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A Review – Childhood Asthma And Obesity

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Abstract:
Introduction: *Asthma, overweight and Obesity are growing public health problem which pose as a serious health hazard for children. The prevalence of both conditions has increased considerably in the past decades. The aim of this review is to underline the growing health problem caused by combined effect of obesity and asthma by compiling different journals available.*
Materials And Methods: *Different Reviews on childhood asthma and obesity are collected from different journals available so far and are compiled and narrated. RESULTS: We found a significant relationship of obesity with childhood asthma, obese children are more prone to the disease. Sex also plays an important role for disease causation. Males show higher asthma prevalence than females.*
Discussions: *We have collected literature from different authors and studied the impact of obesity with childhood asthma. Many literatures suggests the possible mechanism by which childhood asthma occurs which includes airway inflammation, mechanical changes associated with obesity, changes in airway hyper-responsiveness, changes in physical activity and diet. It was also found that obesity increases the clinical severity of asthma and decreases quality of life in children with asthma. Further studies are required to study the impact of the conditions, asthma and obesity in children.*
Keywords*: Childhood Asthma, Obesity, Overweight, Review*

I. Introduction

Asthma is defined by episodic airflow obstruction, increased airways responsiveness, and airway inflammation characterized by infiltration with eosinophils and T lymphocytes. CD4 T lymphocytes and T helper (Th2) cells mediates secretion of pro inflammatory cytokines such as interleukin IL-4, IL-5, and IL-13. The histo-pathologic appearance of the airways includes denudation of the airway epithelium, thickening of the basement membrane, mucus production, and airway smooth muscle hypertrophy. Although asthma is a chronic, often lifelong disease that affects humans of all ages, the onset of the disease occurs primarily in early childhood [1]. The National Health and Nutrition Examination Survey (1999– 2002) estimated that 31% of children aged 6 to 19 years in the United States are overweight (as defined by gender-specific BMI for age 95%). In addition, the prevalence of childhood overweight has been increasing steadily since the 1960s [2]. The prevalence of asthma as in urban population in India is found as 17.6% [3]. According to the National Family Health Survey-2 (1998-1999) report, the estimated prevalence of asthma in India is 2468 per 100,000 persons. As per International Institute of Population Studies (2000), the prevalence has been reported to be higher in rural than in urban areas. The prevalence among males was slightly higher than among females. Most of the Asian countries including India and China, although reporting relatively lower prevalence rates than those in the West, account for a huge burden in terms of absolute numbers of patients [4].

Obesity and Overweight are a large and growing public health problem for children. The prevalence of asthma and obesity have increased substantially in recent decades in many countries, leading to speculation that obese persons might be at increased risk of asthma development. Population surveys do suggest that persons with asthma are disproportionately obese compared with persons who have never had asthma. Clarifying the nature of the relationship between obesity and asthma incidence and the role of weight management among patients with asthma are both critical areas with important ramifications for the prevention and treatment of asthma[5]. The parallel rise in prevalence of both disorders and the coexistence of both asthma and obesity in many children has led to interest in the relationship between the two epidemics [6]. Along with overweight, the prevalence of childhood asthma is increasing. Acute asthma exacerbations incur significant health care costs and are one of the most common causes of visits to the emergency department [2].

Definition of Overweight/Obesity In Children

In adults, overweight is defined as a body mass index (BMI) (weight in kilograms divided by the square of height in meters] of 25–29.9 kg/m2, and obesity is defined as BMI 30 kg/m2. In children, adult BMI

cut-off points are not an accurate measure of body fatness because BMI changes with age, requiring age-specific cut-off points Most studies of children and adolescents in the United States use the Centres for Disease Control reference curves for BMI that define the 85–94th percentiles as at risk for overweight, and the 95th percentile as overweight (obese)[6]. BMI does not account for body frame and proportion of muscle mass. This limitation is particularly relevant in paediatric studies because of the effects of maturation and growth on lean muscle mass, fat mass and hydration status [7]. In addition, muscle mass increases with higher activity level. Fat mass values are higher among females than males and vary across ethnic groups [8]. Therefore other measures of body weight have been applied, such as the assessment of body fat by skin-fold thickness. Although single skin-fold measurements have only limited precision, reproducibility is improved by using multisite measurements integrated into validated prediction equation[9],[10]. In combination, BMI and skin-fold thickness may reflect a proper measurement to assess body weight in combination with fat distribution [11].

Epidemiology Of Asthma And Obesity

Most cross-sectional and prospective studies in children and adults support a link between obesity and asthma. In addition, most prospective studies in children show that obesity precedes the development of asthma [6]. Several factors more strongly implicated in the cause of asthma and wheeze such as airway mechanics, influences on immune responses and hormonal influences may play a stronger role. Mechanical properties of the respiratory system associated with obesity, such as diminished tidal lung expansion in overweight individuals, may partially account for the findings. Reduced tidal lung expansion compromises force fluctuations acting on the airways. Impaired force fluctuations in turn result in greater contractile responses of airway smooth muscle thereby potentially causing increased airway responsiveness. Increasing BMI was related to several measures of asthma, but not independently to atopy in most studies. Therefore, the effects of increased BMI may be mediated through factors other than the induction of airway eosinophilic inflammation [11].

Sex Differences In The Association Of Obesity And Asthma

Sex differences in the natural course of asthma and wheeze have been known for a long time [12],[13],[14]. While a higher incidence of wheeze and asthma has generally been associated with male sex in preadolescence, females are at higher risk to develop asthma during adolescence. By adulthood women also demonstrate higher asthma rates than men [13],[11]. In many studies the association of asthma with sex and obese children was stronger for girls, other studies found no major differences between boys and girls, and one prospective study showed an association only for boys. The conflicting results might be due to the age at which the association is observed [15]. Obesity prior to or after puberty may be critical and associations may be seen only in specific 'window periods' of development[6].

Mechanism Of Asthma And Its Relationship To Obesity

Several factors more strongly implicated in the cause of asthma and wheeze such as airway mechanics, influences on immune responses and hormonal influences may play a stronger role. Mechanical properties of the respiratory system associated with obesity, such as diminished tidal lung expansion in overweight individuals, may partially account for the findings. Reduced tidal lung expansion compromises force fluctuations acting on the airways. Impaired force fluctuations in turn result in greater contractile responses of airway smooth muscle thereby potentially causing increased airway responsiveness [16],[17]. Severe obesity with excessive increase in adipose tissue will result in extra-thoracic obstruction [11]. Proposed mechanisms for the influence of obesity on development of asthma include airway inflammation, mechanical factors, increased airway hyper-responsiveness (AHR), decreased physical activity, and changes in diet [6].

Airway Inflammation

Obesity is characterized by low-grade systemic inflammation with increased levels of inflammatory cytokines, adipokines, and acute phase proteins, including leptin, interleukin 6, tumor necrosis factor-α, and C reactive protein[18]. It is thought that obesity may upregulate airway inflammation, resulting in asthma. Exhaled nitric oxide is a surrogate marker of inflammation that has been recently studied to evaluate inflammation in the airway of obese people with asthma. There is no convincing evidence that obese patients with asthma have increased airway inflammation as measured by exhaled nitric oxide. In addition, a study of airway inflammation in 727 adult patients with and without asthma[19] revealed no association between BMI and airway inflammation as measured by sputum cell counts[6].

Mechanical Factors

Obesity is associated with changes in airway mechanics that may lead to respiratory symptoms without the airway inflammation typical of asthma. Obesity causes a higher oxygen cost of breathing leading to dyspnea because of decreased compliance from excess weight compressing the chest wall, fatty infiltrate of the chest

wall, and an increase in blood volume. Obesity causes a decrease in functional residual capacity, and decreases in both forced expiratory volume in 1 s (FEV1) and forced vital capacity (FVC), with a normal FEV1/FVC ratio, resulting in rapid shallow breathing[20], [6].

Airway Hyper-Responsiveness

Reductions in lung volumes are thought to increase airway hyper-responsiveness **(**AHR) although the clinical significance is unclear as studies of obese children with asthma often do not show AHR. Studies [21],[15] have found that AHR is greater in non obese asthmatic children than in obese children[6]. Although the relationship between obesity and asthma is reasonably clear, the relationship between obesity and airway responsiveness is less so, a relationship between obesity and asthma occurrence was found however, they found no relationship between obesity and an increase in airway responsiveness [22]. In longitudinal data from the Normative Aging Study, there was also an association between BMI and increased airway hyper-responsiveness with a reported odds ratio of 7[23]. Thus, the data in the literature is conflicting as to whether airway hyper responsiveness is increased by obesity [1].

Diet, Physical Activity

It is possible that obesity is an epiphenomenon, and changes in physical activity or diet are responsible for the increases in both asthma and obesity. It has been proposed that decreases in physical activity may result in both asthma and obesity. Some antioxidants and omega-3 fatty acids may have a protective effect for asthma, but their effects have not been investigated in an epidemiologic study [18]. More frequent intake of seafood and cereals was protective for current severe asthma, and fast food intake was a risk factor for current severe asthma [6]. The level of physical activity has been shown to be inversely related to asthma incidence in men but not women in at least one study[24]. In some prospective studies, no significant association was found[25],[26]. Furthermore, the effect of physical activity on a health outcome might be mediated through an effect on obesity, but physical activity might also affect a health outcome independent of obesity [5]. Studies have looked at overall calorie content of diet and its effect on asthma. Based on weight-loss studies, calorie restriction resulting in weight loss, independent of specific food and nutrient intake, seems to improve asthma [18]. In a study of 10 participants with a BMI $\geq$30[27], an alternate day calorie-restriction diet resulted in 8% weight loss, improvements in asthma symptoms and quality of life (QOL), and decreases in markers of inflammation and oxidative stress[6]. There has been considerable debate as to whether formula feeding is a risk factor for childhood obesity. Dewey et al. studied growth patterns for weight, length, head circumference, and indexes of body composition [28] and found that infants breastfed for[29] months or longer are leaner than formula-fed infants. The impact of breastfeeding on obesity has been investigated in small studies, but no effect was observed [30], [31], [29].

Atopy

Atopy was defined by a positive skin prick test if, 10 minutes following the test, the resulting welt to at least 1 of the 4 allergens was more than 2 mm across and larger than that of a control. While most studies suggest an association between obesity and asthma, such a relationship has not been convincingly demonstrated between obesity and atopy. Since atopy is a risk factor for the development of asthma, it is of interest whether obesity increases atopy via inflammatory cytokines. Studies in children have conflicting results, however. Atopy was assessed by skin prick testing to 4 common environmental aeroallergens [32]. Data from National Health and Nutrition Examination Survey suggests that obesity is associated with an increase in skin test reactivity but not peripheral blood eosinophils. IgE levels were not measured in this study [33]. Report of cross-sectional data showing relationship between BMI and an increase in skin test reactivity[34]. Figueroa-Munoz and co-workers 2001, used data from a National Study of Health and Growth in the United Kingdom to examine if obesity preceded the increase in asthma and wheezing. In their initial report on data from this population, the investigators show a strong relationship between BMI and asthma occurrence cross-sectional. This cross-sectional association may not have been temporally related [35].

Severity Of Disease And Quality Of Life For Children With Obesity And Asthma

Obese children may perceive their asthma as more severe than do normal-weight children, resulting in an erroneous assessment of increased severity. Overweight children report greater limitation of physical activity and are prescribed more medications [36]. The authors concluded that obese children might perceive their asthma as more severe, resulting in increased medication prescriptions and an apparent increase in severity A study of adult patients with asthma [37] found that increasing BMI resulted in decreased QOL[6].

II. Conclusion

Asthma and obesity are both major public health problems and obesity appears to increase the risk of asthma. We found a significant relationship of obesity with childhood asthma. It is also found that obesity increases the clinical severity of asthma and decreases quality of life in children which is more in male sex as compared to female. A further study is required to study the impact of both the conditions, asthma and obesity which can give limelight to physicians and public for acquiring proper direction to lead a quality life with better output to our future generation.

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