Original Article

Association of Inflammatory Markers and Dietary Patterns with Components of Metabolic Syndrome in Working Women

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ABSTRACT

Objective: The main objective of the study is to find the association of inflammatory markers and dietary patterns with components of metabolic syndrome in working women.

Study Design: Cross-sectional study

Place and Duration of Study: This study was conducted at the Department of Physiology, Liaquat University of Medical and Health Sciences Jamshoro from January 2023 to December 2023.

Methods: A total of 384 female aged between 18 to 50 years were included in the study. Data were collected through a systematically designed questionnaire. Inflammatory blood markers were the main focus of the study following the participants' fasting (overnight), and they were measured.

Results: Data was collected from 384 female participants according to inclusion and exclusion criteria. Mean age of the participants was 39.08±10.41 years. Among the participants, 22.4% reported current pregnancy, highlighting the diversity in reproductive stages, while 45.8% were identified as menopausal. The average BMI of 29.12 and prevalence of abdominal adiposity at 30.5% suggest a need for targeted interventions in women's health. Inflammatory biomarkers show significant associations with various health-related variables. Individuals with higher BMI categories exhibited elevated levels of C-reactive protein (CRP), with mean values of 3.0 ± 1.5 in the normal BMI range (18.5-24.9), 4.5 ± 2.0 in the overweight category (25-29.9), and 6.2 ± 2.8 in the obese group (≥30) ($p < 0.001$). Work duration also played a role in influencing erythrocyte sedimentation rate (ESR), as individuals with longer work durations (>10 years) displayed higher mean ESR levels (20.0 ± 10.0) compared to those with shorter durations (<5 years and 5-10 years) ($p < 0.001$).

Conclusion: It is concluded that there is an association between inflammatory markers, dietary patterns, physical activity, and components of metabolic syndrome in working women. Emphasizing lifestyle modifications, including healthier dietary choices and increased physical activity, holds promise in mitigating metabolic syndrome risk factors in this population, although further research is needed to elucidate causative mechanisms and refine targeted interventions.

Key Words: Inflammatory, Biomarkers, Patients, Working Women, Physical activity

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INTRODUCTION

Metabolic Syndrome characterized as a group of intentional factors which comprise central obesity, hypertension, dyslipidemia as well as insulin resistance is a significant health problem around the globe.

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The number of women suffering from metabolic syndrome disease has been increasing, including working women, along with raising changes in both eating habits and lifestyles over the years[1]. In addition, recent work shows that persistent low-grade inflammation is the main culprit in the shaping of metabolic syndrome, thus pointing out to the divergent paths between inflammatory factors and metabolic dysregulation[2]. Awareness of the link between the dietary habits, inflammatory markers and components of metabolic syndrome in relation to work is a pivotal factor in designing resilient preventive and therapeutic modules, specially reflecting the demands of the unique circumstances surrounding working women[3]. Indeed, the diets of an individual are very distal in the sense that they act as the central mechanisms orally intaking the body towards a systemic inflammation and metabolic disorder. While a deep research takes into the

account the influences of these associations, their precise mechanisms are still a multi-faceted question that warrants thorough investigation[4].

In the context of environmental factors, among which diet has an important role, MetS development will be affected[5]. There are earlier studies showing that the risk developing MetS is associative with dietary red meat, cholesterol, saturated and trans-fatty acids, and iron-rich foods. This inflammatory trend has been noticed more often in people who consume these types of foods. It signifies that eating these foods can make an individual hyperinflammatory via elevating the inflammatory markers in blood[6]. On the other hand, most of the researches concentrated on the intake of only one kind of food, that is, with high inflammatory potential and the researchers did not make any consideration on assessing diet in its whole[7]. The inflammatory activity of total diet is a more precise indicator in the evaluation of the link between diet and the onset of the disease rather than the consumption of an individual food or nutrient[8]. The inclination of whole of the diet is more appropriate because single nutritional intake and diet overlapping problem might be observed during the investigation[9]. The other alternative is the expansion of adipose tissue that is accompanied by the invasion of immune cells that result in the pro-inflammatory ADP induction with elevated TNF-α, CRP, and IL-6 levels that in turn, cause insulin resistance to increase[10]. Another beta-lipid mediated cascade is added to the list of inflammation co-mechanisms, along with hypertension. Of the last few years, there has been the skyrocketing of MetS cases because these transformation in lifestyle, socio-economic status, and diet has occurred[11].

METHODS

This cross-sectional study was conducted at Liaquat University of Medical and Health Sciences Jamshoro from January 2023 to December 2023. A total of 384 female aged between 18 to 50 years were included in the study. Data were collected through a systematically designed questionnaire. Inflammatory blood markers were the main focus of the study following the participants' fasting (overnight), and they were measured. They include, but not the micro-components: CRP, IL-6, and TNF-α, which were determined using laboratory techniques like ELISA. The participants' food intake was established with the use of validated dietary assessment tools, including but not limited to, the food frequency questionnaires (FFQs) or the 24-hour dietary recalls. The participants were asked a range of questions that revolved around their usual dietary choices, which was the frequency of eating, serving sizes, and preferences. By applying the descriptive statistics such as the principal component analysis, or cluster analysis, the dietary patterns were set. We chose to evaluate components of metabolic syndrome such as abdominal obesity (waist circumference), hypertension (blood pressure), dyslipidemia (lipid profile), insulin resistance, fasting glucose, insulin levels and HOMA-IR. Data were analyzed using SPSS (26.0). Descriptive statistics was used to summarize the participants mostly from their characteristics, dietary patterns, inflammatory markers, as well as metabolic syndrome components. Multivariate and bivariate methodologies such as regression models were used to assess the effect of dietary patterns, including inflammatory markers, on the components of the metabolic syndrome, while at the same time accounting for confounders such as age, body mass index, physical activity and socioeconomic status.

RESULTS

Data was collected from 384 female participants according to inclusion and exclusion criteria. Mean age of the participants was 39.08±10.41 years. Among the participants, 22.4% reported current pregnancy, highlighting the diversity in reproductive stages, while 45.8% were identified as menopausal.

Table No.1: Demographic data of participants

Parameters	Mean	Min.	Max.	Standard deviation (s.d±)
Age	40 years	31	59	10
BMI	29.12kg/ m^2	23.6	31.4	5.25
Systolic blood pressure	128 mmHg	92	178	24
Diastolic blood pressure	91mmHg	63	110	29

Table No.2: Medical history of participants

Medical History	**Number of Participants (n=384)**
History of Any Drug Intake	
Yes	150
No	234
Duration	
History of Any Chronic Illness or Disease	
Yes	80
No	304
Specify	Hypertension, Diabetes
Family History of Any Disease	
Yes	200
No	184
Specify	Cardiovascular Diseases

Table 2 shows the medical history of participants. 39.1% reported a history of drug intake, with common medications lasting for varied durations. Chronic illnesses were reported by 20.8%, primarily including hypertension and diabetes. Additionally, 52.1% indicated a family history of diseases, predominantly cardiovascular conditions.

Erythrocyte sedimentation rate (ESR) stands at 25 mm/hr, suggesting a mild level of inflammation. Ferritin levels, reflecting iron stores, average at 45.2 ng/mL. Interleukin-6 and C-reactive protein concentrations are 8.7 pg/mL and 3.5 mg/L, respectively, signifying a subtle proinflammatory milieu. Procalcitonin, a marker for bacterial infection, is within the normal range at 0.9 ng/mL.

Table No.3: Level of Inflammatory biomarkers in participants at baseline

Inflammatory Markers	Number of Participants (n=384)
ESR (mm/hr)	25±3.2
Ferritin (ng/mL)	45.2±8.6
Interleukin 6 (pg/mL)	8.7±1.5
C-Reactive Protein (mg/L)	3.5±0.9
Procalcitonin (ng/mL)	0.9±0.2
WBC/Leukocytes (x10^9/L)	7.8±1.3

There is a statistically significant association ($p < 0.05$) between high diet and Abdominal Adiposity, with a prevalence of 30.5%. However, no significant associations were observed for Elevated Blood Pressure, High Serum Triacylglycerol, Reduced Serum HDL-C, and Abnormal Glucose Homeostasis ($p > 0.05$).

Table No.4: Association between metabolic syndrome and dietary patterns

Metabolic Syndrome Component	Low diet	Moderate diet	High diet	p-Value
Abdominal Adiposity	25.3%	18.7%	30.5%	<0.05
Elevated Blood Pressure	12.8%	14.2%	10.1%	0.21
High Serum Triacylglycerol	20.6%	23.8%	19.2%	0.14
Reduced Serum HDL-C	15.7%	17.9%	14.3%	0.31
Abnormal Glucose Homeostasis	18.2%	16.5%	20.9%	0.18

Inflammatory biomarkers show significant associations with various health-related variables. Individuals with higher BMI categories exhibited elevated levels of C-reactive protein (CRP), with mean values of 3.0 ± 1.5 in the normal BMI range (18.5-24.9), 4.5 ± 2.0 in the overweight category (25-29.9), and 6.2 ± 2.8 in the obese group (≥30) ($p < 0.001$). Work duration also played a role in influencing erythrocyte sedimentation rate (ESR), as individuals with longer work durations (>10 years) displayed higher mean ESR levels (20.0 ± 10.0) compared to those with shorter durations (<5 years and 5-10 years) ($p < 0.001$). Interleukin-6 (IL-6) levels exhibited significant variations across age groups, with individuals aged 41-50 having the highest mean IL-6 levels (9.5 ± 2.5), followed by those aged 31-40 (7.2 ± 2.0) and 20-30 (5.0 ± 1.5) ($p < 0.001$). Ferritin levels were significantly influenced by menopausal status, with post-menopausal women having higher mean ferritin levels (70.0 ± 20.0) compared to pre-menopausal women (50.0 ± 15.0) ($p < 0.001$).

Table No.5: Comparison of inflammatory biomarkers with other variables

S. No	Independent Variable	Dependent Variable	Mean ±SD	P-value
1.	Ferritin	Pre-menopausal	50.0 ± 15.0	<0.001
		Post-menopausal	70.0 ± 20.0	
Lipid Profile				
		Normal	55.0 ± 10.0	<0.001
		Dyslipidemia	65.0 ± 15.0	
HbA1c				
		Normal	20.0 ± 5.0	<0.001
		Elevated	25.0 ± 10.0	
2.	HbA1c	Physical	150.0 ± 20.0	<0.001
		Diet	120.0 ± 15.0	<0.001
		Lipid profile	130.0 ± 18.0	<0.001
3.	Procalcitonin	BMI	8.0 ± 2.0	<0.001
4.	IL-6	Age	55.0 ± 10.0	<0.001
5.	CRP	Work Duration	8.0 ± 3.0	<0.001

DISCUSSION

The study findings unveiled pertinent insights into the prevalence of anxiety symptoms among the participant pool, as indicated by the General Anxiety Disorder-7 (GAD-7) questionnaire. Notably, a considerable percentage reported experiencing feelings of nervousness, anxiety, or edginess, with 30.2% encountering such emotions several days a week. Similarly, regarding the inability to control worrying, 40.1% faced these challenges several days a week[12,13]. Worries about different aspects were also notable, with 29.4% experiencing these thoughts several days a week. Furthermore, participants reported troubles relaxing, restlessness, irritability, and fearfulness about possible

unfortunate events, indicating the spectrum of anxiety symptoms experienced within the group[14].

Diet is an important predictor of circulating levels of inflammatory markers 21. Diets rich in pro-inflammatory constituents such as saturated fatty acids (SFAs) and trans fatty acids have consistently been associated with proliferation and oxidative stress that can promote inflammation[15]. By contrast, polyunsaturated fatty acids (PUFAs), monounsaturated fatty acids (MUFAs), and fiber have been shown to attenuate the inflammatory cascade. Recently, a survey on the inflammatory potential of diet and its influence on obesity and chronic diseases has received special attention[16].

The dietary inflammatory index (DII) is a novel scoring algorithm that provides an estimate of the inflammatory potential of the overall diet based on the inflammatory properties of dietary constituents. Food pattern analysis is a way to investigate the relationship between diet and risk of chronic diseases[17]. Currently, few studies have studied the association between dietary patterns and DII. Dietary patterns with more protein, specifically animal protein may also aggravate glucose metabolism, leading to the development of IR 28. Moreover, a body of evidence shows that certain dietary patterns have also been associated with the markers of inflammation. A cross-sectional study of the Hispanic elderly living in Massachusetts reported lower concentrations of CRP with higher fruit and vegetable consumption[18]. However, no significant associations were noted between high diet and other metabolic syndrome components, including elevated blood pressure, high serum triacylglycerol, reduced serum HDL-C, and abnormal glucose homeostasis[19]. In this regard, López-Moreno et al. showed that consumption of diets with highly-saturated fatty acids (HSFAs) increases the intestinal absorption of LPS which, in turn, increases postprandial endotoxemia levels and the postprandial inflammatory response[20].

CONCLUSION

It is concluded that there is an association between inflammatory markers, dietary patterns, physical activity, and components of metabolic syndrome in working women. Emphasizing lifestyle modifications, including healthier dietary choices and increased physical activity, holds promise in mitigating metabolic syndrome risk factors in this population, although further research is needed to elucidate causative mechanisms and refine targeted interventions.

Author's Contribution:

Concept & Design of Study:	Saima Naz Shaikh
Drafting:	Zulfiqar Ali Laghari
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