement

Data are stored in a database and are available on request.

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