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Metabolic syndrome and asthma

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Abstract

Introduction
Bronchial asthma is one of the chronic diseases that most commonly present worldwide. Asthma is still a poorly controlled disease despite the availability and intake of medications in a large percentage of asthmatic patients. Research studies are indicated to identify the effect of metabolic syndrome on the occurrence of asthma and its severity and also to clear the underlying important mechanisms.

Patients and methods
This cross-section study was carried out on 108 patients with asthma. Asthma was diagnosed and classify according to Global Initiative for Asthma guideline. All asthmatic patients were tested for the criteria of metabolic syndrome.

Aim
To determine the prevalence of metabolic syndrome among a population of asthmatics.

Results
Metabolic syndrome was present in 20 (18.5%) patients. Abdominal obesity was present in 59 (54.6%) patients. There were 47 (43.5%) asthmatics with hypertension. Low level of high-density lipoprotein was present in 24.10% of patients, and all patients had normal level of triglycerides.

Conclusion
There is a significant prevalence of metabolic syndrome among asthmatic patients. Proper screening of asthmatic patients for components of metabolic syndrome is highly indicated for control of asthma.

Keywords: Abdominal obesity, asthma, BMI, dyslipidemia, hypertension, metabolic syndrome

Background

In developing countries, asthma is a serious health problem, which has increased in prevalence over the past decades, especially among adolescents and children [1].

Over the years, asthma has become one of the main health problems faced by society and patients. It is estimated that ~300 million persons all over the world have asthma, and this number is expected to increase to ~400 million persons by 2025 [2].

Asthma is considered a heterogeneous condition. Asthma natural history includes acute attacks of deterioration which is called exacerbations, against a background of long-time chronic persistent inflammation with or without structural changes, which may also be associated with presence of reduced lung function and persistent symptoms. Exposure to trigger factor is associated with the underlying phenotype, the severity of hyperresponsiveness and of airflow narrowing, and the severity of bronchial wall inflammation to cause wide variability in the asthma manifestations in individual patients. The challenge to researchers and clinicians is to evaluate and quantify such profiles both collectively and individually in such a way to assess interventions or to compare between different populations meaningful [3].

On the contrary, metabolic syndrome is considered a disorder of energy storage and utilization. Certain criteria are needed to be fulfilled for metabolic syndrome diagnosis.

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Metabolic syndrome is considered present if any three of the following are identified in a patient: hypertension, abdominal obesity, hyperglycemia/diabetes mellitus, low high-density lipoprotein (HDL) cholesterol levels, and high serum triglycerides. The relationship between metabolic syndrome and asthma could be explained by several mechanisms. However, the association between metabolic syndrome and asthma has rarely been investigated [4].

Metabolic syndrome prevalence has been reported from 18 to 46% in different local studies [5].

One of the major components of metabolic syndrome is obesity, and it has also been documented to lead to asthma [6].

Although obesity and asthma are considered two health problems with fast growing of public health significance, especially in developing countries, the association between these two major disorders still at best is shrouded in mystery. The presence of obesity creates important challenges for the management of asthma. Researchers have noted that there is evidence of the influence of both hyperinsulinemia and hyperglycemia, which are the main findings of the metabolic syndrome, on bronchial wall function and structure [7]. The elevated prevalence of lipid abnormalities and hypertension in addition to diabetes also poses challenges in addition to the increasing health care cost. Many previous studies have associated asthma with obesity, particularly central obesity, which is the main component of the metabolic syndrome [7].

Aim

This cross-section study aims to detect the percentage of metabolic syndrome in asthmatic patients seen in the hospitals and clinics and to compare the severity and asthma control between patents with metabolic syndrome and others without the metabolic syndrome.

Patients and methods

This cross-section study was carried out on 108 patients with asthma. The age range was between 19 and 73 years. The patients were diagnosed and classified according to Global Initiative for Asthma (GINA 2018) [8] criteria. The patients were recruited from Al Sahel Teaching Hospital.

All participants were subjected to the following:

(1) Full clinical history including personal, familial, smoking, alcohol intake, drug therapy, environmental risk factors and past history, and also history of the patient's conditions including symptoms of asthma. Moreover, asthma symptoms were detected by presence of positive answer to the following two important questions:
   (a) Have you had whistling or wheezing sound during breathing in the past 12 months?.
   (b) Have you had whistling or wheezing sound with breathing during or after your exercise in the past 12 months?.
(2) Thorough clinical examination, including general as well as local examination.
(3) Pulmonary function tests: using a spirometer, Spirovit SP-10-Schiller (Baar Switzerland). The same technician used the same spirometer for examination.

The following were recorded:

(1) Forced vital capacity (FVC).
(2) Forced expiratory volume in 1 s (FEV1).
(3) FEV1/FVC.
(4) Peak expiratory flow.

In all cases, postbronchodilation spirometry FEV1 was measured. The best value of the three maneuvers was expressed as a percentage of the predicted value, and classification of asthma severity was performed according to GINA guidelines.

Blood samples

From each participant, a venous blood sample was taken after 12 h of fasting. Plasma glucose, triglyceride, and HDL were measured by using Hitachi COBAS C 311 Roch (Mannheim Germany).

Diagnosis of metabolic syndrome

Diagnosis of metabolic syndrome was done according to the guidelines of the American Heart Association and the National Heart, Lung, and Blood Institute [9]. Metabolic syndrome was defined as the patient having at least three of the following criteria:

(1) Abdominal obesity (waist circumference ≥88 cm in women and ≥102 cm in men).
(2) Serum triglycerides equal or more than 150 mg/dl or receiving treatment for raised triglycerides.
(3) Serum HDL less than 50 mg/dl in women and less than 40 mg/dl in men or receiving treatment for low HDL.
(4) Blood pressure equal or more than 130/85 mmHg or receiving treatment for raised blood pressure.
(5) Hyperglycemia (fasting plasma glucose ≥100 mg/dl): this is available for the first 36 months of follow-up or drug medications for raised blood glucose [9].

Height and body weight were measured, and BMI was calculated by kg/m2 (dividing weight by height squared). Moreover, blood pressure was measured in accordance with the American Heart Association recommendations. Blood pressure measurements from both arms were done, with the patient in the supine position and after 15 min of resting period, and only the highest reading was used for documentation and analysis.

If the patients were using antidiabetic or antihypertensive medications, they were considered to have had elevated fasting glucose or elevated blood pressure.

Written informed consent document was obtained from each person, and also approval of Research Ethical Committee of GOTHI was obtained.

Statistical analysis

Review of data and coding was performed. The results was entered and analyzed through SPSS program software (IBM, Chicago, USA). Descriptive statistics was done,

and quantitative variables were expressed as means ± SD. Comparison of means were done using the Student *t* test. Categorical variables were compared with the χ^2 test. *P* values of less than 0.05 were considered statistically significant.

Results

This work was carried out on 108 patients with asthma. The age range was between 19 and 73 years. There was no significant sex difference in mean age of the participants ($P = 0.263$). The females had a longer duration of asthma than the males ($P < 0.001$) (Table 1).

Metabolic syndrome was present in 20 (18.5%) patients, comprising nine males and 11 females (Fig. 1). Asthmatics with metabolic syndrome were significantly older than those without. No difference was noted in the sex distribution between the two categories.

The prevalence of obesity according to BMI was 53.7%. Regarding the BMI distribution of the patients, no patient was underweight (Fig. 2).

There were 47 (43.5%) asthmatics with hypertension. Most patients with asthma had fasting level of blood sugar less than 100 mg/dl. A total of 12 (11.1%) patients had fasting blood sugar more than or equal to 100 mg/dl. Patients already diagnosed as diabetics were five (4.6%) patients. Abdominal obesity was found in 59 (54.6%) patients. There were 42 (38.8%) female patients and 17 (15.7%) male patients. Fig. 3 shows all criteria of metabolic syndrome present in these asthmatic patients. Abdominal obesity was the most prevalent, and elevated triglyceride level the least.

Low level HDL was present in 24.10% of patients, and all patients had normal level of triglycerides.

Comparisons of the metabolic criteria of patients with and without metabolic syndrome are shown in Table 2. Except for fasting blood glucose level, which was comparable in both groups, patients with metabolic syndrome had a statistically significantly higher fasting total cholesterol level, low-density lipoprotein cholesterol, and low levels of HDL cholesterol fractions.

Asthma control and classification of severity

The comparison of severity of asthma and asthma control between the patients with metabolic syndrome and those without is shown in Table 3. The patients not having metabolic syndrome had a well-controlled asthma than the patients having metabolic syndrome. No difference in the disease severity was found between both the groups. The asthma severity was classified according to the criteria of the GINA 2008 classification [10], as intermittent, mild persistent, moderate persistent, and severe persistent.

The comparisons of the pulmonary function tests between those with metabolic syndrome and those without metabolic syndrome are shown in Table 4. There was no statistically significant difference in the mean of predicted FEV1, FEV1/FVC, FEF (25–75%), or peak expiratory flow of asthmatic patients with metabolic syndrome and asthmatic

Table 1: General characteristics of the study population

Characteristic	Males	Females	Total	*P*
Age per years	43.8±17.3	46.5±16.7	48.6±18.3	0.263
Duration of illness (years)	11.5±8.8	17.2±12.2		<0.001
Presence of metabolic syndrome	9	11	20 (18.5%)	0.811

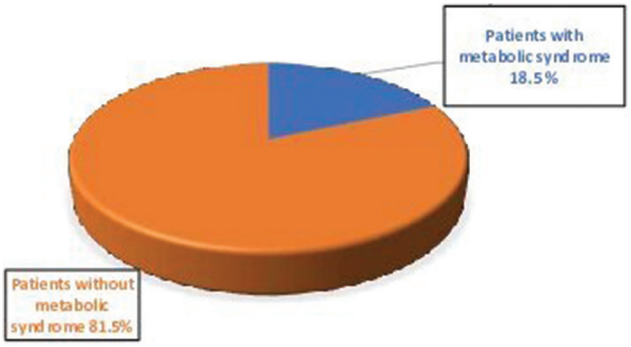

Figure 1: Percentage of patients with metabolic syndrome to those without.

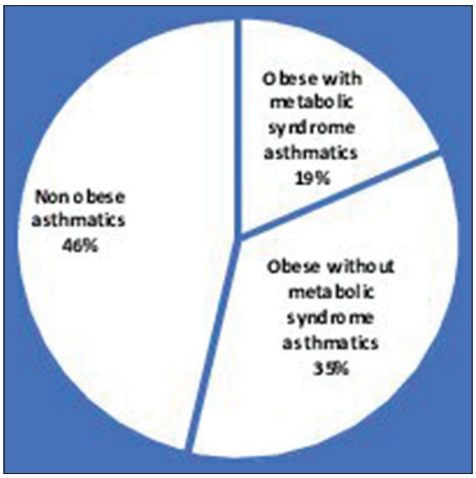

Figure 2: Prevalence of obesity according to BMI.

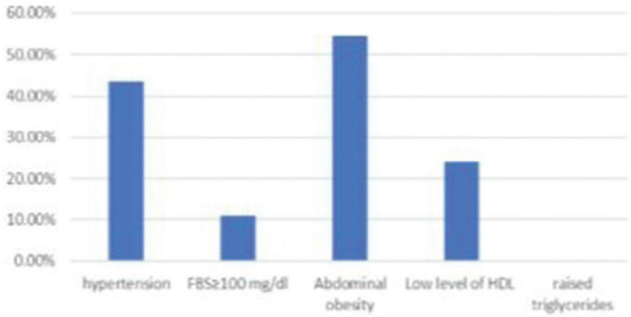

Figure 3: Frequency of metabolic syndrome components in asthmatic patients.

Table 2: Comparison of metabolic criteria of asthmatic patients with metabolic syndrome versus those asthmatic patients without metabolic syndrome

Items	Asthma with (metabolic syndrome)	Asthma without (metabolic syndrome)	*P*
Mean FBS (mg/dl)	88.7±14.5	84.5±9.8	0.193
Mean total fasting cholesterol (mg/dl)	226.4±34.5	187.7±36.6	<0.001
Mean triglyceride (mg/dl)	70.4±15.6	65.3±14.3	0.192
Mean HDL cholesterol (mg/dl)	50.8±6.4	57.9±8.4	<0.001
Mean LDL cholesterol (mg/dl)	145.8±33.3	118.7±28.3	<0.001

Data are expressed as mean±SD for parametric data. FBS, fasting blood sugar; HDL, high-density lipoprotein; LDL, low-density lipoprotein. Student *t* test. *P* more than 0.05: nonsignificant and *P* less than 0.001: highly significant.

Table 3: Comparison of control of asthma and severity in patients with metabolic syndrome and patients not experiencing metabolic syndrome

Item frequency %	Asthma with (metabolic syndrome)	Asthma without (metabolic syndrome)	*P*
Control of asthma			
Well controlled	3 (2.7)	28 (25.9)	<0.001
Partial control	9 (8.3)	35 (32.4)	<0.001
Uncontrolled	8 (7.4)	25 (23.1)	0.005
Asthma severity			
Intermittent	2 (1.85)	27 (25)	<0.001
Mild persistent	2 (1.8)	22 (20.3)	<0.001
Moderate persistent	7 (6.4)	20 (18.5)	0.021
Severe persistent	9 (8.3)	19 (17.6)	0.309

Data are expressed as *n* (%). χ^2, χ^2 test. *P* more than 0.05: nonsignificant; *P* less than 0.001 highly significant.

Table 4: Comparison of the pulmonary function tests between those with (metabolic syndrome) and those without (metabolic syndrome)

	Asthma with (metabolic syndrome)	Asthma without (metabolic syndrome)	*P*
FEV1			
Pre	52.84±19.32	53.04±19.46	0.863
Post	63.26±18.38	63.84±19.44	0.909
FEV1/FVC	57.20±12.02	57.90±10.03	0.804
FEF (25-75%)	31.92±12.34	32.54±13.89	0.855
PEF	32.42±16.23	32.88±16.38	0.913

Data are expressed as mean±SD for parametric data. FEV1, forced expiratory volume in 1 s; FVC, forced vital capacity; PEF, peak expiratory flow. Using Student's *t* test. *P* more than 0.05: nonsignificant.

patients without metabolic syndrome. There was no significant difference in postbronchodilator responses in both groups.

Comorbidities in patients experiencing asthma

The percentage of patients with diabetes was 4.6%, with five patients having diabetes. Hypertension was found in 47 (43.5%) asthmatic patients. Allergic rhinitis was present in 54 (50%), allergic sinusitis in 41 (37.9%), allergic conjunctivitis in 45 (41.6%), and atopic dermatitis was found in three (2.7%) patients. Most [78 (72.2%)] patients did not have any family history of asthma.

Discussion

This cross-section study was carried out on 108 patients with asthma to investigate the prevalence and associations between metabolic syndrome and asthma. The metabolic syndrome is not only associated with an increased risk of heart disease, stroke, and type 2 diabetes but also with other low-grade systemic inflammatory diseases [11].

In this study of asthmatic patients, metabolic syndrome was present in 20 (18.5%) asthmatic patients. This result is high and points to the increasing prevalence of metabolic syndrome in asthmatic patients. Our study found that 47 (43.5%) asthmatics had hypertension. This corresponds with previous studies, which found asthma to have a relationship with metabolic syndrome and its clinical manifestations, such as hypertension [12–14].

In this study, among metabolic syndrome components, abdominal obesity was the most significantly related factor of asthma, and abdominal obesity was present in 59 (54.6%) patients. This is in accordance with many previous studies; many prospective-cohort studies [15,16] and cross-sectional

studies [17] have stated that obesity is a good predictor of asthma. In one previous study, metabolic syndrome per se was not an independent predictor of asthma when BMI was adjusted [16].

Terzano and colleagues stated that abdominal obesity is strongly associated with a metabolic syndrome of obesity, dyslipidemia, hypertension, and hyperglycemic tendencies that is represented at the molecular level by insulin resistance and hyperinsulinism. In some previous studies, using multivariate analysis, insulin resistance was responsible for most of the obesity-associated asthma risks [18–20].

Many epidemiologic previous studies have found that abdominal obesity is more strongly associated with asthma than general body mass [19,21–23].

In the current study, low level of HDL was present in 24.10% of patients with asthma. In one previous study, low HDL cholesterol was strongly associated with asthma, and there was a positive linear association between the number of components of metabolic syndrome and the prevalence of asthma. These observations suggest that metabolic syndrome-related factors other than abdominal obesity could contribute to the relationship between metabolic syndrome and asthma [24].

In our study, all patients had normal level of triglycerides. Wang *et al*. [25] stated that triglyceride was no longer statistically significant in asthmatic patients, and further studies should address the individual component in more detail; for example, repeated measurements of consecutive serum levels in a cohort study should be performed to eliminate confounding factors and help identify the associations of the components of metabolic syndrome with asthma.

Another previous study also found that abdominal obesity was significantly related to asthma. However, the total number of metabolic syndrome components was also statistically significant associated with asthma [26].

In the current study, we found that those having metabolic syndrome had a better control of asthma than those having metabolic syndrome. No difference was found in the disease severity between these two groups. These results are consistent with the literature, which found no statistically significant reduction in FVC and FEV1 with increasing BMI [27]. Obese asthmatics especially those with comorbidities like metabolic syndrome may be considered as a subtype of asthmatics having more severe asthma, poor quality of life, and high risk of obstructive sleep apnea [27]. These results are consistent with the literature [28].

Nakajima *et al*. [29] stated that there is no obstructive pattern that might be associated with metabolic disorders and metabolic syndrome in a severity-dependent manner.

Beuther *et al*. [30] also stated that clinical previous studies did not support the association between increased inflammation in the airways of asthmatics and obesity. Moreover, another study did not find any significant association between presence of metabolic syndrome and pulmonary function tests [31].

Conclusion

Metabolic syndrome was significantly highly prevalent between the asthmatic patients in this study. Moreover, there is poor control of asthma in patients with metabolic syndrome than in those without metabolic syndrome, so screening of patients with asthma for the components of metabolic syndrome is highly required for proper management when indicated, which leads to well control of asthma.

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Nil.

Conflicts of interest

There are no conflicts of interest.

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