Metabolic Asthma

Is There a Link Between Obesity, Diabetes, and Asthma?

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KEYWORDS

• Body mass index • Fetal programming • Lung development • Metabolic syndrome

KEY POINTS

- Regardless of body mass index percentile, children diagnosed with asthma are more likely to have higher triglyceride and insulin blood levels than children without asthma.
- Dyslipidemia and hyperinsulinemia, known silent precursors to cardiovascular disease, are also associated with the development of asthma, and confound its epidemiologic link to obesity.
- Diet and physical exercise may influence the development and persistence of innate and adaptive immune mechanisms involved in the pathogenesis of asthma in children.
- Prenatal events, such as intrauterine exposure to imbalanced maternal nutrition, may cause a shift in the trajectory of structural and functional airway development toward a hyperreactive phenotype.
- Monitoring and dietary/pharmacologic control of triglyceride and glucose metabolism during pregnancy and in the first years of life may become an important component of the prevention and management of asthma.

Childhood obesity has reached epidemic proportions worldwide, prompting First Lady Michelle Obama to launch the "Let's Move!" campaign against childhood obesity in February 2010.[1] Overweight is currently defined as a body mass index (BMI; calculated as the weight in kilograms divided by the height meters squared) from the 85th up to the 95th percentile for age, whereas obesity is defined as a BMI at or greater than the 95th percentile (**Fig. 1**).[2] Data from the Centers for Disease Control and Prevention (CDC) indicate that nearly 1 in 3 children in America are overweight or obese and that the rate of obesity already exceeds 30% in the United States.[3]

What is especially concerning is the rate at which this problem is growing. During the past 3 decades, childhood obesity rates in America have tripled.[4] Furthermore,

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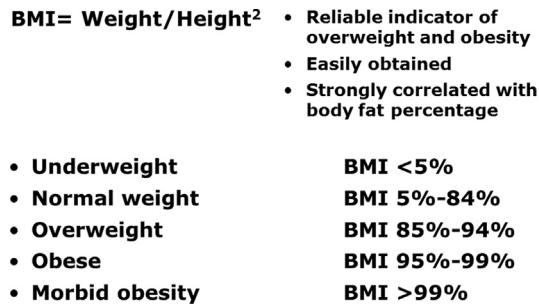

Fig. 1. Body mass index.

numbers are even higher among African-Americans and Hispanics, with nearly 40% of these children overweight or obese. If this trend does not change, estimates show that one-third of all children born in 2000 or later will at some point in their lives have comorbidities typically linked to excessive weight. In particular, the prevalence of metabolic syndrome has increased significantly, and more than 2 million children in the United States currently have this condition, defined by systemic hypertension, atherogenic dyslipidemia, and glucose intolerance.

OBESITY-ASTHMA LINK

A similar epidemiologic pattern has been observed for chronic respiratory diseases, particularly asthma. Four million children younger than 14 years have been diagnosed with asthma in the United States,[5] and the current global estimates of asthma prevalence range from less than 5% to more than 25%.[6] The parallel increase in obesity and asthma rates among children has led many investigators to postulate a relationship between these conditions,[7–10] although whether this relationship is causal or confounded by other factors remains a matter of debate.

Previous studies of the association between asthma and obesity have focused on 3 hypothetical mechanisms. The most simplistic theory is centered on specific nutrients, such as antioxidants and saturated fat,[7] and their role in oxidative lung damage or decreasing the lung's defenses against attacks from biological or chemical agents. The recent emphasis on the potential role of vitamin D deficiency in the pathophysiology of several chronic diseases driven by immunologic or autoimmune mechanisms, including asthma, has given new life to this idea, but the conclusions from interventional trials with high-dose vitamin D supplementation remain controversial.[11]

A second theory is centered on the mechanical effects of abdominal fat on respiratory system resistance and compliance.[8,9] Obesity reduces total lung capacity (TLC), particularly through decreasing the expiratory reserve volume and consequently the functional residual capacity. This process leads to the rapid, shallow breathing pattern that occurs close to closing volume in obese subjects. Perhaps more importantly, breathing at low TLC is associated with reduced peripheral airway diameter, and this in turn alters the bronchial smooth muscle structure and function, leading to airway hyperresponsiveness.

The third theory, which is also the most recent and probably most widely accepted, is based on the inflammatory mechanisms implicated in both conditions.[8,12] In obesity, visceral adiposity is associated with increased expression of multiple soluble mediators that amplify and propagate inflammation locally and systemically. This function involves the recruitment of inflammatory cells by chemokines, such as monocyte chemoattractant protein-1, and the direct synthesis of predominantly