DEVELOPMENTAL MEDICO-LIFE-SCIENCES

ISSN (P): 3007-2786, (E): 3007-2794 DOI: https://doi.org/10.69750/dmls.03.04.0187

ORIGINAL RESEARCH ARTICLE Open Access

Association of Inflammatory and Metabolic Biomarkers with Lifestyle-Related Diseases in Community Population

Amina Tassadaq[1], Arooj Tassadaq[1], Wajih Malik[2], Nazish Jamil[2]

1 Department of Medicine, Punjab Medical College, Faisalabad, Punjab, Pakistan
2 Department of Physiology, Sharif Medical and Dental College, Lahore, Punjab, Pakistan
3 Associate Professor, Sharif Medical and Dental College, Lahore, Punjab, Pakistan

Corresponding Author: Amina Tassadaq, **Email:** aminatassadaq236@gmail.com

ABSTRACT

Background: Chronic inflammation and metabolic dysfunction are closely linked to lifestyle-related diseases such as obesity, hypertension, diabetes mellitus, dyslipidemia, and metabolic syndrome, which are rapidly rising all over the world. Inflammatory and metabolic markers can be useful to identify early those who are at greater cardiometabolic risk.

Objective: To assess the relationship between inflammatory and metabolic biomarkers and lifestyle-related diseases in the community.

Methods: This cross-sectional community-based study was conducted from March 2023 to September 2025 at the Department of Medicine, Punjab Medical College, Faisalabad, Pakistan, and Sharif Medical and Dental College, Lahore, Pakistan. A total of 200 participants aged 20–70 years were enrolled using non-probability consecutive sampling. Structured questionnaires were used to collect anthropometric measurements and lifestyle-related data. The blood samples were used to determine high-sensitivity C-reactive protein (hs-CRP), fasting blood glucose, glycated hemoglobin (HbA1c), lipid profile, and serum uric acid.

Results: Among 200 participants, 112 (56.0%) were females, and 88 (44.0%) were males. Obesity was observed in 39.5%, hypertension in 36.5%, diabetes mellitus in 30.5%, dyslipidemia in 46.0%, and metabolic syndrome in 34.0% of participants. Mean hs-CRP levels were significantly higher among diseased participants (6.1 ± 1.7 mg/L) compared to healthy individuals (2.2 ± 0.8 mg/L; $p<0.001$). In addition, the HbA1c, triglycerides, LDL-C, fasting blood glucose, and serum uric acid levels were also significantly increased among individuals with lifestyle-related diseases. A high level of hs-CRP was most strongly and independently associated with metabolic syndrome.

Conclusion: There is a strong correlation between inflammatory and metabolic markers and lifestyle-related diseases, and they can be useful markers for early recognition of cardiometabolic diseases.

Keywords: Inflammatory biomarkers, Metabolic syndrome, hs-CRP, Lifestyle diseases, Dyslipidemia, Cardiometabolic risk

Received: 25/12/2025
Revised: 05/04/2026
Accepted: 26/04/2026
Published: 30/04/2026

INTRODUCTION

Lifestyle-related disorders have emerged as a serious public health concern across the globe, accounting for a significant amount of morbidity, disability, and premature death [1]. Rapid urbanization, along with bad lifestyle choices, physical inactivity, obesity, smoking, psychological stress, and sedentary behavior, has contributed considerably to the increased incidence of metabolic and cardiovascular illnesses in both developed and developing nations. Obesity, hypertension, type 2 diabetes mellitus, dyslipidemia, and metabolic syndrome are all widespread in community populations and place a significant burden on healthcare systems. These illnesses are strongly associated with cardiovascular disease, renal

failure, cerebrovascular abnormalities, and a worse quality of life [2].

Chronic low-grade systemic inflammation is a well-known essential pathophysiologic process in lifestyle-related diseases [3]. When there is an excess of adipose tissue, especially visceral fat deposits, acute phase reactants such as C-reactive protein and inflammatory cytokines such as interleukin-6 and tumor necrosis factor alpha are released more often. Chronic inflammatory activation promotes oxidative stress, insulin resistance, impaired glucose metabolism, endothelial dysfunction, and the progression of atherosclerosis. Inflammation, therefore, serves as a critical molecular link between unhealthy lifestyles and metabolic dysfunctions [4].

Furthermore, metabolic markers have a significant influence on the development and progression of cardiometabolic diseases [5]. Serum uric acid, triglycerides, LDL-C, HDL-C, fasting blood glucose, and glycated hemoglobin (HbA1c) are all biomarkers for metabolic health and cardiovascular risk. Obesity is strongly associated with hyperglycemia, dyslipidemia, hypertriglyceridemia, diabetes, hypertension, and metabolic syndrome. Insulin resistance, vascular inflammation, and cardiovascular disease have all been associated with hyperuricemia and dyslipidemia [6].

High sensitivity CRP (hs-CRP) is a well-studied inflammatory measure that may predict systemic inflammation and cardiovascular risk [7]. High hs-CRP levels have been associated with obesity, diabetes, hypertension, metabolic syndrome, and eventual cardiovascular events. The link between inflammatory and metabolic indicators may therefore be a valuable tool for understanding illness onset and development in seemingly healthy community groups [8].

Pakistan is a developing nation that is also experiencing significant epidemiological transitions, with noncommunicable illnesses becoming more widespread as a result of lifestyle changes, decreased physical activity, and nutritional alterations [9]. Although lifestyle-related disorders are becoming more prevalent, there is limited evidence, mostly from hospital settings, that comprehensively investigates the relationship between inflammatory and metabolic indicators in the general population [10]. Biomarker testing might be effective in identifying high-risk patients early on, improving preventive health care measures, and lowering long-term effects from cardiometabolic disorders [11]. As a result, the current study sought to evaluate the link between inflammatory and metabolic markers and lifestyle-related disorders in a community setting, as well as to determine if these indicators may be utilized to identify people at increased cardiometabolic risk.

MATERIALS AND METHODS

This cross-sectional community-based analytical study was carried out between March 2023 and September 2025 at the Department of Medicine, Punjab Medical College, Faisalabad, Pakistan, and Sharif Medical and Dental College, Lahore, Pakistan. The study aimed to assess the relationship between metabolic and inflammatory markers and lifestyle-related illnesses in the adult population at the community level. The WHO sample size estimation approach, which included a 5% margin of error, a 95% confidence interval, and the anticipated incidence of lifestyle-related metabolic disorders in the general population, yielded a total sample size of 200 individuals.

A non-probability sequential selection method was used to pick participants from community screening camps, outpatient medical camps, and preventive health awareness campaigns in urban and semi-urban settings and establishments. Adults between the ages of 20 and 70 were the target population. All participants, male and female, voluntarily consented to take part in the research. To prevent influencing inflammatory biomarker concentrations, people with a history of autoimmune diseases, chronic inflammatory diseases, active infections, cancer, chronic kidney disease, chronic liver disease, thyroid diseases, pregnancy, recent surgery, use of steroids, immunosuppressive medications, or anti-inflammatory drugs were excluded. Before the study began, the Institutional Ethical Review Committees of both institutions granted ethical permission (Ref No: ERC/PMC-SMDC/2023-117).

Each participant gave informed permission after being fully told about the objectives, methods, confidentiality, and voluntary nature of participation. Anonymity and confidentiality were guaranteed for the duration of the study. A pre-validated, standardized questionnaire was used to gather the data.

Age, gender, marital status, employment, smoking, diet, physical activity, sleep patterns, alcohol use, and a family history of cardiovascular disease, diabetes mellitus, obesity, dyslipidemia, and hypertension were among the comprehensive sociodemographic and clinical data. Other lifestyle characteristics that were examined were smoking, fast food consumption, exercise frequency, and sitting time.

An anthropometric assessment is performed by qualified medical professionals using conventional clinical methods. A calibrated digital scale was used to assess the participants' body weight while they were wearing light clothing and no shoes. A stadiometer fixed on the wall was used to measure height. The following formula was used to get the Body Mass Index (BMI):

$$\textbf{BMI} = \textbf{Weight (kg)} \div \textbf{[Height (m)]}^{2}$$

Waist and hip circumferences were measured using a non-stretchable measuring tape, as recommended by the WHO. After 10 minutes of sitting, blood pressure was taken using a standard mercury sphygmomanometer. Two measurements at five-minute intervals yielded an average measurement for analysis. Before a blood sample was taken, participants were told to fast for ten to twelve hours.

A 5 mL aseptic venous blood sample was drawn by skilled lab staff. For biochemical analysis, every blood sample was forwarded to the lab. High-sensitivity C-reactive protein (hs-CRP), fasting blood glucose (FBG), glycated hemoglobin (HbA1c), total cholesterol, triglycerides, high-density lipoprotein cholesterol (HDL-C), low-density lipoprotein cholesterol (LDL-C), very low-density lipoprotein cholesterol (VLDL-C), and serum uric acid levels. While the immunoturbidimetric test method was used to measure blood hs-CRP levels, automated chemistry analyzers and commercially available reagent kits were used to quantify the fasting glucose and lipid profiles. Both high-performance liquid chromatography (HPLC) and conventional laboratory quality control methods were used to measure HbA1c levels.

Widely accepted clinical criteria were used to identify lifestyle-related diseases. A BMI of ≥30 kg/m2 is considered obese. Systolic blood pressure (SBP) > 140 mmHg and/or diastolic blood pressure (DBP) ≥ 90 mmHg, together with the use of antihypertensive medications, were considered indicators of hypertension. When the HbA1c level is ≥6.5% or the fasting glucose level is ≥126 mg/dL, diabetes mellitus is diagnosed. The Adult Treatment Panel III criteria were followed in order to diagnose dyslipidemia based on the abnormal lipid levels in the blood.

etabolic syndrome is defined by the International Diabetes Federation (IDF). SPSS 26.0 was used to analyze the data. While biomarker concentrations and anthropometric measures were stated as mean ± standard deviation, percentages or frequencies were used to represent categorical data. One-way ANOVA and the independent sample t-test were used to examine continuous variables between illness groups. The chi-square test was used for categorical data. The associations between metabolic parameters and inflammatory indicators were also examined using Pearson correlation analysis. Multivariate logistic regression analysis was used to determine the independent characteristics linked to metabolic syndrome and lifestyle-related illnesses after adjusting for confounding variables. Throughout the investigation, P-values below 0.05 were considered statistically significant.

RESULTS

The current study included a total of 200 individuals. The study population ranged from 21 to 69 years, with an average age of 45.8 ± 12.4 years. Of the participants, 112 (56.0%) were female, and 88 (44.0%) were male. Many of the study participants had harmful lifestyle behaviors, such as sitting excessively, smoking, and eating too much fast food. Obesity was detected in 79 (39.5%) patients, hypertension in 73 (36.5%), diabetes mellitus in 61 (30.5%), dyslipidemia in 92 (46.0%), and metabolic syndrome in 68 (34.0%). The high incidence of physical inactivity in the study group reflects a substantial burden of modifiable lifestyle-related risk factors in the general population. Table 1 provides a detailed summary of the individuals' demographic and clinical features.

Biomarker profiles of the subjects with lifestyle-related diseases were significantly abnormal when compared with those of healthy persons. Diseased participants had significantly higher mean hs-CRP levels (6.1 ± 1.7 mg/L) than healthy controls (2.2 ± 0.8 mg/L) ($p<0.001$), showing that there was a significant association between systemic inflammation and mean hs-CRP levels. Participants with diabetes mellitus and metabolic syndrome had significantly elevated fasting glucose and HbA1C levels, reflecting poor glycemic control and metabolic abnormalities. Likewise, the levels of total cholesterol, triglycerides, LDL-C, and serum uric acid were significantly higher in individuals with obesity, hypertension, dyslipidemia, and metabolic syndrome. However, in the diseased group, the HDL-C concentration was significantly decreased compared to that of the healthy individuals. These results show that inflammatory activation is closely related to metabolic abnormalities in lifestyle-related diseases. The inflammatory and metabolic markers in healthy and diseased participants are compared in detail in Table 2.

Additional subgroup analysis showed that there was a strong correlation between lifestyle-related diseases and high levels of hs-CRP. The mean values of the hs-CRP were highest in the metabolic syndrome group (6.1 ± 1.7 mg/L), followed by the diabetes mellitus group (5.9 ± 1.6 mg/L), the obesity group (5.8 ± 1.5 mg/L), the dyslipidemia group (5.6 ± 1.4 mg/L), and the hypertension group (5.4 ± 1.3 mg/L). The healthy participants had significantly lower values of hs-CRP (2.2 ± 0.8 mg/L). These findings suggest a progressive increase in systemic inflammation as metabolic abnormalities and the burden of cardiometabolic disease worsen. Table 3 represents the detailed association of the hs-CRP level with lifestyle-related diseases.

Lifestyle behavior analysis also showed a significant difference between levels of hs-CRP, triglycerides, fasting blood glucose, and LDL-C in physically inactive participants as compared to physically active participants. The smokers exhibited higher inflammatory markers and worse lipid profiles, and those who ate fast food three or more times a week had significantly abnormal metabolic parameters. The results of these studies contribute to the evidence of the importance of unhealthy lifestyle behaviors in the community population for the development of chronic inflammation and metabolic dysfunction.

Multivariate logistic regression analysis was used to examine the independent predictors after controlling for any confounding factors such as age, gender, and smoking status. Metabolic syndrome (OR=5.2, $p<0.001$), high triglycerides (OR=4.1, $p=0.001$), raised HbA1c (OR=3.8, $p=0.003$), obesity (OR=3.5, $p=0.005$), and physical inactivity (OR=2.9, $p=0.011$) were all observed to be

independently correlated with elevated hs-CRP. Furthermore, smoking was found to be a statistically significant independent risk factor for metabolic syndrome. Table 4 provides a detailed presentation of the findings of multivariate regression.

The current study's findings demonstrated a strong correlation between metabolic and inflammatory indicators and lifestyle-related illnesses in the general population. High inflammatory indicators, especially high-sensitivity C-reactive protein, and metabolic markers were substantially associated with obesity, hypertension, diabetes mellitus, dyslipidemia, and metabolic syndrome. This implies that early cardiometabolic risk might be predicted and prevented in clinical practice using these indicators.

Table 1: Demographic and Clinical Characteristics of Participants (n=200)

Variable	Frequency (%)
Male	88 (44.0%)
Female	112 (56.0%)
Mean Age (Years)	45.8 ± 12.4
Smokers	52 (26.0%)
Physically Inactive	118 (59.0%)
Fast-Food Consumption (>3 times/week)	94 (47.0%)
Obesity	79 (39.5%)
Hypertension	73 (36.5%)
Diabetes Mellitus	61 (30.5%)
Dyslipidemia	92 (46.0%)
Metabolic Syndrome	68 (34.0%)

Table 2: Comparison of Inflammatory and Metabolic Biomarkers Between Healthy and Diseased Participants

Biomarker	Healthy Individuals (n=72)	Lifestyle Disease Group (n=128)	p-value
hs-CRP (mg/L)	2.2 ± 0.8	6.1 ± 1.7	<0.001
Fasting Blood Glucose (mg/dL)	92 ± 11	154 ± 36	<0.001
HbA1c (%)	5.1 ± 0.4	7.5 ± 1.2	<0.001
Total Cholesterol (mg/dL)	171 ± 24	238 ± 39	<0.001
Triglycerides (mg/dL)	128 ± 31	228 ± 47	<0.001
LDL-C (mg/dL)	97 ± 19	151 ± 33	<0.001
HDL-C (mg/dL)	52 ± 8	37 ± 7	<0.001
Serum Uric Acid (mg/dL)	4.9 ± 1.0	7.3 ± 1.5	<0.001

Table 3: Association of hs-CRP Levels with Lifestyle-Related Diseases

Disease Condition	Mean hs-CRP (mg/L)	p-value
Obesity	5.8 ± 1.5	<0.001
Hypertension	5.4 ± 1.3	<0.001
Diabetes Mellitus	5.9 ± 1.6	<0.001
Dyslipidemia	5.6 ± 1.4	<0.001
Metabolic Syndrome	6.1 ± 1.7	<0.001
Healthy Participants	2.2 ± 0.8	—

Table 4: Multivariate Logistic Regression Analysis for Metabolic Syndrome Predictors

Variable	Odds Ratio (OR)	95% Confidence Interval	p-value
Elevated hs-CRP	5.2	2.6 – 9.4	<0.001
Elevated Triglycerides	4.1	1.9 – 7.8	0.001
Elevated HbA1c	3.8	1.7 – 6.9	0.003
Obesity	3.5	1.6 – 6.4	0.005
Physical Inactivity	2.9	1.4 – 5.2	0.011
Smoking	2.2	1.1 – 4.1	0.029

DISCUSSION

The present study reported that metabolic and inflammatory markers are closely related with the lifestyle-related disorders in the general population [5]. High hs-CRP, Fasting blood glucose, HbA1c, Triglycerides, LDL-C, and serum uric acid levels were all significantly associated with obesity, hypertension, diabetes mellitus, and dyslipidemia, and metabolic syndrome. These studies show that chronic inflammation and metabolic problems have a major role in the etiology and development of cardiometabolic diseases in the general population [6,7].

Urbanization, sedentary lives, bad eating habits, smoking, obesity, and inactivity are the main causes of lifestyle-related diseases, which are on the increase worldwide [8]. It is now known that chronic, low-grade inflammation is a key contributor to insulin resistance, endothelial dysfunction, oxidative stress and atherosclerosis. Adipose tissue (AT), particularly visceral AT, is an active endocrine tissue secreting inflammatory

cytokines like Tnf-a and Il-6 that promote the synthesis of C-reactive-protein (CRP) in liver and alter the metabolism. The association between inflammation and the progression of cardiometabolic diseases is supported by the considerably higher levels of hs-CRP in those with metabolic syndrome and obesity in the present study [9].

Further, it showed that the concentration of fasting blood glucose and HbA1c (HbHbA1c) were significantly higher in diabetics with metabolic syndrome [10]. Cardiovascular effects are associated with chronic hyperglycemia which leads to oxidative stress, vascular damage, inflammatory changes, and vascular dysfunction [11]. The results are consistent with previous studies reporting a strong association between the presence of metabolic syndrome, obesity and cardiovascular morbidity and high HbA1c and glucose levels. Additionally, glycemic control is poor, leading to the exacerbation of chronic inflammatory state and lipid abnormalities and thereby deteriorating the cardiometabolic status [12]. Dyslipidaemia occurred in a high percentage of the group studied and was associated with high TGs, high LDL-C and low HDL-C [13]. There were significant associations with most of these lipid abnormalities and inflammatory markers, especially the hs-CRP. Hypertriglyceridemia and high LDL-C lead to oxidative alteration and inflammatory activation of vascular tissues and thereby to endothelial dysfunction and atherogenesis. Lower levels of HDL-C further inhibit reverse cholesterol transport and anti-inflammatory protection. The results of the present study support the previous studies that have demonstrated a strong association between metabolic and inflammatory pathways in lifestyle diseases [14].

Additionally, the study found that the blood uric acid levels of sick individuals were much higher [15]. It is widely recognized that hyperuricemia is a significant metabolic indicator of insulin resistance, obesity, hypertension, metabolic syndrome, and cardiovascular disease [16]. Elevated uric acid promotes the development of cardiometabolic disorders by increasing oxidative stress, endothelial dysfunction, and inflammatory activation. The potential utility of blood uric acid as an early metabolic risk factor in lifestyle-related disorders was further supported by the results of this investigation [1,2].

According to a lifestyle behavior study, smokers and physically inactive individuals had much higher levels of metabolic and inflammatory biomarkers than healthy individuals and physically active individuals [5,7]. Smoking is linked to oxidative stress and endothelial damage, whereas sedentary lifestyles are linked to obesity, insulin resistance, dyslipidemia, and chronic inflammation. Additionally, it was shown that consuming fast food often was associated with a bad metabolic profile, which highlights the substantial impact of unhealthy eating habits on cardiometabolic health. In other words, these results emphasize how lifestyle modification techniques, including regular exercise, a balanced diet, quitting smoking, and managing weight, may lower the burden of non-communicable illnesses [17].

The most significant independent risk factor for metabolic syndrome in multivariate logistic regression analysis was an increase in hs-CRP, which was followed by increases in triglycerides, HbA1c, obesity, and physical inactivity [18]. This finding has therapeutic ramifications for inflammatory indicators that identify high-risk individuals before late-stage problems arise. Thus, biomarker-based screening programs in community settings might aid in early diagnosis, risk stratification, and the development of preventive intervention methods to lessen long-term cardiovascular and metabolic effects [19].

Even if the outcomes are impressive, there are a few disadvantages to be aware of. Conclusions on the causal links between inflammatory biomarkers and lifestyle-related disorders are not possible due to the cross-sectional study methodology [20]. There may be some non-genericity in the population as a whole since the study was conducted in specific community populations in collaboration with two institutions. Additionally, self-reported questionnaires that may have memory bias were used to quantify food intakes and physical activity. Larger multicenter longitudinal investigations are advised to confirm these results and evaluate long-term inflammatory and metabolic outcome-related clinical outcomes [16].

CONCLUSION

The present study showed strong associations of inflammatory and metabolic biomarkers with lifestyle-related diseases in the community population. hs-CRP, fasting blood glucose, HbA1c, triglycerides, LDL-C, and serum uric acid levels were significantly associated with obesity, hypertension, DM, dyslipidemia, and metabolic syndrome. In the development and progression of cardiometabolic disorders, chronic inflammation and metabolic dysregulation seem to be central. Of the biomarkers studied, hs-CRP was the best independent predictor of metabolic syndrome, suggesting that it could be used clinically for the early detection of high-risk individuals. Adverse inflammatory and metabolic profiles were significantly associated with unhealthy lifestyle behaviors such as physical inactivity, smoking, and poor dietary habits. Community-based biomarker screening programs, along with lifestyle modification strategies, could be effective in reducing the mounting burden of non-communicable diseases and long-term cardiovascular and metabolic health outcomes. The need for early prevention and intervention for lifestyle-related diseases is still important to minimize morbidity and mortality.

Conflict of Interest: The authors declare no conflict of interest.

Funding: No external funding was received for this study.

Authors' Contributions: A.T. conceived and designed the study and prepared the initial manuscript. A.T. and W.M. contributed to participant recruitment, data collection,

biochemical assessment, and statistical analysis. N.J. contributed to interpretation of the findings, critical manuscript revision, and supervision. All authors reviewed and approved the final manuscript.

Acknowledgments: The authors sincerely acknowledge all study participants and the staff involved in community screening, specimen collection, laboratory investigations, and data management.

Data Availability: The datasets generated and analysed during the current study are available from the corresponding author upon reasonable request.

REFERENCES

1. Ferreira LDNM, Fisberg RM, Sarti FM, Rogero MM. Association between inflammatory and metabolic biomarkers and common mental disorders among adults: 2015 Health Survey of São Paulo, SP, Brazil. *Metabolites*. 2024;14(10):535. doi:10.3390/metabo14100535.
2. Kuring JK, Mathias JL, Ward L, Tachas G. Inflammatory markers in persons with clinically significant depression, anxiety or PTSD: a systematic review and meta-analysis. *J Psychiatr Res*. 2023;168:279-292. doi:10.1016/j.jpsychires.2023.10.009.
3. Thylur DS, Goldsmith DR. Brick by brick: building a transdiagnostic understanding of inflammation in psychiatry. *Harv Rev Psychiatry*. 2022;30:40-53. doi:10.1097/HRP.0000000000000326.
4. Bauer ME, Teixeira AL. Inflammation in psychiatric disorders: what comes first? *Ann N Y Acad Sci*. 2019;1437:57-67. doi:10.1111/nyas.13712.
5. Angiulli F, Conti E, Zoia CP, Da Re F, Appollonio I, Ferrarese C, et al. Blood-based biomarkers of neuroinflammation in Alzheimer's disease: a central role for periphery? *Diagnostics (Basel)*. 2021;11:1525. doi:10.3390/diagnostics11091525.
6. Miller AH, Raison CL. The role of inflammation in depression: from evolutionary imperative to modern treatment target. *Nat Rev Immunol*. 2016;16:22-34. doi:10.1038/nri.2015.5.
7. Hasheminasabgorji E, Jha JC. Dyslipidemia, diabetes and atherosclerosis: role of inflammation and ROS-redox-sensitive factors. *Biomedicines*. 2021;9:1602. doi:10.3390/biomedicines9111602.
8. Hotamisligil GS. Inflammation, metaflammation and immunometabolic disorders. *Nature*. 2017;542:177-185. doi:10.1038/nature21363.
9. Stein DJ, Benjet C, Gureje O, Lund C, Scott KM, Poznyak V, et al. Integrating mental health with other non-communicable diseases. *BMJ*. 2019;364:l295. doi:10.1136/bmj.l295.
10. Alberti KGMM, Eckel RH, Grundy SM, Zimmet PZ, Cleeman JI, Donato KA, et al. Harmonizing the metabolic syndrome: a joint interim statement of the International Diabetes Federation Task Force on Epidemiology and Prevention; National Heart, Lung, and Blood Institute; American Heart Association; World Heart Federation; International Atherosclerosis Society; and International Association for the Study of Obesity. *Circulation*. 2009;120:1640-1645. doi:10.1161/CIRCULATIONAHA.109.192644.
11. Lin S, Pan J, Zhu X, Lan R, Sun X, Shen R, et al. Associations of metabolic indicators and inflammation-related indices with adverse cardiovascular events in US adults: NHANES 1999-2018. *Lipids Health Dis*. 2026;25(1):57. doi:10.1186/s12944-026-02866-w.
12. Tian X, Chen S, Zuo Y, Zhang Y, Zhang X, Xu Q, et al. Association of lipid, inflammatory, and metabolic biomarkers with age at onset for incident cardiovascular disease. *BMC Med*. 2022;20(1):383. doi:10.1186/s12916-022-02592-x.
13. Šebeková K, Staruchová M, Mišľanová C, Líšková A, Horváthová M, Tulinská J, et al. Association of inflammatory and oxidative status markers with metabolic syndrome and its components in 40-to-45-year-old females: a cross-sectional study. *Antioxidants (Basel)*. 2023;12(6):1221. doi:10.3390/antiox12061221.
14. Cho SMJ, Lee H, Shim JS, Jeon JY, Kim HC. Association between physical activity and inflammatory markers in community-dwelling, middle-aged adults. *Appl Physiol Nutr Metab*. 2021;46(7):828-836. doi:10.1139/apnm-2020-1069.
15. Dehghani Firouzabadi F, Jayedi A, Asgari E, Akbarzadeh Z, Janbozorgi N, Djafarian K, et al. Association of dietary and lifestyle inflammation score with metabolic syndrome in a sample of Iranian adults. *Front Nutr*. 2021;8:735174. doi:10.3389/fnut.2021.735174.
16. Dugani SB, Moorthy MV, Li C, Demler OV, Alsheikh-Ali AA, Ridker PM, et al. Association of lipid, inflammatory, and metabolic biomarkers with age at onset for incident coronary heart disease in women. *JAMA Cardiol*. 2021;6(4):437-447. doi:10.1001/jamacardio.2020.7073.
17. Carrasco-Marín F, Zhao L, Hébert JR, Wirth MD, Petermann-Rocha F, Phillips N, et al. Association of a dietary inflammatory index with cardiometabolic, endocrine, liver, renal and bone biomarkers: cross-sectional analysis of the UK Biobank study. *Nutr Metab Cardiovasc Dis*. 2024;34(7):1731-1740. doi:10.1016/j.numecd.2024.03.010.
18. Farmanfarma KK, Kaykhaei MA, Adineh HA, Mohammadi M, Dabiri S, Ansari-Moghaddam A. Prevalence of metabolic syndrome in Iran: a meta-analysis of 69 studies. *Diabetes Metab Syndr*. 2019;13:792-799. doi:10.1016/j.dsx.2018.11.055.
19. Pérez-Martínez P, Mikhailidis DP, Athyros VG, Bulló M, Couture P, Covas MI, et al. Lifestyle recommendations for the prevention and management of metabolic syndrome: an international panel recommendation. *Nutr Rev*. 2017;75:307-326. doi:10.1093/nutrit/nux014.
20. Zhu Z, Wu F, Lu Y, Wu C, Wang Z, Zang J, et al. Total and nonheme dietary iron intake is associated with metabolic syndrome and its components in Chinese men and women. *Nutrients*. 2018;10:1663. doi:10.3390/nu10111663.

This Article May be cited as: Tassadaq A, Tassadaq A, Jamil N. Association of inflammatory and metabolic biomarkers with lifestyle-related diseases in the community population: inflammatory and metabolic biomarkers in lifestyle-related diseases. *Dev Med Life Sci.* 2026;3(4):10-15. doi:10.69750/dmls.03.04.0204