# Relation between Asthma and Body Mass Index in 6-15 Years Old Children

**Akefeh Ahmadiafshar[1,2], Sara Tabbekhha[2], Noureddin Mousavinasab[1], and Parisa Khoshnevis[2]**

[1] *Metabolic Diseases Research Center, Zanjan University of Medical Sciences, Zanjan, Iran*

[2] *Pediatric Ward, Ayatollah Mousavi Hospital, Zanjan University of Medical Sciences, Zanjan, Iran*

***Received: 15 Oct. 2012 ; Received in revised form: 12 Jan. 2013; Accepted: 20 Feb. 2013***

**Abstract-** Childhood asthma and obesity are significant public health problems. Most prospective studies suggest that obesity increases the risk of asthma. But, some authors did not found this association. In this study the association between asthma and body mass index (BMI) was investigated. This case-control study was conducted on 200 asthmatic children aged 6-15 years and 200 children without asthma. The criteria for asthma diagnosis and its classification were on the basis of National Asthma Education and Prevention Program (NAEPP). BMI of patients and controls were also measured and BMI grater than 85% and 95% were defined as overweight and obese respectively. The data was analyzed by SPSS software. The BMI among the asthmatic children (17.9 kg/m$^2$) was higher than the BMI among the non-asthmatics (16.5 kg/m$^2$), *P*=0.0001. This relationship was significant in both males and females. 18% of asthmatic children were classified as overweight and 13.5% of them were obese *versus* 7.5% and 6% respectively in non asthmatics (*P*=0.0001). However, there was no significant relationship between severity, duration of asthma, kind of medication and BMI in children with asthma (*P*>0.05). Result of this study showed that there is an association between asthma symptoms and obesity in children. Therefore, any attempts for weight control in asthmatic children might be beneficial.



*Acta Medica Iranica*, 2013; 51(9): 615-619.

**Keywords:** Asthma; BMI; Obesity; Overweight

## Introduction

In recent decades the prevalence of many chronic disorders such as asthma and obesity has dramatically increased (1,2). These disorders are influenced by genetic and environmental factors and could be associated with many important co-morbidities such as cardiovascular disorders, hypertension, metabolic syndrome, diabetes and psychological disorders (1-4).

This rising trends will put heavy burden on social and health services. Therefore exploring the effective factors and preventive measures could be beneficial. The role of some inflammatory events and mechanisms in obese patients was identified as predisposing factors for asthma development and several investigators introduced increased asthma and obstructive pulmonary disorders in obese and overweight patients (5-10). However, there are several studies that did not show any association between asthma and obesity (11-15). Some limited studies have shown increased prevalence of obesity in asthmatic patients (16,17).

It is unclear weather this association might be affected by mechanical and restrictive effects of obesity on respiratory system, or obesity may be arise from limitation of activity and medications in asthmatics. This study investigates the prevalence of overweight and obesity in children and youth with asthma and its association with the severity of asthma.

## Materials and Methods

This study was carried out in Allergy and Pediatric Clinic of Mousavi Hospital in Zanjan City (Zanjan, Iran) from March to September 2010 in 6-15 years children with diagnosed asthma and similar children without asthma that serially recruited to study. Patients with asthma were ascertained by history, clinical findings and pulmonary function tests and their allergic status was

**Corresponding Author:** Akefeh Ahmadiafshar
Sub Specialist of Allergy and Clinical Immunology, Zanjan University of Medical Sciences, Zanjan, Iran
Tel: +98 241 4131329, Fax: +98 241 4131328, E-mail: akefeh45@zums.ac.ir

confirmed by at least one positive skin prick test (wheal diameter at least 3 mm) to common allergens including; tree, grass, weed, cockroach, mite, cat or mold. The severity of disease in asthmatic group was also classified to mild, moderate and sever on the basis of NAEPP guideline (18).

Non-asthmatic children were outpatients of pediatric clinic who attended for acute illness such as cold or sore throat without history of asthma or allergic disorders. Patients with chronic systemic disorders such as cystic fibrosis, cardiac, renal and gastrointestinal diseases were excluded from study.

Height (m) and weight (kg) of all subjects were measured during the clinic visit by a trained person with Seca scale (769 Digital Column Scale). BMI was calculated as weight (kg)/height$^2$ (m$^2$) and was converted into age and gender specific BMI percentiles on the basis of CDC growth chart and overweight was defined as BMI>85$^{th}$ and obese as BMI>95$^{th}$ percentile (19). Study was approved by Ethic committee of Zanjan University of Medical Sciences and all subjects or their parents filled the informed consent before study. Furthermore, parents were questioned about severity, duration of asthma and any medication being administered to the children. Data was analyzed by SPSS software student t-test for parametric data and Chi-square analysis was used for categorical measures. The odds ratio (OR) was calculated with the 95% confidence interval (CI) and *P*-value less than 0.05 was considered statistically significant.

## Results

In this study 400 children (200 asthmatics, 200 non-asthmatics) with mean age 9.6 ± 2.6 were evaluated. The gender and ages of cases and control group were similar (*P*-values were 0.92 and 1, respectively).

The height of asthmatic and non-asthmatic group was similar. But, there was statistically significant difference between the weight of asthmatic and control. Furthermore, the BMI among the asthmatic children (17.9 kg/m$^2$) was significantly higher than the BMI among the non-asthmatics (16.5 kg/m$^2$), *P*=0.0001 (Table 1).

In differential analyses of data from girls and boys, asthmatic children had significantly higher weight and BMI. This relationship was significant in both boys and girls (Table 2).

Thirty six (18%) of asthmatic children were classified as overweight (OR: 3.13, 95% CI: 1.65-5.95) and 27 (13.5%) of them were obese (OR: 2.44, 95% CI: 1.2-4.97). Whereas the frequency of overweight and obesity in control group was 15 (7.5%) and 12 (6 %) respectively, (*P*=0.0001).

We did not find significant association between severity and duration of asthma with obesity or overweight in children with asthma (*P*>0.05). Atopic sensitization, as assessed by skin prick tests, was non-significantly related to BMI (Table 3).

There was no association between kinds of medication in asthmatic children and their BMI ratio.

**Table 1.** Weight, height and BMI levels in asthmatic and non asthmatic children.

| Variety | Group | Mean | SD | *P*-value |
|---|---|---|---|---|
| Weight | Asthmatic | 33.26 | 12.007 | 0.04 |
| | Non-asthmatic | 30.89 | 10.944 | |
| Height | Asthmatic | 134.21 | 14.66 | 0.856 |
| | Non-asthmatic | 134.46 | 14.13 | |
| BMI | Asthmatic | 17.91 | 3.58 | 0.0001 |
| | Non-asthmatic | 16.56 | 2.95 | |

**Table 2.** BMI measures in asthmatic boys and girls vs. non asthmatic children.

| Gender | Groups | No | BMI Mean (SD) | *P*-value |
|---|---|---|---|---|
| Boys | Asthmatic | 104 | 18.01 (3.53) | 0.0001 |
| | Non-asthmatic | 105 | 16.44 (2.74) | |
| Girls | Asthmatic | 96 | 17.8 (3.65) | 0.02 |
| | Non-asthmatic | 95 | 16.69 (3.17) | |

**Table 3.** Asthma severity, atopic status and duration of disease in normal weight, overweight and obese asthmatic children.

| Variability | Normal weight | Overweight | Obese | *P*-value |
|---|---|---|---|---|
| Number (%) | 137 (68) | 36 (18) | 27 (13) | - |
| Asthma severity: | | | | |
| Mild | 76 | 19 | 11 | 0.645 |
| Moderate | 45 | 14 | 12 | |
| Sever | 16 | 3 | 4 | |
| Atopy | 85 | 22 | 17 | 0.87 |
| Asthma Duration | | | | |
| month | 23.13 | 22.69 | 23.7 | 0.97 |
| SD | (15.99) | (16.96) | (15.39) | |

## Discussion

In this study the weight and BMI of asthmatic patients was significantly greater than children without asthma. Some studies were in agreement with our study (16,17,20). Previous studies also showed increasing risk of asthma in overweight and obese population (6-10,21-23).

There are several possible mechanisms explaining this relationship, including: reduction of functional residual capacity (FRC) and tidal volume (TV) in obese patients and increasing production of inflammatory adipokines such as: IL-6, eotaxin, TNF-α, monocyte chemotactic protein (MCP-1) and leptin (5,24,25). In contrast, some investigations didn't find any association between BMI and asthma (11-15).

This disparity might be mediated through other factors such as genetic, habitual and environmental factors in different population or could be result from the differences in sample size.

Several studies were shown this relation only in girls especially in adolescence (4,10,26-28). However, our finding was similar to studies of Oddy *et al.* (29) and Tai *et al*. (20) that found this association in both boys and girls. Although, there are some investigations that demonstrated this relation was more prevalent in boys (21,30).

In this study obesity and overweight didn't related on severity of asthma. It is in constant with study of Hom *et al.* who found no association between BMI and emergency department admission rates in children with asthma (31). Lung *et al.* showed obese asthmatics were not at greater risk for asthma exacerbation or higher treatment burden than normal weight children with asthma (32). However there are several studies implicated a positive association between obesity and asthma severity and also attenuated response to inhaled corticosteroids (10,33,34).

Similar to some previous studies, we didn't find any relation between BMI and atopic status of asthmatic children (8,29). However there were several studies that show more prevalence of atopy among overweight and obese individuals (27,30,35,36).

We didn't evaluate activity of asthmatic patients, however asthma duration and medications were not related to overweight and obesity. These factors could be influence on activity and eating habits of asthmatic patients. Von Mutuis *et al*. demonstrated that the time spent watching TV and the frequency of exercising per week was also not associated with asthma (8). In contrast Tsai *et al*. found a significant interaction between asthma and BMI on time spent in moderate and vigorous activity (37).

In conclusion there were significant association between asthma and overweight and obesity as determined by increasing BMI level. Thus any intervention for prevention and control of these disorders could be improved health and quality of life.

## Acknowledgment

This study is graduated thesis of Dr Sara Tabbakhha and approved by research committee of Metabolic Disease Research Center of Zanjan University of Medical Sciences. We acknowledge patients and their parents who participated in this study.

## References

1. Van Cleave J, Gortmaker SL, Perrin JM. Dynamics of obesity and chronic health conditions among children and youth. JAMA 2010;303(7):623-30.
2. Kelishadi R. Childhood Overweight, Obesity, and the Metabolic Syndrome in Developing Countries. Epidemiol Rev 2007;29(1):62-76.

3. Bahreinian S, Ball G, Becker A, Kozyrskyj A. Comorbidity with depression and overweight in children with asthma. Allergy Asthma and Clinical Immunology 2010;6(suppl2):P10. www.aacijournal.com/content/6/S2/P10
4. Moreau D, Kalaboka S, Choquet M, Annesi-Maesano I. Asthma, obesity, and eating behaviors according to the diagnostic and statistical manual of mental disorders IV in a large population-based sample of adolescents. Am J Clin Nutr 2009;89(5):1292-8.
5. Shore SA. Obesity and asthma: possible mechanisms. J Allergy Clin Immunol 2008;121(5):1087-93.
6. Matos SM, Jesus SR, Saldiva SR, Prado MS, D'Innocenzo S, Assis AM, Rodrigues LC, Alcantara-Neves NM, Cruz ÁA, Simões Sde M, Barreto ML; SCAALA (Social Change, Asthma and Allergy in Latin America) Study Group. Overweight, asthma symptoms, atopy and pulmonary function in children of 4-12 years of age: findings from the SCAALA cohort in Salvador, Bahia, Brazil. Public Health Nutr 2011;14(7):1270-8.
7. Sutherland TJ, Cowan JO, Young S, Goulding A, Grant AM, Williamson A, Brassett K, Herbison GP, Taylor DR. The association between obesity and asthma: interactions between systemic and airway inflammation. Am J Respir Crit Care Med 2008;178(5):469-75. .
8. Von Mutius E, Schwartz J, Neas LM, Dockery D, Weiss ST. Relation of body mass index to asthma and atopy in children: the National Health and Nutrition Examination Study III. Thorax 2001;56(,11):835-8.
9. Beuther DA, Sutherland ER. Overweight, obesity, and incident asthma: a meta-analysis of prospective epidemiologic studies. Am J Respir Crit Care Med 2007;175(5):661-6.
10. Cassol VE, Rizzato TM, Teche SP, Basso D, Centenaro DF, Maldonado M, Moraes EZ, Hirakata VN, Solé D, Menna-Barreto SS. Obesity and its relationship with asthma prevalence and severity in adolescents from southern Brazil. J Asthma 2006;43(1):57-60.
11. Henkin S, Brugge D, Bermudez OI, Gao X. A case-control study of body mass index and asthma in Asian children. Ann Allergy Asthma Immunol 2008;100(5):447-51.
12. Leung TF, Kong AP, Chan IH, Choi KC, Ho C, S., Chan MH, So WY, Lam CW, Wong GW, Chan JC. Association between obesity and atopy in Chinese schoolchildren. Int Arch Allergy Immunol 2009;149(2):133-40.
13. Deesomchok A, Fisher T, Webb KA, Ora J, Lam YM, Lougheed MD, O'Donnell DE. Effects of obesity on perceptual and mechanical responses to bronchoconstriction in asthma. Am J Respir Crit Care Med 2010;181(2):125-33.
14. To T, Vydykhan TN, Dell S, Tassoudji M, Harris JK. Is obesity associated with asthma in young children? J pediatr 2004;144(2):162-8.
15. Vàzquez-Nava F, Morales Romero J, Crodova Fernandez JA, Saldívar-González AH, Vázquez-Rodriguez CF, Barrientos Gomez Mdel C, Lin-Ochoa D, Vázquez Rodríguez EM. Association between obesity and asthma in preschool Mexican children. Scientific World Journal 2010;7(10):1339-46.
16. Epstein LH, Wu YW, Paluch RA, Cerny FJ, Dorn JP. Asthma and maternal body mass index are related to pediatric body mass index and obesity: results from the Third National Health and Nutrition Examination Survey. Obes Res 2000;8(8):575-81.
17. Nathell L, Jensen I, LarssonL K. High prevalence of obesity in asthmatic patients on sick leave. Respir Med 2002;96(8):642-50.
18. NAEPP. (National Asthma Education and Prevention Program) Expert panel reports3: Guidelines for the diagnosis and management of asthma.: J Allergy Clin Immunol 2007;120(Suppl):S94–S138.
19. Kuczmarski RJ, Ogden CL, Grummer-Strawn LM, Flegal KM, Guo SS, Wei R, Mei Z, Curtin LR, Roche AF, Johnson CL. CDC growth charts: United States. Adv Data 2000;314:1-24.
20. Tai A, Volkmer R, Burton A. Association between asthma symptoms and obesity in preschool (4-5 year old) children. J Asthma 2009;46(4):362-5.
21. Bibi H, Shoseyov D, Feigenbaum D, Genis M, Friger M, Peled R, Sharff S. The relationship between asthma and obesity in children: is it real or a case of over diagnosis? J Asthma 2004;41(4):403-10.
22. Musaad SM, Patterson T, Ericksen M, Lindsey M, Dietrich K, Succop P, Khurana Hershey GK. Comparison of anthropometric measures of obesity in childhood allergic asthma: central obesity is most relevant. J Allergy Clin Immunol 2009;123(6):1321-7.
23. Amra B, Rahmani A, Salimi S, Mohammadzadeh Z, Golshan M. Association between Asthma and Body Mass Index in Children. Iran J Allergy Asthma Immunol 2005;4(1):33-7.
24. Lugogo NL, Hollingsworth JW, Howell DL, Que LG, Francisco D, Church TD, Potts-Kant EN, Ingram JL, Wang Y, Jung SH, Kraft M. Alveolar Macrophages from Overweight/Obese Asthmatic Subjects Demonstrate a Pro-inflammatory Phenotype. Am J Respir Crit Care Med 2012;186:11-6.
25. Poulain M, Doucet M, Major GC, Drapeau V, Sériès F, Boulet LP, Tremblay A, Maltais F. The effect of obesity on chronic respiratory diseases: pathophysiology and therapeutic strategies. CMAJ 2006;174(9):1293-9.

26. Castro-Rodríguez JA, Holberg CJ, Morgan WJ, Wright AL, Martinez FD. Increased incidence of asthmalike symptoms in girls who become overweight or obese during the school years. Am J Respir Crit Care Med 2001;163(6):1344-9.
27. Hancox R, Milne BJ, Poulton R, Taylor DR, Greene JM, McLachlan CR, Cowan JO, Flannery EM, Herbison GP, Sears MR. Sex differences in the relation between body mass index and asthma and atopy in a birth cohort. Am J Respir Crit Care Med 2005;171(5):440-5.
28. Weiss ST, Shore S. Obesity and asthma: directions for research. Am J Respir Crit Care Med 2004;169(8):963-8.
29. Oddy WH, Sherriff JL, de Klerk NH, Kendall GE, Sly PD, Beilin LJ, Blake KB, Landau LI, Stanley FJ. The relation of breastfeeding and body mass index to asthma and atopy in children: a prospective cohort study to age 6 years. Am J Public Health 2004;94(9):1531-7.
30. Yoo S, Kim HB, Lee SY, Kim BS, Kim JH, Yu JH, Kim BJ, Hong SJ. Association between obesity and the prevalence of allergic diseases, atopy, and bronchial hyperresponsiveness in Korean adolescents. Int Arch Allergy Immunol 2011;154(1):42-48.
31. Hom J, Morley EJ, Sasso P, Sinert R. Body mass index and pediatric asthma outcomes. Pediatr Emerg Care 2009;25(9):569-71.
32. Lang JE, Hossain J, Smith K, Lima JJ. Asthma severity, exacerbation risk, and controller treatment burden in underweight and obese children. J Asthma 2012;49(5):456-63.
33. Akerman MJ, Calacanis CM, Madsen MK. Relationship Between Asthma Severity and Obesity. Journal of Asthma 2004;41(5):521-6
34. Anderson WJ, Lipworth BJ. Does body mass index influence responsiveness to inhaled corticosteroids in persistent asthma? Ann Allergy Asthma Immunol 2012;108(4):237-42.
35. Calvert J, Burney P. Effect of body mass on exercise-induced bronchospasm and atopy in African children. J Allergy Clin Immunol 2005;116:773-9.
36. Schachter LM, Peat JK, Salome CM. Asthma and atopy in overweight children. Thorax 2003;58(12):1031-5.
37. Tsai SY, Ward T, Lentz MJ, Kieckhefer GM. Daytime Physical Activity Levels in School-Age Children With and Without Asthma. Nurs Res 2012;61(4):252-9.