



**Review Article**

# Asthma and Metabolic Syndrome—Correlation and Review of Literature

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**Abstract:** There is a strong link between asthma and metabolic syndrome. This relationship has been shown by various researchers. A bidirectional relationship exists between asthma and metabolic syndrome. The aim of this study was to access the correlation between metabolic syndrome and asthma. Using internet search, a comprehensive literature review was done and words such as asthma, respiratory problems, chronic obstructive pulmonary diseases, metabolic syndrome, obesity, insulin resistance were searched from Google scholar, Yahoo, Pubmed, Medline, Web MD, Scopus to check for various articles published on this subject. The references of the relevant articles were also searched. Analyses of results of various studies from various parts of the world were considered and their prevalences were noted to access the correlation between asthma and metabolic syndrome. Obesity, which is a component of metabolic syndrome is a risk factor for asthma. This study concludes with evidences from various studies that there is a strong link between asthma and metabolic syndrome.

**Keywords:** Asthma, Obesity, Metabolic Syndrome, Diabetes, Insulin

## 1. Introduction

Reavens syndrome/Metabolic syndrome is a syndrome that involves at least one of the three disorders of dyslipidemia, insulin resistance, obesity and/or hypertension [1]. Metabolic syndrome has been associated with several chronic diseases in adults [1]. There are close links between asthma and metabolic syndrome [2]. This is buttressed by the fact that improvement in asthma symptoms following weight reduction in patients with metabolic syndrome has been observed [2]. Though asthma has been epidemiologically linked to obesity, obesity appears to be a predisposing factor for the asthma onset.<sup>2</sup> Obesity may predispose to increased TH2 inflammation or tendency to atopy. The relationship between obesity and asthma has been widely studied in the past, however metabolic syndrome carries a condition of systematic inflammation that could potentially explain the influence of onset and severity [2].

## 2. Asthma and Metabolic Syndrome

Asthma is associated with long term disability [3, 4]. It has been reported that people with asthma have an increased risk

of cardiovascular diseases and metabolic disorders due to direct involvement of common inflammatory mediators. Metabolic syndrome is also characterised by inflammation [5]. The prevalence of asthma has been increasing worldwide during the past half century [6]. Metabolic syndrome is made up of various components such as elevated triglycerides, reduced glucose tolerance or diabetes mellitus. Obesity is a major component of metabolic syndrome that indicates a significant increased risk of cardiovascular disease [7]. Markers of metabolic syndrome such as insulin resistance have been associated with reduced lung function and asthma. However the direct impact of hyper-insulinemia and insulin resistance on lung function and inflammation is not fully understood [8].

## 3. Link Between Asthma and Metabolic Syndrome—Review of Literature

Adeyeye OO et al (Nigeria) carried out a local study to assess the presence of metabolic syndrome among asthmatic patient. It was found that asthma control was affected by the

presence of metabolic syndrome ( $p < 0.05$ ). They concluded that metabolic syndrome presence is high in the population of asthma patient [9]. In a meta-analysis study, Beuther DA et al involved seven studies and compared normal weight, overweight and obesity body mass index (BMIs  $> 25$ ). A dose-response effect of elevated BMI on asthma incidence was observed. The odds ratio (OR) for incident asthma due to obesity was observed in men (OR, 1.46, 95 CI: 1.05-2.02) and women (OR, 1.68; 95%CI, 1.45-1.94);  $p = 0.232$  for the comparison [10]. Uzunlulu et al studied a total of 188 non-diabetic patients with metabolic syndrome. They concluded that the prevalence of metabolic syndrome was slightly higher in the asthma group than in the control group (36.7% vs. 33.7% respectively). The difference however was not statistically significant ( $p > 0.05$ ) [11]. Brumpton BM in the Hunt study concluded that obesity is a risk factor for incident asthma in adults (obesity is also a component of metabolic syndrome). Major finding was that metabolic syndrome was a risk factor for incident asthma (adjusted OR 1.57, 95%CI, 1.37-1.87) [12]. Metabolic syndrome and two of its component (high waist circumference and elevated glucose or diabetes were associated with an increased risk of incident asthma in adult.) [12]. However, Assad N et al in the longitudinal CARDIA study concluded that BMI is a stronger predictor of incident asthma among women than metabolic syndrome [13]. Forno E et al in their study summarized that obesity increases both the risk of and asthma and asthma severity and is a well are risk factor for insulin resistance and the metabolic syndrome in children and adolescents. They found that insulin resistance and metabolic syndrome are associated with worsened lung function in obese/non-obese adolescents. Asthma and metabolic syndrome synergistically decrease lung function as do obesity and insulin resistance. These factors contribute to the pathogenesis of asthma severity in obese patients [14]. Wats H et al focus that almost half of patients with chronic obstructive pulmonary diseases (COPD) had co-existing metabolic syndrome with a slightly lower frequencies in patients with severe COPD. The co-existing metabolic syndrome was found to be associated with an increase in the level of some systemic inflammatory markers and physical inactivity, independent of lung function in comparison [15].

In the Strong Heart Study, Fawn Yeh et al did a multicenter prospective study and cardiovascular and its risk factors among they find that patients that had reduced lung function was independently associated with metabolic syndrome as diabetes mellitus, and that obesity and inflammation are associated with reduced lung function in metabolic and diabetes mellitus. Impaired any function parch before the development of metabolic syndrome or diabetes mellitus in one patients [16].

Ford et al estimated the prevalence of metabolic syndrome using the 2007 Pediatric International Diabetes Federation (IDF) definition and recruited 2014 participants. The prevalence of metabolic syndrome was approximately 4.5% over a 5 year period [17]. In 2009, Lee EJ et al concluded that metabolic syndrome is associated with asthma-like symptoms.

The major components of metabolic syndrome implicated in their study that was linked to asthma-like symptoms were abdominal obesity and hypertension [18].

Guerra S et al also considered a relation between body mass index, chronic bronchitis, and emphysema. They found that flow that obese women were at increase risk of acquiring asthma [19]. Lin WY et al found a correlation between impaired lung function and obesity and metabolic syndrome. They suggested that obesity and insulin resistance may be the common pathway underlying lung function impairment and metabolic syndrome among adults [20]. Parkhales S et al explored an asthma –obesity interaction among obese and non-obese people with asthma. They found that people with asthma had lung function and more co-morbidities compared with normal weight people with asthma. Also they concluded that obese individuals, who make urgent visit for respiratory symptoms are more likely to receive a misdiagnosis of asthma [21]. Similarly, Tai A et al found an association between asthma syndrome and obesity in preschool children. The relationship was said to be evident for both male and female subjects [22].

#### 4. Pathogenesis

The relationship between asthma, obesity and abnormal metabolism is not well understood, nor has it been adequately explored in children [22]. Evidence suggest that insulin resistance is a strong independent factor for asthma development, but is a actually unknown whether a direct effect of insulin on the lung is involved [8]. The mechanisms linking metabolic syndrome and asthma are yet to be fully understood [23]. However the improvement in asthma symptoms following a reduction in weight raises the suspicion for the fact that there is a link between these two entities, though the basis for this is not fully established. Obesity is said to increase the levels of adiponectin which causes activation of pulmonary adiponectin receptors which leads to allergen challenges, which are eventually airway responses [24]. It is believe that obese patient are prone to asthma, and asthma patients tend to be obese [23, 24]. This bidirectional relationship has been known for years [2, 23, 24]. Both male and female overweight and obese patient have increased risk of asthma [25, 26].

Increased expression of pro-inflammatory mediators has been observed in obese asthmatics [27]. These mediators reduced drastically in these patient following weight loss and gastric bypass surgery changes in the expression of pro – inflammatory mediators such as leptin, IL-6, TNF-alpha, C-reactive protein and adiponectin have been demonstrated in obese patient with asthma [2, 28]. This stresses their role in the pathogenesis of obesity-linked asthma.

Lipoproteins play a role in the pathogeneses of asthma. This supports the use of statins in asthmatic patients; though there are still some controversies about this. In a large Danish study, it was observe that insulin resistance was more related to asthma risk than any of the anthropometric parameters [29]. Markers of metabolic syndrome such as C-reactive protein

and correlates such as hyperglycemia, diabetes or hypertension have all been associated with reduced lung function and asthma or even COPD [2, 5, 30].

The obesity-link changes in cytokines, chemokines and energy regulating hormones have been suggested to promote local and systematic inflammation and may play a role in the connection between metabolic syndrome and incident asthma [23, 24, 31].

Also it has been suggested that common genetics shared by both obesity and asthma may contribute to the obesity-asthma association [22, 23]. It has also been hypothesized that systemic low grade inflammation associated with insulin resistance maybe one of the underlying mechanisms of asthma development [33, 34]. Metabolic syndrome has been known to increase the severity of asthma [35, 36].

## 5. Conclusion

Both metabolic syndrome and asthma prevalences are high in the general population. It is therefore important to screen patients with these conditions and manage them effectively to improve outcome.

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