

Original Article

Airway Obstruction Worsens in Young Adults with Asthma Who Become Obese

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What is already known about this topic? The finding that obesity is associated with airway obstruction in children has been examined only in cross-sectional studies.

What does this article add to our knowledge? This longitudinal study demonstrates that children with mild to moderate asthma who became obese in young adulthood had worse obstructive pulmonary function compared with those who remained nonobese.

How does this study impact current management guidelines? Development of obesity by young adulthood in subjects with childhood asthma was associated with worsening obstructive pulmonary function, emphasizing the importance of monitoring weight in children with asthma as they grow into adulthood.

BACKGROUND: Few studies have examined how developing obesity in early adulthood affects the course of asthma.

OBJECTIVE: We analyzed lung function and asthma impairment and risk among nonobese children with asthma, comparing those who were obese in young adulthood with those who remained nonobese.

METHODS: We carried out the *post hoc* analysis of 771 subjects with mild to moderate asthma who were not obese (pediatric definition, body mass index [BMI] < 95th percentile) when enrolled in the Childhood Asthma Management Program at ages 5-12 years. The subjects were then followed to age 20 years or more. For visits at ages 20 years or more, spirometry values as percent predicted and recent asthma symptom scores and prednisone exposure were compared between 579 subjects who were nonobese at all visits and 151 who were obese (adult

definition of BMI ≥ 30 kg/m²) on at least 1 visit (median number of visits when obese = 4, IQR 2-7).

RESULTS: Compared with participants who were nonobese (BMI 23.4 ± 2.6 kg/m²), those who became obese (BMI 31.5 ± 3.8 kg/m²) had significant decreases in forced expiratory volume in the first second (FEV₁)/forced vital capacity (FVC) ($P < .0003$) and FEV₁ ($P = .001$), without differences in FVC ($P = .15$) during visits at ages 20 years or more. For each unit increase of BMI, FEV₁ percent predicted decreased by 0.29 ($P = .0009$). The relationship between BMI and lung function was not confounded by sex or BMI at baseline. Asthma impairment (symptom scores) and risk (prednisone use) did not differ between the 2 groups.

CONCLUSION: Becoming obese in early adulthood was associated with increased airway obstruction, without impact on

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Abbreviations used

<i>BMI- Body mass index</i>
<i>CAMP- Childhood Asthma Management Program</i>
<i>FEV₁- Forced expiratory volume in the first second</i>
<i>FVC- Forced vital capacity</i>
<i>Pediatric definition of obesity- BMI \geq 95th percentile</i>
<i>Adult definition of obesity- BMI \geq 30 kg/m²</i>

asthma impairment or risk. © 2015 American Academy of Allergy, Asthma & Immunology (J Allergy Clin Immunol Pract 2015;■:■-■)

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Both obesity and asthma are increasing in incidence and prevalence in the United States. Numerous cross-sectional studies have demonstrated higher rates of asthma in obese individuals compared with normal weight controls for both children and adults (reviewed in Refs.¹⁻⁴). Longitudinal studies⁵⁻⁷ have found that development of obesity in school-age years is associated with greater incident asthma during adolescence. Several groups have found that among individuals with asthma, those who are obese have worse control, greater need for albuterol and oral corticosteroids, are more often hospitalized, have a decreased response to inhaled corticosteroids, and have lower quality of life.⁸⁻¹² Furthermore, weight gain worsens asthma symptoms among those with severe or difficult-to-treat asthma.¹³ and weight loss improves both asthma control and lung function.¹⁴⁻¹⁶ However, obesity-related dyspnea is often misinterpreted as an asthma symptom, which indicates that obesity can produce symptoms without affecting asthma.^{17,18}

Cross-sectional studies have assessed the effects of obesity in youth on specific aspects of pulmonary function. A cross-sectional analysis of children with asthma aged 5-12 years enrolled in the Childhood Asthma Management Program (CAMP) found that increased body mass index (BMI), assessed as a continuous variable, was associated with increased forced vital capacity (FVC) and forced expiratory volume in the first second (FEV₁), but decreased FEV₁/FVC ratio.¹⁹ There were no associations between increased BMI and clinical symptoms.¹⁹ Other cross-sectional studies have confirmed the finding in children with asthma that increased BMI is associated with decreased FEV₁/FVC, with the findings similar in white, African American, and Hispanic groups²⁰ and in those with asthma and without asthma and in both sexes.²¹

Longitudinal studies examining the impact of weight gain on asthma are limited. A study of adults with asthma over 7-11 years of follow-up, which focused on the effects of weight gain, not the development of obesity, on lung function²² found that increases in BMI were related to decrements in FEV₁ and FEV₁/FVC. These findings were most prominent in individuals who had no airway obstruction at baseline. However, no longitudinal studies have been performed in children or young adults, and no longitudinal study has focused on the outcome of obesity.

This study examined children aged 5-12 years, who were not obese at entry in CAMP and were followed over an average of 16 years with frequent follow-up visits with assessment of lung

function and collection of height, weight, and measures of asthma impairment and risk. During young adulthood, 25% had become obese. We hypothesized that those who had become obese in young adulthood would have greater airway obstruction than those who remained nonobese.

METHODS

Study and subjects

The CAMP trial was a 4- to 6-year-long multicenter randomized controlled trial that measured the effects of budesonide, nedocromil, and a placebo on asthma outcomes in 1041 participants 5-12 years of age. The protocol and primary outcomes have been published previously.^{23,24} During the trial and 12 years of post-trial follow-up, visits occurred every 4-12 months. Visits consisted of height and weight measurements, spirometry, and questionnaires to assess asthma symptoms, health care utilization, and prednisone courses, all standardized across the 8 CAMP clinical centers²³ (see the [Online Repository at www.jaci-inpractice.org](http://www.jaci-inpractice.org) for clinical centers). CAMP procedures were approved by Institutional Review Boards at each of the clinical centers and for the CAMP Data Coordinating Center. Written informed consent was obtained from all participants.

Data were available on 897 participants followed for 16.2 ± 1.1 years (9-17.8 years) with age at final visits 20 years or more (24.7 ± 2.3 , range 20 to 30 years). Baseline BMI percentiles were calculated from CDC growth charts.²⁵ We excluded 126 participants who were obese (by the pediatric definition BMI \geq 95th percentile²⁶) at enrollment. We evaluated spirometry measures and measures of asthma impairment and risk by obesity status during follow-up visits when participants were 20 years or older. Obesity during the visits was defined using the adult definition BMI \geq 30 kg/m².^{2,26,27}

Pulmonary function

Pulmonary function was determined by spirometry both before and after the use of bronchodilator (two 90- μ g actuations of a pressurized metered-dose inhaler). Measures examined were percent of predicted FEV₁, FVC, and FEV₁/FVC. Baseline percent predicted spirometry values were determined using Wang et al²⁸ for those 6 and 7 years old and Hankinson et al²⁹ for those older than 7 years. Airway hyperresponsiveness was defined as the concentration of methacholine that caused a decrease of 20% from baseline FEV₁.³⁰

Asthma impairment and risk

Impairment: Asthma symptoms since the last visit were assessed at each visit using the American Thoracic Society's Division of Lung Diseases questionnaire for children. For this analysis, answers to questions about wheezing and shortness of breath after playing hard or exercise as "yes" or "no" were used.

Risk: Participants were asked about their use of prednisone since the last visit at each visit.

Statistical analysis

The association between obesity status during young adulthood and lung function measures over time was assessed in this analysis. Baseline characteristics were evaluated across 2 groups based on obesity status during young adulthood: (a) nonobese group: not obese at enrollment and at all follow-up visits at age 20 or more, or (b) became-obese group: not obese at enrollment, but were obese during at least 1 follow-up visit at age 20 or more. Unadjusted comparisons were assessed using *t* tests for measured variables or Fisher's exact tests for categorical variables.

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