The Egyptian Journal of Hospital Medicine (April 2023) Vol. 91, Page 5184- 5189

Study of Relation between Asthma Severity and Obesity in Egyptian Children

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ABSTRACT

Background: The rising incidence of asthma has sparked a debate over a possible link between the two disorders asthma and obesity, which is a leading cause of morbidity accounting for nearly 300,000 deaths annually.**Objective:** To determine whether child obesity is associated with a higher risk of bronchial asthma and more severe asthma symptoms or not.
Patients and Methods: The study comprised one hundred kids with asthma. They were divided into two groups according to their body mass index. Group I included 50 patients, overweight or obese with mild, moderate and severe persistent asthma. Group II included 50 patients, non-obese with mild, moderate and severe persistent asthma. Complete clinical examination, anthropometric measurements, as well as pulmonary functions were assessed among all cases. **Results:** Pulmonary functions revealed much better results among the non-obese asthmatics than obese ones. However, Body mass index showed no significant correlation to spirometric values except with PEF25-75% in obese group (significantly negative). **Conclusion:** Spirometry parameters were significantly better among non-obese asthmatics when compared to obese asthmatics.
Keywords: Asthma, Obesity, Body mass index.

INTRODUCTION

Exacerbations are a hallmark of asthma, a chronic inflammatory condition of the airways. Bronchial epithelium injury initiates a healing process that leads to structural and functional changes in the airways. This remodeling process occurs in tandem with the chronic inflammatory response. In the developed world, bronchial asthma has reached epidemic proportions and is a global health problem **(1).** Pulmonary function testing is an objective way to evaluate a child's respiratory health and a valuable resource for diagnosing and treating asthma **(2).** Obesity is a leading cause of death worldwide, responsible for an estimated 300,000 deaths annually. Asthma's rising incidence over the same period of time has prompted discussion of a possible causal relationship between the two **(3).** Obesity and asthma have been linked in a new report from the Southern California Children's Health Study. Over 2000 youngsters who were not overweight at the study's outset were tracked for up to a decade. About half as many kids who were diagnosed with asthma as those who weren't went on to become overweight as kids who didn't. The data also revealed an interesting fact, children who were already overweight at baseline were the ones most affected by the increased risk of obesity associated with asthma, whereas children with asthma who were of normal weight at baseline did not face an increased risk of obesity **(4).** We aimed at this study to determine whether child obesity is associated with a higher risk of bronchial asthma and more severe asthma symptoms or not.

SUBJECTS AND METHODS

This study was carried out at the Pediatric Clinic, Zagazig University Hospital. It included 100 children with mild, moderate and severe persistent asthma**.** They were divided into 2 groups: Group 1 that included 50 overweight (BMI>85%) and children with simple obesity (BMI>95%). Group 2, which included 50 patients with normal weight (BMI less than 85%).

Inclusion Criteria: Age range between 5-12 years. Diagnosis of asthma according to the Gina guidelines**.** Suffering from mild, moderate and severe persistent asthma according to severity classification of Gina guidelines **(5).**

Exclusion Criteria: Age of patients less than 5 years (to be able to perform the pulmonary function tests). Clinical symptoms consistent with an acute respiratory infection at the time of testing or within the past three weeks. Suspicion of suffering from any chronic respiratory disease other than bronchial asthma.

All patients were subjected to the following: Detailed History including focusing on frequency of symptoms, number of exacerbations, limitation of usual activities, and medications use.

Full clinical examination:

a- General examination: This included heart rate, respiratory rate, temperature and blood pressure.

b- Anthropometric measurements: The same evaluator used a Harpender 5 stadiometer mounted on the wall to determine the subject's height (Haltain Limited, Crmych, Dyfeed, United Kingdom). The scale's accuracy was verified by weighing the subject. Body mass index was determined by using the formula: Weight (kg)/height (m^2). All these parameters were plotted on the Egyptian growth curves (2019), which are available in Pediatric clinic. Skin fold thickness including triceps skin fold thickness were also assessed by determining the midpoint between the acromion and olecranon process on the posterior surface of the right arm and mark it.

Pulmonary Function Tests: It was done using spirometry. A spirometer is a basic volume recorder with an inverted drum (air chamber) that sits on top of a water-filled chamber. A pen, attached by pulley, writes on paper that spins around a drum that is counterbalanced by a weight. The gar chamber is linked to the mouth by a tube. The drum goes up as a person breathes into the tube, filling the chamber with air from their lungs. Exhalation is represented by a pen falling to the page, and inspiration by a pen rising to the page.

It comprised the following spirometric parameters (Figure 1): Spirometry readings were reported as a percentage of the age-, height-, and gender-adjusted expected value. An aberrant FVC, FEV1, or FEF25-75 was defined as being below 80% of the normal anticipated value. Less than 75% FEV1/FVC ratio was considered pathologic.

Received: 28/12/2022
Accepted: 01/03/2023

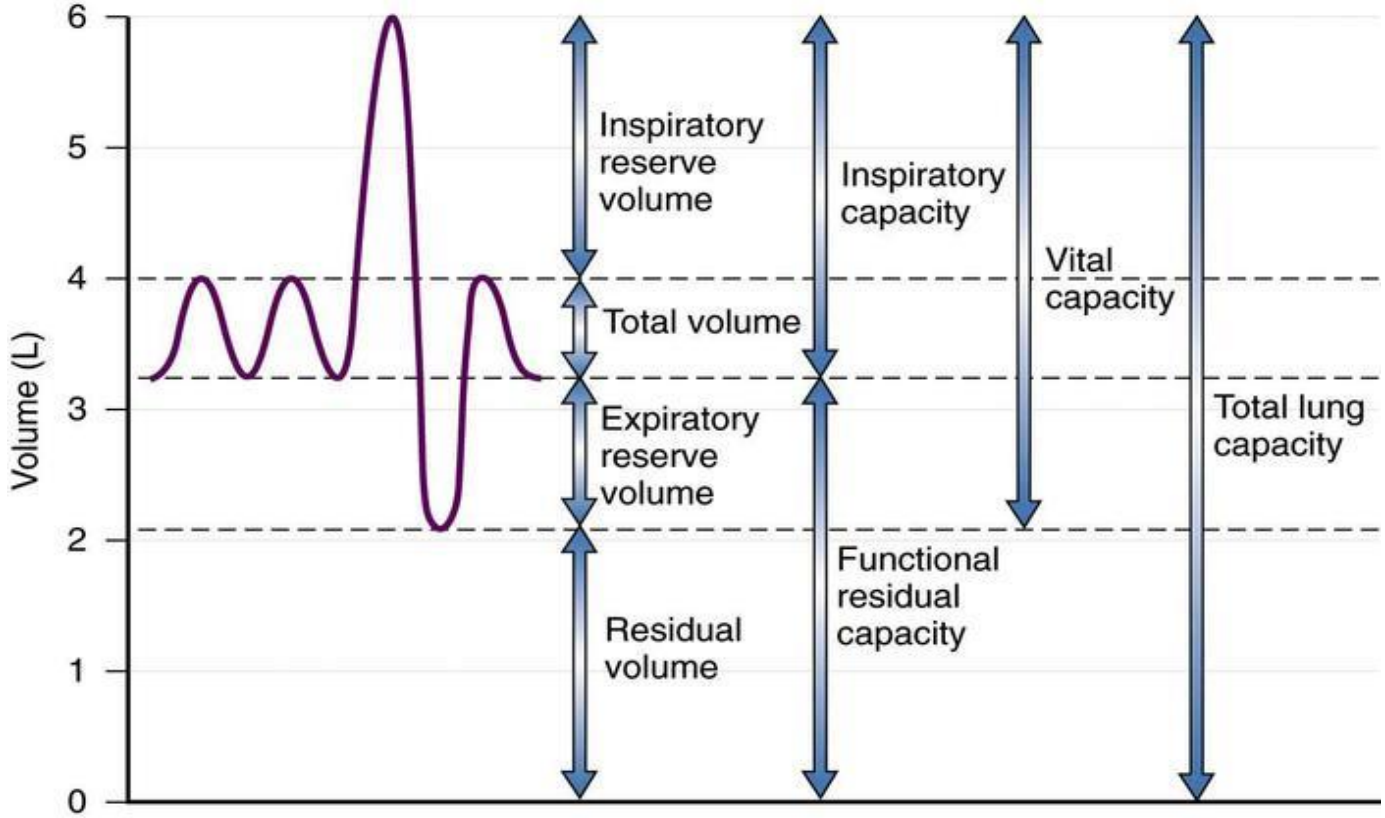

Figure (1): Pulmonary function parameters.

Ethical Consideration:

The Academic and Ethical Committee of Faculty of Medicine, Zagazig University approved the project. All of the subjects signed written informed permissions before being included in the study. The Declaration of Helsinki, the World Medical Association's code of ethics for studies involving humans guided the conduct of this work.

Statistical analysis

Data were collected, tabulated, and analysed using IBM SPSS version 23 for Windows Edition (Armonk, New York: IBM Corp). Quantitative data were described using measures like mean and standard deviation as well as the median and range. Qualitative data were described using measures like numbers and adjectives (percentage). The t test was used to compare two groups of normally distributed variables. The Mann-Whitney U test was used to compare two sets of data where the distributions were not the same. Percentages and other categorical variables were compared using Chi-square test or Fisher exact tests. Growth Vision 2 was used to transform the anthropometric data into standard deviation scores.

RESULTS

There was no statistically significant difference in sex between group 1 (obese) and group 2 (non-obese) (P value = 0.834). The mean age of group 1 was 9.68 ± 2.81 years, while the mean age of group 2 was 10.16 ± 2.49. Group 1 (obese) had significant higher weight as compared to group 2 (non-obese) (p value = 0.001). There was no significant difference in habitat between group 1 and 2 (P value = 0.418). There was no significant difference in family history of asthma between group 1 and 2 (P value = 0.841). There was no significant difference in family history of obesity between group 1 and 2 (P value = 0.096). Obese group had a significantly higher BMI as compared to non-obese group (23.87 ± 8.60 versus 18.27 ± 3.65, P value = 0.001).

Table (1): Demographic characters of the studied groups

Sex		Obese	Non Obese	Chi-Square	P value
Males	No.	33	32	0.044	0.834
	%	66	64		
Females	No.	17	18		
	%	34	36		
Comparison	Mean age			T-Test value	P value
Obese	9.68 ± 2.81			0.903	0.369
Non Obese	10.16 ± 2.49				
Comparison	Weight			T-Test value	P value
Obese	41.10 ± 8.50			3.401	0.001
Non Obese	35.80 ± 7.01				
Habitat		Obese	Non Obese	Chi-Square	P value
Urban	No.	31	27	0.657	0.418
	%	62	54		
Rural	No.	19	23		
	%	38	46		
Family H of asthma		Obese	Non Obese	Chi-Square	P value
(0) -ve FH of asthma	No.	26	25	0.040	0.841
	%	52	50		
(1) +ve FH of asthma	No.	24	25		
	%	48	50		
Family H of obesity		Obese	Non Obese	Chi-Square	P value
(0) -ve FH of obesity	No.	36	28	2.778	0.096
	%	72	56		
(1) +ve FH of obesity	No.	14	22		
	%	28	44		
Comparison	BMI			T-Test value	P value
Obese	23.87 ± 8.60			4.237	0.001
Non Obese	18.27 ± 3.65				

When comparing both groups of the study regarding FVC, FEV1, and PEF we found that group 2 (non-obese) had significantly higher values of FVC than group 1 (obese) (88.06 ± 16.75 versus 81.10 ± 17.77, P value = 0.047). Groups 2 (non-obese) had significantly higher values of FEV1 than group 1 (obese) (87.010 ± 13.06 versus 81.36 ± 11.28, P value = 0.021). Group 2 (non-obese) had significantly higher FEV1/FVC than group 1 (obese) (94.70 ± 10.84 versus 90.52+9.37, P value = 0.042). There was no significantly difference in PEF between group 1 (obese) and group 2 (non-obese) (69.026 ± 13.21 versus 61.68 ± 14.21, P value = 0.833).

Table (2): Comparison of the mean of FVC, FEV1, PEF**25-75%**, FEV1/FVC between groups

Comparison	**Obese**	**Non-Obese**	**T-Test value**	**P value**
FVC	81.10 ± 17.77	88.06 ± 16.75	2.015	0.047
FEV1	81.36 ± 11.28	87.10 ± 13.06	2.352	0.021
PEF	73.68 ± 12.54	73.00 ± 18.90	0.212	0.833
FEV1/FVC	90.52 ± 9.37	94.70 ± 10.84	0.142	0.042
PEF 25-75%	61.68 ± 14.21	69.26 ± 13.21	0.464	0.007

There was no significant difference in FVC, FEV1, PEF, FEV1/FVC between patients with higher values of TSF as compared to patients with normal values of TSF (P value = 0.142, 0.848, 0.924, 0.762 respectively) (Figure 2).

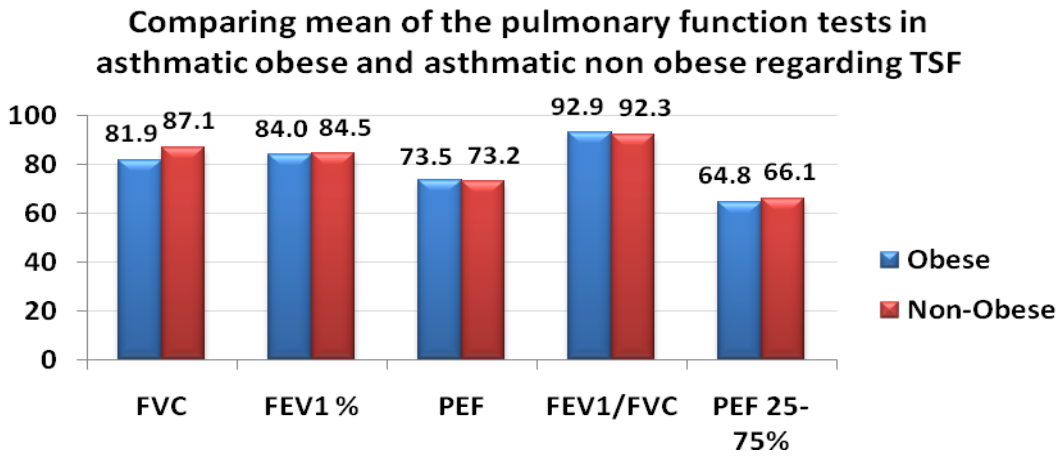

Figure (2): Comparison of mean of pulmonary function tests according to Triceps skin fold (TSF) thickness in asthmatic patients (Both groups).

There was significant negative correlation between BMI and PEF25-75% (P value = 0.039). There was no significant correlation between BMI and FVC, FEV1, FEV1/FVC (P value = 0.369, 0.307, 0.10 respectively) as shown in table (3).

Table (3): Correlation between the mean of BMI with FVC, FEV1, PEF, FEV1/FVC in group 1 (obese)

Correlation	P value	R
BMI and FVC	0.369	0.130
BMI and FEV1	0.307	-0.148
BMI and PEF	0.097	-0.238
BMI and FEV1/FVC	0.101	-0.235
BMI and PEF 25-75%	0.039	-0.293

Table (4) showed that there was no significant correlation between BMI with FVC, FEV1, PEF, FEV1/FVC (P value = 0.380, 0.714, 0.326, 0.955 respectively).

Table (4): Correlation between the mean of BMI with FVC, FEV1, PEF, FEV1/FVC in group 2 (non-obese)

Correlation	P value	R
BMI and FVC	0.380	0.127
BMI and FEV1	0.714	0.053
BMI and PEF	0.326	0.142
BMI and FEV1/FVC	0.955	-0.008
BMI and PEF 25-75%	0.153	-0.205

Obese group had a significantly higher uncontrolled cases as compared to non-obese group (P value= 0.0008). So, obesity worse control of asthma in children (Table 5).

Table (5): Comparison of controlled cases and uncontrolled cases between group 1 (obese) and group 2 (non-obese)

Control		Obese	Non Obese	X^2	P-Value
Controlled Cases	No	11	27	14.02	0.0008
	%	22%	54%		
Partially Controlled Cases	No	16	15		
	%	32%	30%		
Uncontrolled Cases	No	23	8		
	%	46%	16%		

DISCUSSION

Asthma is a chronic inflammatory disorder of the airways in which many cells play a role. The chronic inflammation causes an associated increase in airway hyperresponsiveness that leads to recurrent episodes of wheezing, breathlessness, and coughing particularly at night or in early morning [(6)].

Obesity is also a major cause of morbidity in children. A number of prospective studies have shown that weight gain can precede the development of asthma. There is evidence of a positive association between asthma and obesity in adults and children [(2)].

In our study as regards basic demographic data, there was no statistically significant difference and both groups were comparable regarding habitat, family history of asthma, family history of obesity and other atopic manifestations. Our study demonstrated that more boys had asthma than girls in childhood, this trend switches in adulthood when women develop more asthma. The data are conflicting to whether sex affects the development of asthma in children. Several studies have addressed sex difference in association with asthma. A prospective birth cohort following 4452 children for 11 years found that boys were 38% more

likely to wheeze than girls [7]. In another birth cohort, 4393 children who were asthma-free during the first 2 years of life were followed up for 14 years for development of asthma [8]. In this cohort, boys at the age of 2-3 years had an increased risk of subsequent asthma with a hazard ratio of 1.6, but the effect was not seen for girls (hazard ratio, 0.8). This suggest a possible role for sex hormones in gender differences in asthma progression.

One study showed that boys between age 6 and 11 were associated with a seven-time increased risk of new asthma symptoms than girls [9]. Contrary, a study showed that asthma severity was stronger in women with early menarche than in women without early menarche [10]. There are no well established mechanisms to explain the association of sex hormones with asthma, but estrogen may play a role in asthma, and may do so by modifying the inflammatory response to favor a TH2 response. Estrogen or progesterone administered to human peripheral blood mononuclear cells induces production of the TH2 cytokines IL-4 and IL-13 [11].

In our study, non-obese (group 2) showed higher values of FVC than group1 (88.06 ± 16.75 versus 81.10 ± 17.77, P-value = 0.047), higher FEV1 (87.010 ± 13.06, versus 81.36 ± 11.28, P-value = 0.021), higher FEV1/FVC (94.70 ± 10.84, vs 90.52 ± 9.37, P-value = 0.042), higher PEF (84.010 ± 12.06, versus 80.23 ± 11.33, p vales = 0.022).

Thus our study demonstrated that non-obese asthmatics have higher spirometric values when compared to obese asthmatics of the same degree of severity (mild to moderate persistent asthma). One study, **Wechsler *et al.*** [12] suggests that obese children may perceive their asthma as more severe than do normal-weight children. A study of 64 children with asthma found that pulmonary function test results, levels of activity, and maximal aerobic power were reduced. Overweight children reported greater limitation of physical activity and were prescribed more medications. The authors concluded that obese children might perceive their asthma as more severe, resulting in increased medication prescription and an apparent increase in severity. More studies have been published in this area. A study in 1996 children in Los Angeles **Chowdhury *et al.*** [13] found no difference in the time to achieve asthma control, ability to maintain asthma control, baseline pulmonary function, or number of control medications prescribed between normal-weight and obese children. Also, a study of 213 children with asthma aged 3-5 years **Ng *et al.*** [14] found that an increased BMI was associated with more asthma-related missed school days, lifetime hospital admissions, emergency department visits, and activity limitations. On the contrary **To *et al.*** [15], found no statistically significant association between obesity and asthma in children. Thus, it is still not clear whether obesity increases asthma severity. This supported the fact that the diagnosis of asthma is usually based on the presence of characteristic symptoms

Because of its low cost and ease of use, spirometry is the modality of choice for detecting and evaluating airway blockage. Peak expiratory flow (PEF) measurement is more variable (and less reliable) than spirometry and should not be utilised as the primary technique of pulmonary function assessment. Nonetheless, it can be useful as a screening tool for individuals with asthma symptoms. However, PEF measurements are helpful for daily outpatient monitoring of air flow limitation, exacerbation identification, and treatment effect evaluation [1].

In our study there was no significant association between body mass index and FEV_1, PEF or FEV_1/FVC in both groups 1 and 2 [(P-value = 0.369, 0.307, 0.097 respectively) in group 1, (P-value = 0.380, 0.714, 0.320 respectively) in group 2]. These results agree with **Bruzzese *et al.*** [16] who reported that although obesity was prevalent in asthmatic patients, BMI did not correlate with any of the spirometric variables.

Our results in some extent agree with **Chan *et al.*** [17], who showed that overall, there was only a weak connection between BMI and asthma, and it was only significant among boys. While, females didn't show a correlation between asthma and BMI, boys with asthma were more likely to have a higher BMI than boys without asthma. Lack of correlation of BMI to spirometric parameters can be explained by the fact that BMI does not differentiate between a muscular built and a fatty built, which is the factor attributing to more severe asthma. Body mass index (BMI) is not a reliable measure of obesity in youngsters. Females have a higher fat mass value when calculating BMI than males do. Previous studies in children found conflicting results when examining the correlation between obesity and asthma, and researchers believe this is because equivalent BMI readings imply different amounts of adiposity for different sex.

Our results disagree with **Chan *et al.*** [17] studies, which came to the conclusion that there is association between higher BMI and more severe asthma symptoms. Our study also disagrees with the study carried by **Cole *et al.*** [18], which was a cross-sectional observational study of the relation between BMI and lung function tests among adult obese patients.

In the light of our results, we observed that obesity is a contributing factor for worsening of asthma as revealed by spirometric parameters that were much better in non-obese than obese children. However, there is no significant correlation between body mass index with spirometric variables. Clearly, weight control should play a role in the management of obese asthmatic patients. In adults, studies to date have shown associations of weight loss with improvements in asthma symptoms, lung function, hospitalizations, and medication use. Although the effect of weight control on childhood asthma has not been well established, evidence suggests that weight management early in life

may also play a role in lowering the incidence of childhood asthma. Thus, obesity can be considered as a cause of more severe asthma symptoms.

CONCLUSION

Obese asthmatic children have worse spirometric values and are less controlled in comparison with non-obese asthmatic children. Obesity is a contributing factor in worsening of bronchial asthma. Body mass index is a poor indicator of adiposity in children. Further studies must be conducted regarding the mechanism by which obesity affects the pathogenesis of asthma.

Sponsoring financially: Nil.
Competing interests: Nil.

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