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# The association between dietary inflammatory index and metabolic syndrome components in Iranian adults

*Leila Nikniaz*[a], *Zeinab Nikniaz*[b,*], *Nitin Shivappa*[c,d,e], *James R. Hébert*[c,d,e]

[a] *Tabriz Health Services Management Research Center, Tabriz University of Medical Sciences, Tabriz, Iran*
[b] *Liver and Gastrointestinal Diseases Research Center, Tabriz University of Medical Sciences, Tabriz, Iran*
[c] *Cancer Prevention and Control Program, University of South Carolina, Columbia, SC 29208, USA*
[d] *Department of Epidemiology and Biostatistics, Arnold School of Public Health, University of South Carolina, Columbia, SC 29208, USA*
[e] *Connecting Health Innovations LLC, Columbia, SC 29201, USA*

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ABSTRACT

*Aims:* Investigating the association between the dietary inflammatory index (DII®) and metabolic syndrome (MetS) components and liver enzymes in Iranian population.
*Methods:* The present cross-sectional study consist of 606 participants from East-Azarbaijan-Iran. The MetS status was determined using ATPIII NCEP criteria. Moreover, liver enzymes including alanine aminotransferase and aspartate aminotransferase were measured. The DII was calculated according to Shivappa et al. method using a validated quantitative FFQ. Logistic regression was used to determine the association between DII and MetS.
*Results:* About 34.3% of the participants had metabolic syndrome. Higher DII score was significantly associated with MetS [OR: 2.26 (95% CI: 1.03, 4.92)] after adjusting for covariates. After adjustment, participants in the highest quartile of DII score had significantly higher FBG [OR: 2.56 (95% CI: 1.00, 7.05)] compared with the participants in the lowest quartile of DII score. No other significant association was observed between DII and liver enzymes level and other MetS components ($P > 0.05$).
*Conclusions:* The results showed that the DII score was associated with overall MetS and FBG, after adjusting for all covariates. For precise conclusion there is a need for longitudinal studies with larger sample size and considering more food parameters.


## 1. Introduction

Metabolic syndrome has become one of the major public health problem worldwide [1]. In addition to the traditional components of the MetS including abdominal obesity, dys-

* *Corresponding author.*
E-mail address: nikniazz@tbzmed.ac.ir (Z. Nikniaz).
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lipidemia, hyperglycemia and hypertension, other disorders such as nonalcoholic fatty liver disease (NAFLD) [2] are also thought to be part of the cluster. Studies had shown that the prevalence of MetS in Middle Eastern societies is high [1,3,4]. Iran as a Middle Eastern country is also shown the high prevalence of this syndrome. According to the result of recent a meta-analysis study, the prevalence of MetS in Iran was about 36.5% [5]. The exact pathogenesis of MetS is not clear; however, the genetic/ethnic predisposition, life style and environmental factors such as dietary habits and sedentary lifestyles, increasing age and body mass index are shown to be associated with increased prevalence of MetS [6]. Moreover, inflammation is also considered as a risk factor for MetS[7]. Studies have shown that obesity is associated with increasing inflammatory factors and can serve as a precursor to metabolic disorder [8]. Moreover, dietary patterns have been shown to be associated with inflammation like Mediterranean diet decreases inflammation [9,10] while western dietary pattern increase inflammation [10]. In this regard, the dietary inflammatory index (DII) was developed to assess the pro-inflammatory and anti-inflammatory properties of the individuals' diet and it was hypothesized that this index could predict inflammation-related outcomes in any population. In this regard, different studies assessed the association of DII and MetS in different populations and yielded mainly inconsistent results [11–15]. Although some earlier studies reported the significant association between DII and MetS components [13–15], the association between pro-inflammatory DII score and overall MetS has been reported in only one study conducted in France [11]. To the best of our knowledge, there is no study that assesses the association between DII score and MetS and liver enzymes in Iranian population. So, in the present study, we hypothesized that there may be association between dietary inflammatory index, metabolic syndrome and liver enzymes level in Iranian population.

## 2. Method

In the cross-sectional analysis of lifestyle promotion project (LPP) data set, probability proportional to size multistage stratified cluster sampling was used as a sampling method. The method of sampling is described in detail elsewhere [16]. In brief, the updated postal code was used as the sampling frame and the clusters were selected based on postal code. 150 clusters were selected. After determining the cluster start point, enrollment and data collection was started. In each cluster, 5 participants were enrolled (750 participants). This began from the household at the cluster start point and continued toward the other households until the required number of participants enrolled. Consecutive households were selected based on geographical location of buildings to the right-hand side of each building. Finally, 606 samples were included in statistical analysis, after excluding incomplete information. People were included in the present study if their original nationality was Iranian and aged between 18–64 years. Subjects with severe chronic illness requiring bed rest, physical disability, mental disability, and pregnant women were excluded.

The Ethics Committee of Tabriz University of Medical Sciences approved the present study (registration number: 1394.383) and all participants have signed the written informed consent.

The trained health professionals visited households and gathered the dietary and demographic information. The demographic information included age, education, smoking status, and physical activity level. The socio-demographic characteristics and smoking status were collected through questionnaire. The physical activity level was assessed using the short form of international physical activity questionnaire (IPAQ). For BMI calculation, the body weight of each subject was measured with a Seca scale (Dubai, United Arab Emirates) and height was measured with measuring tape according to standard protocols and BMI was calculated by dividing weight (kg) to height$^2$ (m$^2$).

For determining the MetS status, waist circumference, blood pressure, serum level of triglyceride (TG), high-density lipoprotein-cholesterol (HDL-C), and fasting blood glucose were measured according to standard methods. Briefly, 10 ml 12-h fasting blood sample was collected. After centrifuging the blood samples at 2000 rpm for 10 min at room temperature, the levels of serum HDL-C, TG and glucose were measured by enzymatic colorimetric methods (Pars Azmoon kit, Tehran, Iran) using an automatic analyzer (Abbott, model Alcyon 300, USA). Blood pressure was measured with a standard manual sphygmomanometer in sitting position. Waist circumference was measured at the minimum circumference between the iliac crest and the rib cage with an anthropometric tape while the subjects were wearing light clothing. Participants were classified as having MetS according to the adult panel III (ATP III) criteria [17].

The DII® was calculated according to Shivappa et al. method. A complete description of the DII calculation is available elsewhere [18]. Briefly, the mean daily intake of 30 food parameters was assessed using a validated quantitative FFQ [19]. The food parameters included in calculation of DII in the present study were vitamin B12, vitamin B6, β-carotene, caffeine, carbohydrate, cholesterol, energy, total fat, fiber, vitamin B9, iron, Magnesium, Mono-unsaturated fatty acid, vitamin B3, ω-3 fatty acids, ω-6 fatty acids, protein, poly unsaturated fatty acids, vitamin B2, saturated fatty acid, selenium, vitamin B1, vitamin A, vitamin C, vitamin D, vitamin E and zinc, tea, garlic and onion. All food parameters were adjusted for energy using the energy density method. The z-score was calculated and converted to centered percentile score. To obtain the food parameter-specific DII score, this value is multiplied by its respective overall food parameter score. Finally, the DII score was calculated by summing all food parameter-specific DII score. More positive score indicate the more pro-inflammatory diet and more negative score indicate more anti-inflammatory diet.

### 2.1. *Statistical analysis*

For statistical analyses, the statistical package for social sciences (SPSS) V18 was used. The Kolmogrov–Smirnov test was used for assessing the data distribution. Participants were categorized according to quartiles of DII. The differences in continuous variables across different quartiles of DII were determined using One-way ANOVA. The $\chi^2$ test was used to compare the categorical variables

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