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Original Research Article

Association between Lifestyle Factors and Metabolic Syndrome among Adults: A Cross-Sectional Study

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Abstract:

Background: Metabolic syndrome (MetS) is a cluster of metabolic abnormalities including central obesity, hypertension, dyslipidemia, and impaired glucose metabolism that significantly increase the risk of cardiovascular disease and type 2 diabetes mellitus. Lifestyle factors such as physical inactivity, unhealthy dietary habits, tobacco use, alcohol consumption, inadequate sleep, and prolonged sedentary behavior contribute substantially to the development of MetS. This study aimed to evaluate the association between lifestyle factors and metabolic syndrome among adults.

Methods: A hospital-based cross-sectional study was conducted among 200 adults aged 18 years and above. Data regarding socio-demographic characteristics, dietary habits, physical activity, smoking, alcohol intake, sleep duration, and sedentary behavior were collected using a structured questionnaire. Anthropometric measurements, blood pressure, fasting blood glucose, triglycerides, and HDL cholesterol were recorded. Metabolic syndrome was diagnosed according to the modified National Cholesterol Education Program Adult Treatment Panel III (NCEP ATP III) criteria. Statistical analysis included Chi-square test, independent t-test, and multivariable logistic regression.

Results: Of the 200 participants, 64 (32.0%) were diagnosed with metabolic syndrome. Physical inactivity, frequent fast-food consumption, smoking, inadequate sleep (<7 hours/day), and prolonged sedentary behavior (>8 hours/day) were significantly associated with metabolic syndrome ($p<0.05$). Logistic regression identified physical inactivity, obesity, and unhealthy dietary habits as independent predictors of metabolic syndrome.

Conclusion: Lifestyle factors play a significant role in the development of metabolic syndrome. Promotion of healthy dietary practices, regular physical activity, adequate sleep, and smoking cessation may substantially reduce the burden of metabolic syndrome among adults.

Keywords: Metabolic Syndrome, Lifestyle Factors, Physical Activity, Obesity, Diet, Adults.

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Introduction

Metabolic syndrome (MetS) is a constellation of interrelated metabolic abnormalities characterized by central obesity, elevated blood pressure, hyperglycemia, hypertriglyceridemia, and reduced high-density lipoprotein cholesterol (HDL-C). These abnormalities markedly increase the risk of cardiovascular disease, type 2 diabetes mellitus, chronic kidney disease, and premature mortality [1,2]. Owing to rapid urbanization, changing dietary patterns, sedentary lifestyles, and increasing obesity, metabolic syndrome has emerged as a major public health challenge worldwide [3].

Globally, nearly one-fourth of the adult population is estimated to have metabolic syndrome, with prevalence varying from 20% to 40% depending on the diagnostic criteria and population studied [4]. In India, the prevalence ranges from 20% to 35%, with higher rates observed among urban populations because of westernized dietary habits, reduced physical activity, occupational stress, and increasing obesity [5,6].

Lifestyle behaviors are among the most important modifiable determinants of metabolic syndrome. Regular physical activity improves insulin sensitivity, reduces visceral adiposity, lowers blood pressure, and favorably modifies lipid profiles [7]. Conversely, sedentary behavior and prolonged screen time have been associated with increased adiposity and metabolic dysfunction [8].

Dietary habits significantly influence metabolic health. Diets rich in fruits, vegetables, whole grains, legumes, and unsaturated fats reduce the risk of metabolic syndrome, whereas frequent consumption of processed foods, sugar-sweetened beverages, refined carbohydrates, and saturated fats increases cardiometabolic risk [9,10]. Smoking contributes to insulin resistance and endothelial dysfunction, while excessive alcohol intake promotes dyslipidemia and abdominal obesity [11].

Sleep duration and quality have recently emerged as important determinants of metabolic syndrome. Both short and prolonged sleep duration have been associated with obesity, insulin resistance, hypertension, and chronic low-grade inflammation [12]. Psychological stress and inadequate sleep further aggravate hormonal disturbances, increasing cortisol levels and promoting central fat accumulation [13].

Several epidemiological studies have demonstrated significant associations between unhealthy lifestyle behaviors and metabolic syndrome [14–17]. However, regional variations in dietary habits, socioeconomic conditions, and lifestyle practices necessitate population-specific evidence. Understanding these associations is essential for designing effective preventive strategies and community-based interventions.

The present study was therefore undertaken to evaluate the association between various lifestyle factors and metabolic syndrome among adults attending a tertiary care hospital.

Objectives

Primary Objective: To determine the association between lifestyle factors and metabolic syndrome among adults.

Secondary Objectives

- To estimate the prevalence of metabolic syndrome.
- To assess dietary habits, physical activity, smoking, alcohol consumption, sleep duration, and sedentary behavior among adults.
- To identify independent predictors of metabolic syndrome.

Materials and Methods

Study Design: Hospital-based cross-sectional study.

Study Setting: Department of Community Medicine in collaboration with the Department of Biochemistry and General Medciine of a tertiary care teaching hospital.

Study Duration: Six months.

Study Population: Adults aged ≥18 years attending the outpatient department.

Sample Size: 200 participants selected using convenient sampling.

Inclusion Criteria:

- Adults aged 18 years and above.
- Individuals willing to participate.
- Participants providing written informed consent.

Exclusion Criteria

- Pregnant women.
- Patients with malignancy.
- Individuals with severe chronic illness.
- Patients receiving corticosteroid therapy.

Data Collection: Information regarding age, gender, education, occupation, smoking, alcohol intake, dietary habits, sleep duration, physical activity, and sedentary behavior was collected using a pretested structured questionnaire.

Anthropometric measurements included height, weight, body mass index (BMI), waist circumference, and blood pressure. Venous blood samples were collected after overnight fasting for estimation of fasting blood glucose, triglycerides, and HDL cholesterol using standard enzymatic methods.

Metabolic syndrome was diagnosed according to the modified NCEP ATP III criteria. Participants with three or more of the following components were classified as having metabolic syndrome:

- Waist circumference ≥90 cm (men), ≥80 cm (women)
- Blood pressure ≥130/85 mmHg
- Fasting blood glucose ≥100 mg/dL
- Triglycerides ≥150 mg/dL
- HDL cholesterol <40 mg/dL (men), <50 mg/dL (women)

Statistical Analysis: Data were analyzed using SPSS version 26. Continuous variables were expressed as mean ± standard deviation, while categorical variables were presented as frequencies and percentages. Independent t-test and Chi-square test were used for comparison between groups. Multivariable logistic regression analysis was performed to identify independent predictors of metabolic syndrome. A p-value <0.05 was considered statistically significant.

Results

Among the 200 study participants, the mean age was 43.8 ± 12.4 years. Males constituted 54% of the study population. The overall prevalence of metabolic syndrome was 32%. Individuals with metabolic syndrome had significantly higher BMI, waist circumference, fasting blood glucose, triglycerides, and blood pressure compared with participants without metabolic syndrome (p<0.001). Physical inactivity, unhealthy dietary habits, smoking, inadequate sleep, and prolonged sedentary behavior were significantly associated with metabolic syndrome.

Table 1: Baseline Characteristics of Participants (n=200)

Variable	Value
Mean age (years)	43.8 ± 12.4
Male	108 (54%)
Female	92 (46%)
Married	156 (78%)
Urban residence	128 (64%)
Mean BMI (kg/m²)	27.1 ± 4.2

Table 2: Lifestyle Characteristics

Variable	n (%)
Physically inactive	88 (44)
Regular exercise	112 (56)
Smokers	46 (23)
Alcohol users	38 (19)
Fast-food ≥3/week	82 (41)
Sleep <7 h/day	74 (37)
Sedentary time >8 h/day	68 (34)

Table 3: Prevalence of Metabolic Syndrome

Variable	n (%)
Metabolic syndrome	64 (32)
No metabolic syndrome	136 (68)

Table 4: Association Between Lifestyle Factors and Metabolic Syndrome

Lifestyle Factor	MetS Present (n=64)	MetS Absent (n=136)	χ^2	p-value
Physical inactivity	42 (65.6%)	46 (33.8%)	17.52	<0.001
Regular exercise	22 (34.4%)	90 (66.2%)		
Fast-food intake ≥3/week	36 (56.3%)	46 (33.8%)	9.21	0.002
Smoking	24 (37.5%)	22 (16.2%)	11.18	0.001
Alcohol consumption	18 (28.1%)	20 (14.7%)	5.14	0.023
Sleep <7 hours/day	32 (50.0%)	42 (30.9%)	6.72	0.010
Sedentary time >8 hours/day	30 (46.9%)	38 (27.9%)	6.88	0.009

Table 5: Clinical and Biochemical Parameters According to Metabolic Syndrome Status

Parameter	MetS Present (n=64)	MetS Absent (n=136)	p-value
BMI (kg/m²)	30.1 ± 3.8	25.6 ± 3.2	<0.001
Waist circumference (cm)	97.6 ± 8.1	84.8 ± 7.3	<0.001
Systolic BP (mmHg)	142 ± 14	122 ± 11	<0.001
Diastolic BP (mmHg)	90 ± 9	78 ± 8	<0.001
Fasting blood glucose (mg/dL)	118.4 ± 20.3	91.8 ± 11.5	<0.001
Triglycerides (mg/dL)	186.3 ± 44.8	132.5 ± 29.4	<0.001
HDL cholesterol (mg/dL)	39.6 ± 6.2	48.9 ± 7.1	<0.001

Table 6: Multivariable Logistic Regression Analysis for Predictors of Metabolic Syndrome

Variable	Adjusted Odds Ratio (AOR)	95% CI	p-value
Physical inactivity	2.84	1.48–5.46	0.002
BMI ≥25 kg/m²	3.42	1.78–6.56	<0.001
Fast-food intake	2.13	1.12–4.04	0.021
Smoking	1.94	1.01–3.76	0.046
Sleep <7 hours/day	1.82	1.01–3.29	0.047
Sedentary behavior	2.08	1.11–3.90	0.023

Discussion

The present study demonstrated a 32% prevalence of metabolic syndrome, which is comparable with previous Indian studies reporting a prevalence ranging from 25% to 35% among adults. The increasing prevalence reflects the growing burden of obesity, unhealthy dietary habits, and sedentary lifestyles associated with rapid urbanization [18–20].

Physical inactivity emerged as one of the strongest predictors of metabolic syndrome. Participants who did not engage in regular physical activity had nearly three times higher odds of developing metabolic syndrome than physically active individuals.

Regular exercise enhances insulin sensitivity, promotes weight reduction, improves lipid metabolism, and reduces systemic inflammation, thereby lowering cardiometabolic risk [21,22].

Unhealthy dietary habits, particularly frequent consumption of fast foods and processed foods, were significantly associated with metabolic syndrome. Diets rich in refined carbohydrates, saturated fats, and added sugars promote obesity, dyslipidemia, and insulin resistance. Conversely, diets abundant in fruits, vegetables, whole grains, and unsaturated fats have been shown to reduce the risk of metabolic syndrome [23,24].

Smoking and alcohol consumption were also significantly associated with metabolic syndrome. Smoking induces oxidative stress, endothelial dysfunction, chronic inflammation, and insulin resistance, whereas excessive alcohol intake contributes to abdominal obesity, hypertension, and dyslipidemia [25,26].

Sleep duration of less than seven hours per day showed a significant association with metabolic syndrome. Inadequate sleep alters glucose metabolism, increases cortisol secretion, disrupts appetite-regulating hormones, and promotes weight gain. Similar findings have been reported in several epidemiological studies [27,28].

Sedentary behavior was another important determinant identified in the present study. Individuals with prolonged sitting time exhibited significantly higher odds of metabolic syndrome, independent of physical activity. Prolonged sedentary time adversely affects glucose utilization, lipid metabolism, and energy expenditure [29].

Obesity, particularly central obesity, remained the strongest independent predictor of metabolic syndrome. Increased visceral adiposity contributes to chronic low-grade inflammation, insulin resistance, and abnormal adipokine secretion, which play pivotal roles in the pathogenesis of metabolic syndrome [30,31, 32, 33].

The findings emphasize that metabolic syndrome is largely preventable through lifestyle modification. Community-based interventions promoting healthy dietary practices, regular exercise, smoking cessation, reduced sedentary behavior, and adequate sleep may substantially reduce the burden of metabolic syndrome.

Conclusion

The prevalence of metabolic syndrome among adults in the present study was high (32%). Physical inactivity, unhealthy dietary habits, smoking, alcohol consumption, inadequate sleep, prolonged sedentary behavior, and obesity were significantly associated with metabolic syndrome. Lifestyle modification remains the cornerstone for the prevention and management of metabolic syndrome. Early identification of high-risk individuals and implementation of comprehensive lifestyle intervention programs are recommended to reduce future cardiovascular and metabolic complications.

Strengths of the Study

- Comprehensive assessment of multiple lifestyle factors.
- Standard diagnostic criteria for metabolic syndrome.
- Inclusion of anthropometric, clinical, and biochemical parameters.
- Identification of independent predictors using multivariable analysis.

Limitations

- Cross-sectional design precludes causal inference.
- Single-center study with limited generalizability.
- Lifestyle information was self-reported, introducing potential recall bias.

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Conflict of Interest

The authors declare no conflict of interest.

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