Original Article

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Prevalence of Metabolic Syndrome in Patients with Bronchial Asthma in Kurdish Patients: A Cross-sectional Study

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ABSTRACT

Introduction: The Metabolic Syndrome (MetS) is a cluster of biochemical and physiological abnormalities associated with the development of cardiovascular diseases and type 2 diabetes. It may also increase the risk of bronchial asthma, a chronic inflammatory disorder. In Iraq and the Middle East, both MetS and asthma conditions are rising due to urbanisation and lifestyle changes. Specific data concerning the burden and characteristics of MetS among asthma patients attending tertiary care centres in this region remains limited.

Aim: To assess the MetS prevalence among bronchial asthma patients.

Materials and Methods: The present cross-sectional study was conducted at Azadi General Teaching Hospital in Duhok, Kurdistan Region of Iraq, from June 2023 to February 2024. A total of 100 patients with bronchial asthma were recruited through convenience sampling. General and medical information was collected, including age, gender, place of residence, asthma medication, adherence to regular asthma treatment, smoking status, personal history of co-morbidities, obesity, and Waist Circumference (WC). Biomedical measurements comprised Blood Pressure (BP), Fasting Blood Sugar (FBS), Triglycerides (TG), High-Density Lipoprotein (HDL), Low-Density Lipoprotein (LDL), and Total Cholesterol (TChol). In addition, physical activity levels and asthma diagnosis were assessed. Contributing factors to MetS were analysed using independent t-tests and Chi-square tests, with statistical significance set at $p<0.05$.

Results: Among 100 asthma patients, 27% were diagnosed with MetS. Compared with non-MetS patients, those with MetS were more likely to receive regular therapy ($p<0.0001$), had higher rates of persistent asthma ($p=0.009$), and longer disease duration ($p=0.0004$). Hypertension ($p=0.0001$) and diabetes ($p<0.0001$) were significantly more prevalent in MetS patients. They also demonstrated worse metabolic profiles, including lower HDL, higher BMI, greater WC, elevated TGs, increased fasting glucose, and higher smoking prevalence (all $p<0.05$).

Conclusion: The present study confirms that MetS is a common and clinically relevant Co-morbidity in patients with bronchial asthma in Duhok, Iraq. The significant association between MetS and factors indicative of greater asthma severity and significantly worse metabolic profiles necessitates a multidisciplinary approach.

Keywords: Co-morbidity, Metabolic dysfunction, Obesity, Respiratory disorders

INTRODUCTION

Asthma is widely recognised as a heterogeneous disease which most commonly results in chronic airway inflammation and unpredictable limitations of airflow during exhalation according to medical research [1]. The condition affects more than 350 million people worldwide [2], which makes it a major public health crisis. In recent decades, the global prevalence of asthma has risen in parallel with the global epidemic of obesity [1]. This parallel rise has prompted extensive research into the complex relationship between asthma and metabolic dysfunction.

MetS is a standalone term and indicates a cluster of related risk factors of metabolic origin that greatly affects an individual's risk of systemic diseases, especially of cardiovascular disease and Type 2 Diabetes Mellitus (T2DM). MetS is often categorised by key hallmark findings that includes central obesity, hypertension, hyperglycaemia or reduced insulin sensitivity, and dyslipidaemia (high TG and low HDL-C) [1]. The reported prevalence of MetS varies according to the diagnostic criteria, ranging from 12.5% to 31.4% [3].

A considerable body of epidemiological evidence supports a strong association between MetS and asthma, which extends beyond the mechanical limitations imposed by weight gain [4]. Obesity itself is a known risk factor for developing asthma, and patients who have asthma complicated by obesity often experience a distinct sub-phenotype characterised by increased symptoms, a poor response to conventional treatments like Inhaled Corticosteroids (ICS), and greater overall morbidity [5].

The common link between two entities exists because both conditions share fundamental pathophysiological mechanisms. The adipose tissue generates pro-inflammatory substances into the bloodstream through visceral fat which releases adipokines such as leptin and IL-6 to create a body-wide state of inflammation that harms lung structure and function [6].

Insulin Resistance (IR), a key component of MetS, also functions as an independent risk factor for asthma beyond Body Mass Index (BMI) alone. The combination of IR with hyperinsulinaemia creates a risk which leads to structural changes in airways through increased smooth muscle contraction and growth that results in Airway Hyper-Responsiveness (AHR) [7]. A research study which examined the MetS components in asthma demonstrated that abdominal obesity together with high glucose levels and hypertension acts as the main factor which links the two conditions [5].

The Middle East region which includes Iraq is experiencing demographic and epidemiological changes that are increasing the incidence of chronic non-communicable diseases [8]. A cross-sectional study in Erbil city reported that 30.6% of the general population had MetS. The adult population of Iraq shows high rates of overweight at 66.9% and obesity at 32.9% [8]. Urbanisation together with lifestyle changes, which currently impact the Middle East, has led to increasing rates of MetS and asthma among the local population. A meta-analysis of cross-sectional studies across Middle Eastern countries reported a pooled MetS prevalence of 25%, with variations from 2.2-44% in Turkey to 22-50% in the UAE [9]. A study conducted in Iraq discovered that 53% of hospitalised

patients in Erbil had the condition, which affected elderly people and those with family histories of diabetes or hypertension at higher rates [10]. The country of Iraq shows high asthma prevalence rates, which include 6.94% of people in Kirkuk [11], yet researchers have not conducted studies on the relationship between MetS and asthma in Iraq, which creates a gap in scientific knowledge. Health data from 2024 to 2025 reveal that asthma rates remain high in Iraq, with 10.5% physician-diagnosed asthma of adults affected, which demonstrates the necessity for comprehensive screening programs [12].

According to existing national and regional prevalence studies with established data on MetS in the general population, the specific burden and characteristics of MetS among asthma patients at tertiary care centers in Duhok governorate need further research. Understanding this co-morbidity profile is crucial, as the presence of MetS severely compromises asthma control and patient outcomes [1,13].

The present study aimed to determine the prevalence of MetS among patients with bronchial asthma.

MATERIALS AND METHODS

The present cross-sectional study was conducted at Azadi General Teaching Hospital in Duhok, Kurdistan Region of Iraq, between June 2023 and February 2024. Ethical approval was obtained from the Iraqi Council for Medical Specialisations (IBMS), Medical Branch (registration no. 156 C, February 2023). Written informed consent was obtained from all participants, and confidentiality was maintained in accordance with the health ethics committee guidelines.

Inclusion and Exclusion criteria: One hundred patients with bronchial asthma, aged 22-72 years, from different areas of Duhok Governorate were recruited through convenience sampling. Eligibility required a confirmed asthma diagnosis based on clinical presentation, treatment response, and/or spirometry. Patients with other chronic respiratory diseases, such as Chronic Obstructive Pulmonary Disease (COPD), were excluded. Asthma duration (4-15 years) was recorded using patient self-report via a structured questionnaire.

MetS was defined according to the ATP III criteria [14].

Sample size calculation: The sample size was calculated by the statistician using the Cochrane formula, yielding 85 participants; however, 100 patients were ultimately included to maximise recruitment within the study period.

Study Procedure

Patient information was obtained using a structured proforma. Demographic and clinical variables included gender, age, residence, smoking status, physical activity, asthma symptoms, duration, level of control, and medications (bronchodilators, inhaled/oral steroids, oral theophylline). Anthropometric measurements were recorded: weight (nearest kilogram, using a calibrated electronic scale) and height (nearest centimetre, using a Centre for Disease Control (CDC) measuring board).

Additional health data included family history of asthma, personal history of chronic diseases (diabetes mellitus, hypertension, dyslipidaemia), and current use of lipid-lowering or antihypertensive therapy.

Risk factors assessment: All participants underwent a standardised medical history and physical examination.

Blood Pressure (BP) assessment: Systolic Blood Pressure (SBP) and Diastolic Blood Pressure (DBP) were measured by trained staff using a sphygmomanometer with the cuffs appropriate to arm size. BP was recorded as the mean of two readings after participants had been seated for a minimum of five minutes. BP was classified according to ATP III criteria as hypertension as ≥130/≥85 mmHg [14].

Anthropometric measurements: Height and weight were measured to calculate BMI (BMI=kg/m^2). Cutoff values were based on both the World Health Organisation (WHO) and the National Institute Health (NIH) breakpoints:

BMI <18.5 (underweight); BMI 18.5-24.9 (normal weight); BMI 25-29.9 (overweight); and BMI ≥30 (obese) [15].

Waist Circumference (WC): The WC was measured by a non-elastic tape at the midway between the lowest rib border and the iliac crest at the end of a relaxed exhalation. Cut-off values for males >102 cm, females >88 cm were considered central obesity depending on ATP III [14].

Physical activity level: Physical activity was defined as any movement of the body that involves the use of skeletal muscle, resulting in energy expenditure beyond resting energy expenditure. Vigorous physical activity was defined as a large increase in heart rate, and shortness of breath was observed when biking, running, or swimming. Moderate physical activity was in reference to activities such as walking that were 30 minutes in duration. Sedentary behaviours were in reference to activities such as watching TV [16].

Smoking: In this study, smokers were defined as individuals who reported smoking more than 20 cigarettes daily for a cumulative duration of more than six months. Non-smokers were individuals who reported never smoking, and ex-smokers who reported quitting cigarette smoking for at least six months before the interview date.

Laboratory assessments

Participants fasted for 12-14 hours before morning blood sampling and avoided smoking or vigorous activity for ≥2 hours prior. Serum samples were analysed for lipid profile and Fast Blood Sugar (FBS). Dyslipidaemia was classified using National Cholesterol Education Program (NCEP) ATP III guidelines [15].

Asthma was diagnosed based on clinical symptoms (episodic breathlessness, chest tightness, wheeze) and evidence of reversible airway obstruction. Asthma control was classified as controlled, partly controlled, or uncontrolled according to the Global Initiative for Asthma 2023 guidelines. Asthma severity was defined by the level of treatment required to achieve control (mild, moderate, or severe), consistent with GINA 2023 recommendations [17]. MetS was diagnosed using ATP III criteria [14]. The diagnosis of asthma and T2DM were confirmed by an internist with 15 years of experience.

STATISTICAL ANALYSIS

The statistical calculations were performed using IBM Corp. (2020). IBM SPSS Statistics for Windows (Version 27.0), IBM Corp (2020). Data were summarised as mean (SD) for continuous variables and number (%) for categorical variables. Group comparisons were performed using the independent t-test and Pearson Chi-square test, with statistical significance set at $p<0.05$.

RESULTS

One hundred patients with bronchial asthma were included. Among these patients, 45 were males, and 55 were females. The mean age and asthma duration of the patients were 49 and 13.5 years, respectively. Regarding treatment, Inhaled Beta-Agonists (IBA) were reported in 96 (96%) of patients, while combinations such as IBA plus ICS and ICS plus Long-Acting Beta-Agonists (LABA) were each used in 51 (51%) of cases. Oral steroids were less common, at 18 (18%), and theophylline was reported in 40%. Interestingly, 49% of the patients were on regular treatment for asthma. In terms of disease severity and control, 51 (51%) had persistent asthma, while 38 (38%) had controlled asthma. Family history was positive in 15 (15%) of patients [Table/Fig-1].

Patients with MetS tended to be older (p=0.0004) and had a longer duration of asthma compared to those without MetS. Persistent

Variables	Number	Percentage
Age, (22-72 yrs)	Mean: 49	SD: 12.3
Gender		
Male	45	45
Female	55	55
Residence		
Urban	68	68
Rural	32	32
Duration of asthma (y)	Mean: 13.5	SD: 1.5
Medication for asthma		
IBA	96	96
IBA+ICS	51	51
ICS+LABA	51	51
Oral steroid	18	18
Theophylline	40	40
Regular treatment for asthma	49	49
Smoker	11	11
Ex-smoker	13	13
None smoker	76	76
Regular physical activity	24	24
Persistent asthma	51	51
Controlled asthma	38	38
Family history of asthma	15	15
Personal history of		
Diabetes mellitus	14	14
Hypertension	17	17
Dyslipidaemia	25	25
Obese, BMI ≥30	23	23
WC, >102cm male and >88cm female	60	60
High BP, systolic>130, diastolic >85	28	28
High FBS	20	20
High TG	43	43
Low HDL	25	25
High LDL, ≥130mg/dL	31	31
High Total cholesterol, ≥200mg/dL	30	30
MetS	27	27

[Table/Fig-1]: Characteristics of patients diagnosed with bronchial asthma.
IBAs: Inhaled-agonists; ICS: Inhaled corticosteroids; LABAs: Long-acting beta-2 agonists
MetS: Metabolic Syndrome

asthma was more common among MetS patients (p=0.009), though asthma control status did not differ between groups. Co-morbidities such as diabetes (p=0.00006) and hypertension (p=0.00001) were far more prevalent in the MetS group. These patients also showed higher BMI (p=0.03), larger WC (p<0.0001), and elevated SBP (p=0.004) compared to non-MetS individuals [Table/Fig-2].

Characteristics	Study groups		p-value
	MetS (n=27, 27%) No. (%)	Non-MetS n=73, 73%) No. (%)	
Age mean (sd)	52.7 (13.16)	48.5 (14.19)	0.1[a]
Age groups (Years)			
<40	4 (14.3)	24 (85.7)	0.31[b]
40-49	6 (31.6)	13 (68.4)	
50-59	9 (36)	16 (64)	
60 and over	8 (28.57)	20 (71.43)	
Sex			
Male	10 (22.22)	35 (77.78)	0.1[b]
female	17 (30.91)	38 (69.10)	
Residence			
Urban	18 (26.47)	50 (73.53)	0.4[b]
Rural	9 (28.13)	23 (71.87)	
Duration of asthma (y) mean (sd)	14.4 (7.82)	10.5 (2.83)	0.0004
Regular treatment			
Yes	20 (40.82)	29 (59.18)	0.0005[b]
No	7 (13.73)	44 (86.27)	
Smoker			
Yes	3 (27.27)	8 (72.73)	<0.0001[b]
no	24 (26.97)	65 (73.03)	
Smoking type			
Ex-smoker	4 (30.77)	9 (69.23)	0.1[b]
None Smoker	20 (26.32)	56 (73.68)	
Physical activity			
Yes	7(29.17)	17 (70.83)	0.3[b]
No	20 (26.32)	56 (73.68)	
Persistent asthma			
Yes	19 (37.25)	32 (62.75)	0.009[b]
No	8 (16.33)	41 (83.67)	
Controlled asthma			
Yes	8 (21.05)	30 (78.95)	0.1[b]
No	19 (30.65)	43 (69.35)	
Diabetes mellitus			
Yes	11 (78.57)	3 (21.43)	0.00006[b]
No	16 (18.60)	70 (81.40)	
Hypertension			
Yes	12 (70.59)	5 (29.41)	0.00001[b]
No	15 (18.07)	68 (81.93)	
Characteristics	**MetS (n=27, 27%) Mean (SD)**	**Non-MetS n=73, 73%) Mean (SD)**	**p-value**
BMI	29.5 (3.53)	26.9 (4.66)	0.03[a]
BMI categories no. (%)			
Normal weight	0 (0.0)	40 (100)	<0.01[b]
Overweight	7 (19)	30 (81)	
Obese	20 (87)	3 (13)	
WC	99.5 (7.30)	88 (9.96)	0.00005[a]
SBP	140.5 (26.32)	120.5 (12.84)	0.004[a]
DBP	85 (12.28)	79 (9.93)	0.09[a]
FBS	115 (33.02)	97 (19.36)	0.04[a]
TG	190 (73.91)	122 (37.25)	0.0008[a]
HDL	38 (8.76)	49 (9.02)	0.0001[a]
LDL	140 (37.65)	125 (32.63)	0.1[a]
TChol	216 (38.74)	196 (34.01)	0.08[a]

[Table/Fig-2]: Characteristics of patients with and without Metabolic Syndrome (MetS) in bronchial asthma.
SD: Standard deviation; BMI: Body mass index; WC: Waist circumference; SBP: Systolic blood pressure; DBP: Diastolic blood pressure; FBS: Fasting blood sugar; TG: Triglycerides; HDL: High-density lipoprotein, LDL: Low-density lipoprotein; TChol: Total cholesterol

Among the study participants, high WC was observed in 60% overall, with all 27 (100%) in the MetS group and 33 (45.21%) in the non-MetS group. Elevated TGs were found in 43 (43%) overall, including 23 (85.19%) with MetS and 20 (27.40%) without MetS. High BP was present in 28 (28%) overall, 21 (77.78%) in MetS and 7 (9.60%) in non-MetS. Raised FBS was noted in 20 (20%) overall, 16 (59.26%) in MetS and 4 (5.48%) in non-MetS. Low HDL was seen in 25 (25%) overall, 11 (40.47%) in MetS and 14 (19.18%) in non-MetS [Table/Fig-3].

The study showed that 24 patients (24%) met none of the criteria. The largest group, comprising 29 patients (29%), met two of the

ATP III criteria	MetS No. (%)		Total No. (%)
	MetS (n=27, 27%)	Non-MetS n=73, 73%)	
High WC	27 (100)	33 (45.21)	60 (60.0)
High TG	23 (85.19)	20 (27.40)	43 (43.0)
High BP	21 (77.78)	7 (9.60)	28 (28.0)
High FBS	16 (59.26)	4 (5.48)	20 (20.0)
Low HDL	11 (40.47)	14 (19.18)	25 (25.0)

[Table/Fig-3]: Distribution of ATP III criteria of metabolic and non-Metabolic Syndrome (MetS) in patients with bronchial asthma.
ATP III-Adult Treatment Panel III; WC: Waist circumference; FBS: Fasting blood sugar; TG: Triglycerides; HDL: High-density lipoprotein

criteria. Following this, 20 patients (20%) met one criterion, 15 patients (15%) met three criteria, seven patients (7%) met four criteria, and five patients (5%) met all five criteria [Table/Fig-4].

ATP III Criteria (n=100)	No. (%)
0	24 (24)
1	20 (20)
2	29 (29)
3	15 (15)
4	7 (7)
5	5 (5)

[Table/Fig-4]: Patients with different criteria of Metabolic Syndrome (MetS).

DISCUSSION

The primary finding of this study revealed that 27% of the asthmatic patients met the criteria for MetS. This prevalence rate aligns closely with broader meta-analysis findings, which estimate the pooled prevalence of MetS among patients with asthma to be 25% [18]. When compared regionally and locally in Iraq and the surrounding area, the 27% prevalence is consistent with the general population burden of MetS reported elsewhere in the Kurdistan region, such as the 30.6% prevalence found among apparently healthy subjects in Erbil city [8]. The study prevalence is also comparable to other international studies in patient cohorts, such as one in Turkish asthmatic patients reporting 36.7% prevalence [19], a Nigerian study which reported 17.7% in asthmatics [20]. However, other studies have reported much higher rates, such as 57.5% in asthma patients in Egypt [21]. Differences in study methodology, specific diagnostic criteria used, age distribution, and population characteristics (such as diet and physical activity) likely account for these variations in reported prevalence.

A critical finding was the dramatically worse metabolic profile observed in the MetS group. When comparing patients with MetS to those without, the MetS group exhibited significantly poorer metabolic markers across almost all metrics measured ($p<0.05$ for all relevant components). MetS assists in identifying asthma patients with notably higher cardiometabolic risk.

The current study showed that the central obesity is significantly linked to the MetS in asthmatic patients (99.5 vs. 88 cm; $p<0.001$). Central obesity (abdominal adiposity) is consistently recognised as a key risk factor connecting MetS and asthma [22]. The condition shows a stronger link to non-atopic asthma and lung function impairment than general adiposity measures. Abdominal fat existence creates mechanical restrictions which limit diaphragm and chest wall movement that results in reduced lung capacity [5].

The definition of MetS states that multiple risk factors must cluster together to produce systemic health effects which medical professionals use to diagnose this condition. Both diabetes and hypertension are commonly reported metabolic co-morbidities of chronic lung diseases, including asthma [23]. The research demonstrated that people with high BP and fasting glucose levels in excess of 100 mg/dL showed the most common metabolic health issues, which included dyslipidaemia that affected 25% of individuals with low HDL and 43% of individuals with high TG.

The current research demonstrates that asthmatic patients who experience both high BP and elevated fasting glucose levels show dyslipidaemia patterns which align with established metabolic abnormalities that exist in asthma research. People who have asthma commonly exhibit MetS features, which include low HDL cholesterol levels and increased TG levels according to multiple cross-sectional studies [21,24,25]. A study examined 320 patients with bronchial asthma, showing that more than half the patients met MetS criteria, while low HDL levels and high TG levels appeared as the most common abnormalities, which showed a connection to increased BP and fasting glucose levels, and these conditions had a strong relationship with asthma status [21]. Research showed that almost 20 percent of asthmatic patients presented with low HDL levels while a significant number of them had hypertension, which supports the finding that dyslipidaemia represents a common metabolic disorder found in asthma patient populations [24]. Beyond prevalence, more recent work shows that lipid abnormalities in asthma have clinical effects. The prospective cohort study found that dyslipidaemia, which doctors define through abnormal TG, TC, LDL and HDL levels, caused worse asthma control together with more severe asthma phenotypes because of metabolic dysregulation that affected respiratory function beyond basic risk factor coexistence [25].

The presence of MetS brought about particular clinical features which showed that patients had more severe asthma symptoms which were harder to treat. MetS patients displayed both longer asthma symptoms and increased cases of continuous asthma (14.4 vs. 10.5 years). The increased rate of continuous illness matches existing research, which shows that MetS patients experience worse asthma control, together with increased disease severity [14]. The MetS patients treated their condition through regular medication, which demonstrated that they needed continuous structured drug treatment because they found it hard to manage their disease [26].

The primary connection between MetS and asthma exists because IR and systemic inflammation work together as a common link between the two conditions [5]. The clinical presentation of IR shows itself through increased fasting glucose levels (115 vs. 97, $p=0.04$ in the current study) which act as an independent risk factor that affects both immune cell activities and systemic inflammation while increasing the likelihood of developing asthma. The metabolic disorder results in airway structural damage and functional impairment through its effects on the body. The mitochondrial energy production process gets disrupted by IR, which results in AHR through its effects on bronchial reactivity. The increased MetS components which include abdominal obesity and hyperlipidaemia, create a pro-inflammatory condition through the release of cytokines such as IL-6 and leptin [27]. Elevated TG levels establish a direct link between obesity and asthma development [4].

The asthmatic population exhibits high rates of MetS, which presents severe symptoms in this region. Therefore, the region requires complete screening and treatment procedures. The process of diagnosing and treating metabolic disorders needs to be executed because it directly impacts asthma treatment success.

Central obesity and metabolic disorders make it essential for people to adopt healthier lifestyles. The research demonstrated that dietary changes and exercise routines and weight loss efforts should be the primary focus for MetS management and asthma symptom improvement [1]. The implementation of weight reduction programs leads to better asthma control and decreased usage of asthma treatment medications [27].

Furthermore, pharmacological interventions aimed at managing the metabolic co-morbidities are gaining attention as potential novel therapeutic strategies for obese/MetS-associated asthma. Certain anti-diabetic medications, such as Metformin and GLP-1R agonists, are being investigated for their beneficial effects on decreasing asthma burden by modulating inflammation and insulin signalling pathways [13].

Facilities need to establish screening procedures which test asthma patients for MetS components because this practice will enhance their treatment results while providing better healthcare facilities for integrated metabolic and respiratory care [21,24]. Asthma patients require screening tests which assess MetS components because this process helps identify their necessary treatment methods which will enhance their asthma management results [24]. In asthmatic patients diagnosed with MetS, appropriate assessment for cardiovascular risk is essential. Emphasis should be placed on lifestyle modification, including increased physical activity, weight loss, and dietary changes; specifically, daily vigorous activities and a low glycaemic diet are recommended [1,28]. Additionally, appropriate medical control of co-morbid conditions such as hypertension, diabetes, and dyslipidaemia is strongly advised to optimise both metabolic and respiratory health [1,29].

A key strength of this study is that all diagnoses of asthma and T2DM were confirmed by an internist with 15 years of experience.

Limitation(s)

The study was conducted over a short time period, which resulted in a relatively small sample size. In addition, the cross-sectional design limits the ability to establish a causal relationship between asthma and MetS.

CONCLUSION(S)

The present study highlights that MetS is a prevalent and clinically important co-morbidity among patients with bronchial asthma in Duhok, Iraq. The findings demonstrate a strong association between MetS and more severe asthma symptoms, contributing to poorer metabolic health and reduced asthma control. The coexistence of these conditions underscores the need for comprehensive patient evaluation and integrated management. Coordinated care involving both respiratory and metabolic specialists is essential to optimise treatment strategies and improve overall patient outcomes.

REFERENCES

[1] Jishna G, Abraham E, Verma G, Mathew LT, Acharya S, Kumar S, et al. Association of asthma with patients diagnosed with metabolic syndrome: A cohort study in a tertiary care hospital. Cureus. 2023;15(10):e47558.

[2] Collaborators, GCRD. Global, regional, and national deaths, prevalence, disability-adjusted life years, and years lived with disability for chronic obstructive pulmonary disease and asthma, 1990–2015: A systematic analysis for the Global Burden of Disease Study 2015. The Lancet. Respiratory Medicine. 2017;5(9):691.

[3] Noubiap JJ, Nansseu JR, Lontchi-Yimagou E, Nkeck JR, Nyaga UF, Ngouo AT, et al. Geographic distribution of metabolic syndrome and its components in the general adult population: A meta-analysis of global data from 28 million individuals. Diabetes Research and Clinical Practice. 2022;188:109924. Doi: 10.1016/j.diabres.2022.109924.

[4] Beuther DA, Sutherland ER. Overweight, obesity, and incident asthma: A meta-analysis of prospective epidemiologic studies. American Journal of Respiratory and Critical Care Medicine. 2007;175(7):661-66.

[5] Agrawal A, Mabalirajan U, Ahmad T, Ghosh B. Emerging interface between metabolic syndrome and asthma. American Journal of Respiratory Cell and Molecular Biology. 2011;44(3):270-75.

[6] van Zelst CM, de Boer GM, Turk Y, van Huisstede A, In't Veen JC, Birnie E, et al. Association between elevated serum triglycerides and asthma in patients with obesity: An explorative study. in Allergy and asthma proceedings. 2021. OCEAN SIDE PUBLICATIONS INC.

[7] Singh S, Prakash Y, Linneberg A, Agrawal A. Insulin and the lung: Connecting asthma and metabolic syndrome. Journal of Allergy. 2013;2013(1):627384.

[8] Ismael SA, Ahmed HF, Hasan MT. Prevalence of metabolic syndrome in a sample of population in Erbil city, Iraq. Zanco Journal of Medical Sciences (Zanco J Med Sci). 2016;20(2):1280-87.

[9] Ansarimoghaddam A, Adineh HA, Zareban I, Iranpour S, HosseinZadeh A, Kh F. Prevalence of metabolic syndrome in Middle-East countries: Meta-analysis of cross-sectional studies. Diabetes & Metabolic Syndrome: Clinical Research & Reviews. 2018;12(2):195-201.

[10] Amina KFM, Azeezb SS, Dizayec KF. Estimating the prevalence of metabolic syndrome and its treatment measures taken in Erbil. Journal of Medicinal and Pharmaceutical Chemistry Research. 2025;7:183-94.

[11] Samad AA, Kanbar CB. Prevalence of bronchial asthma among patients attending tertiary allergy center/Kirkuk/Iraq. Al-Kitab Journal for Pure Sciences. 2019;3(2):120-30.

[12] Alsajri AH, Al-Qerem W, Hammad AM, Alasmari F, Eberhardt J, Mohamed Noor DA. Prevalence and risk factors of asthma among Iraq adults: A cross-sectional study. Journal of Asthma and Allergy. 2025:983-91.

[13] Bartziokas, K, Papaioannou AI, Drakopanagiotakis F, Gouveri E, Papanas N, Steiropoulos P. Unraveling the link between ınsulin resistance and bronchial asthma. Biomedicines. 2024;12(2):437.

[14] Detection, NCEPEPo and ToHBCi Adults, Third report of the National Cholesterol Education Program (NCEP) expert panel on detection, evaluation, and treatment of high blood cholesterol in adults (Adult Treatment Panel III). 2002: The Program; https://www.ahajournals.org/doi/10.1161/circ.106.25.3143.

[15] WHO. Obesity and overweight. 2026 8/3/2026]; Available from: https://www.who.int/news-room/fact-sheets/detail/obesity-and-overweight?utm_source=chatgpt.com.

[16] Bull FC, Al-Ansari SS, Biddle S, Borodulin K, Buman MP, Cardon G, et al. World Health Organization 2020 guidelines on physical activity and sedentary behaviour. British Journal of Sports Medicine. 2020;54(24):1451-62.

[17] Global Initiative for Asthma (GINA). Global Strategy for Asthma Management and Prevention, 2023 Update. Fontana, WI: GINA; 2023. Available from:https://ginasthma.org/2023-gina-main-report/.

[18] Karamzad N, Izadi N, Sanaie S, Ahmadian E, Eftekhari A, Sullman MJ, Safiri S. Asthma and metabolic syndrome: A comprehensive systematic review and meta-analysis of observational studies. Journal of Cardiovascular and Thoracic Research. 2020;12(2):120.

[19] Uzunlulu M, Oguz A, Gedik C, Aslan G, Arik S. Is prevalence of metabolic syndrome high in patients with asthma? Acta Clinica Belgica. 2011;66(1):49-52.

[20] Adeyeye, OO, Ogbera AO, Ogunleye OO, Brodie-Mens AT, Abolarinwa FF, Bamisile RT, et al. Understanding asthma and the metabolic syndrome-a Nigerian report. International Archives of Medicine. 2012;5(1):01-07.

[21] Ali AH. Prevalence and predictors of metabolic syndrome among patients with bronchial asthma: A cross sectional study. The Open Respiratory Medicine Journal. 2021;15:14.

[22] Agrawal A, Prakash Y. Obesity, metabolic syndrome, and airway disease: A bioenergetic problem? Immunology and allergy clinics of North America. 2014;34(4):785.

[23] Camargo CA, Boulet L-P, Sutherland ER, Busse WW, Yancey SW, Emmett AH, et al. Body mass index and response to asthma therapy: Fluticasone propionate/salmeterol versus montelukast. Journal of Asthma. 2010;47(1):76-82.

[24] Ghatas TS. Metabolic syndrome and asthma. Journal of Medicine in Scientific Research. 2021;4(4):8.

[25] Liu, L, Y Liu, X Zhang, YL Yuan, ZH Chen, AC-Y Hsu, et al. Dyslipidemia is associated with worse asthma clinical outcomes: A prospective cohort study. The Journal of Allergy and Clinical Immunology: In Practice. 2023;11(3):863-72. e8.

[26] Witte A, Türk Y, Braunstahl G-J. Obesity-related asthma: New insights leading to a different approach. Current Opinion in Pulmonary Medicine. 2024;30(3):294-302.

[27] de Boer, GM, Tramper-Stranders GA, Houweling L, van Zelst CM, Pouw N, Verhoeven GT, et al. Adult but not childhood onset asthma is associated with the metabolic syndrome, independent from body mass index. Respiratory Medicine. 2021;188:106603.

[28] Dixon, AE, Holguin F. Diet and metabolism in the evolution of asthma and obesity. Clinics in Chest Medicine. 2018;40(1):97.

[29] Brumpton, BM, Camargo Jr CA, Romundstad PR, Langhammer A, Chen Y, Mai X-M. Metabolic syndrome and incidence of asthma in adults: The HUNT study. European Respiratory Journal. 2013;42(6):1495-502.

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