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Relationship Between Healthy Eating Index and Metabolic Syndrome

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ABSTRACT

Background and Objective: Dietary quality may have an important effect on the manifestation of metabolic syndrome. Some studies showed there is an association between a Healthy Eating Index (HEI) as one of the most important dietary quality and metabolic syndrome. The goal of this study was the survey effects of dietary quality as a healthy eating index on metabolic syndrome besides demographic factors. **Materials and Methods:** This survey was a case-control study done on 350 males and females (including 175 metabolic syndrome and 175 healthy persons) with age range 20-65 years old that were guided by laboratories and general recalling in Chalus, northern Iran. A food frequency questionnaire (FFQ) is used for the collection of information on dietary intake and the healthy eating index was assessed with standard methods. **Results:** The chance of morbidity for metabolic syndrome was the same concerning HEI in quartile 4 (maximum score) versus quartile 1 (minimum score) although this chance decreased after adjustment for confounder variables (age, sex, dietary energy, education, job and marriage status). There was no significant difference ($p \geq 0.05$) in the procedure of odds ratio in quartiles and models (P trend) of HEI. **Conclusion:** There was no significant relation between HEI and the incidence of metabolic syndrome.

KEYWORDS

Cardiovascular disease, dietary intake, dietary quality, dyslipidemia, food frequency questionnaire, healthy eating index, metabolic syndrome

INTRODUCTION

Metabolic syndrome (MetS) is a condition with some of the metabolic risk factors that may cause chronic complications[1]. Although the born of this condition is back many years ago, the new version of that have made by Reaven in 1980[2]. National Cholesterol Education Panel-Adult Treatment Panel III (NCEP-ATP III) define MetS as including obesity, dyslipidemia, increasing blood pressure and hyperglycemia[3].

Metabolic syndrome may lead to diabetes mellitus, cardiovascular disease (CVD), stroke and cancers[4-6]. Prevalence of MetS is different around the world, especially in Iran[7,8] so the distribution of that is relatively high in different locations of Iran (>25%)[9,10].

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The causes of MetS are undefined, however, it seems that there is an association between genetic, metabolic and environmental factors that can affect the appearance[11].

Diet is one of the most important indexes among environmental factors that is investigated by scientists for displaying of effects of dietary factors on MetS such as dietary fibre[12], fruits and vegetables[13] and dairy products[14]. Dietary quality indices are factors that can use as useful tools for the evaluation of diet and nutrient intake so those could give us valuable information about the association between nutrients and the risk of chronic diseases[15,16]. One of the best dietary quality indices is a Healthy Eating Index (HEI) which could use for the evaluation of diets and their nutrients[16].

There are a lot of studies that have used these indices in their surveys. It is reported that HEI was low in patients with type 2 diabetes and they were at high risk for CHD but were not healthy subjects[17]. It is revealed that low a quality diet in women is associated inversely with cardiometabolic risk factors such as abdominal obesity[18].

It was found that subjects with metabolic syndrome have low dietary quality[19]. But, a lot of cohort studies have shown controversial results with HEI scores and chronic disease. In a study, higher HEI scores were weakly associated with lower BMI and lower blood pressure for men but were not associated with lipid profiles[20]. It is reported that HEI scores were weakly associated with low risk of CVD in men[21] but were not associated with low chronic disease risk in women[22].

So, regarding the controversy about this and to assess dietary quality in a study, it was decided to survey the relationship between HEI and metabolic syndrome in a case-control study.

MATERIALS AND METHODS

Study area: The study was carried out at the Faculty of Medical Sciences, Biochemistry Lab, Islamic Azad University, Chalus, Iran from January, 2015 to May, 2016.

Study design: A case-control study was conducted on 175 patients with metabolic syndrome and 175 healthy subjects (male and female) in the age range 20-65 years old after screening and selection of persons based on essential characteristics.

These persons were guided from many laboratories and general recalling in Chalus, northern Iran. Criteria for selection of subjects with metabolic syndrome was based on the definition of NCEP-ATP III as Waist Circumference (WC) $\geq$88 cm for female and $\geq$102 cm for male, blood pressure (BP) $\geq$130/85 or medication therapy for it triglyceride (TG) $\geq$150 mg dL^{-1} or medication therapy for it High-Density Lipoprotein (HDL) lower 50 for female and 40 mg dL^{-1} for male and fasting blood sugar $\geq$100 mg dL^{-1} or medication therapy for it. Subjects are referred to a defined laboratory for doing biochemical tests and WC and BP are measured by a trained person. Having at least three items of five is considered a metabolic syndrome patient otherwise was a healthy subject. It informed all of the participants about the goals of the study and they participated in it with full information.

Biographic and demographic characteristics of all subjects (including Age, gender, marriage status, level of education and job) were recorded in a questionnaire.

Assessment of dietary intake: Information on dietary intake in all of the subjects was recorded using of validated Food Frequency Questionnaire (FFQ)[23].

Records of food items were analyzed by Nutritionist IV (N 4) software. It measured the healthy eating index based on the output of N4 and by SPSS software.

Healthy Eating Index (HEI): It is used method of McCullough *et al.*[22] for calculating HEI that is defined as alternate hei (AHEI). This index includes nine groups of food. Measuring each of them was done as grams per day obtained from eaten servings of persons in their FFQ.

Food groups include vegetables, fruits, grains fibre, white meats to red meats ratio, polyunsaturated fatty acids to saturated fatty acids ratio, nuts-legumes and soy, trans fatty acids, alcohol and duration of multivitamin use.

Because it was no accurate information about the use of alcohol and multivitamin in Iranian subjects, these two groups were deleted from the evaluation. Also, it is considered total fibre for measuring instead of grain fibre because data about it was not accurate.

Amounts of consumption of subjects related to seven groups were converted to consumption deciles for evaluation of the status of adherence of persons to food groups. So all of the uptakes of subjects score 1-10. So scores of each person originating from seven items were 7-70. But, there is an exception for item trans-fatty acids so a decile of that should evaluate as a reverse score because if the score of this item was upper means lower quality of diet.

Overall, the person that obtains an upper score (range 7-70) will have upper AHEI and dietary quality and adherence to a healthy diet is more.

Measuring waist circumference: Measuring waist circumference as an index of obesity (especially abdominal type) was done by using a non-stretchable tape measure. This index is obtained by measuring the distance around the smallest area below the rib cage and above the umbilicus[24].

Measuring blood pressure: Measuring blood pressure is done by an expert person and by using a standard sphygmomanometer. But, before evaluating blood pressure, it is requested subjects rest for ten minutes. It is used in the left hand of a person for measuring and that is done twice to consider the mean of those as actual blood pressure[25].

Assessment of biochemical parameters: It is requested of subjects go to the defined laboratory after 10-12 hrs of fasting for measuring fasting blood sugar (FBS), triglyceride (TG) and high-density lipoprotein (HDL). Samples of subjects are collected from venous blood and centrifuged for 5-7 min at 3000 g and 37°C within 20-30 min of collection. Measuring serum levels of FBS and TG was done by using commercial kits and HDL by enzymatic kit (Pars Azmoon Co, Tehran, Iran).

Assessment of other variables: Other variables such as medication and medical therapy, disease status and characteristics of diet and other information were recorded in the questionnaire.

Statistical analysis: It is used software SPSS (version 21) for analyzing data and logistic regression for assessment of the relationship between the healthy eating index and incidence of metabolic syndrome. For diagnosing adherence of subjects from the healthy eating index obtained scores of subjects were classified in quartiles and it is calculated odds ratio of metabolic syndrome in four models: Stock model (non-adjustment), model 1 (adjustment for age and sex), model 2 (more adjustment for energy) and model 3 (more adjustment for job, education and marital status). Quartile 1 is considered as a reference and calculated odds ratio of metabolic syndrome in other quartiles versus quartile 1. For evaluating of P trend, firstly is calculated medium of scores of a healthy eating index between models and quartiles individually and so the P trend is measured with consideration of the medium of each quartile as a quantitative variable.

RESULTS

In MetS patients (cases) number of men and women was 80 and 95 and in healthy subjects (controls) was 86 and 89. The mean age in MetS patients was 50.8±8.85 and in healthy subjects was 43.2±11.16. The

Table 1: Demographic characteristics and status of energy intake of two groups

Variables	MetS patients (N = 175)	Healthy subjects (N = 175)	Comparison (p-value)
Ag (Mean±SD)	50.8±8.85	43.2±11.16	0.00
Sex (%)			
Male	80(45.7)	86(49.1)	0.52
Female	95(54.3)	89(50.9)	
Marriage status (%)			
Single	7(4)	34(19.4)	0.00
Married	168(96)	141(80.6)	
Education (%)			
Illiterate	2(1.1)	0(0)	0.00
Under diploma	61(34.9)	27(15.4)	
Diploma	48(27.4)	37(21.1)	
Over diploma	8(4.6)	9(5.1)	
Bachelor	36(20.6)	61(34.9)	
Master science	18(10.3)	39(22.3)	
PhD	2(1.1)	2(1.1)	
Job (%)			
Housekeeper	63(36)	33(18.8)	0.00
Staff	69(39.4)	109(62.3)	
Worker	2(1.1)	0(0)	
Business	21(12)	12(6.9)	
Unemployed	20(11.4)	21(12)	
Energy intake (Mean±SD)	2709±1030	2697±958	0.91

Table 2: Odds ratio for metabolic syndrome in quartiles of alternate healthy eating index

Models	Quartile 1	Quartile 2 OR* (95% CI**)	Quartile 3 OR (95% CI)	Quartile 4 OR (95% CI)	p-trend
Stock	1	0.82(0.04-1.48)	0.93(0.51-1.71)	1.20(0.66-2.17)	0.47
1	1	0.79(0.42-1.47)	0.91(0.47-1.75)	0.96(0.50-1.84)	0.98
2	1	0.81(0.43-1.52)	0.89(0.46-1.71)	0.92(0.48-1.77)	0.87
3	1	0.70(0.36-1.37)	0.85(0.42-1.69)	0.85(0.43-1.70)	0.73

*Odds Ratio and **Confidence interval

level of education in the control group was higher than case group. In the case of group 96 and the control group, 80.6% were married. Many of the subjects in the two groups were the staff. The level of energy intake approximately was the same in the two groups (2709±1030 kcal in MetS patients v 2697±958 kcal in healthy subjects) in Table 1. Although, there was a difference in some of the demographic factors between the two groups these factors have been adjusted in the next analysis for the healthy eating index.

The chance of morbidity (odds ratio) related to MetS between quartiles of HEI showed in Table 2. In the stock model, there was not a significant difference in the chance of MetS for subjects of quartile 4 versus quartile 1 (OR:1.2, 95% CI 0.66-2.17). But, this chance decreased in other models after adjustment for confounder variables so this reduction was 4% in model 1 (OR:0.96, 95% CI 0.5-1.84), 8% in model 2 (OR:0.92, 95% CI 0.48-1.77) and 15% in model 3 (OR:0.85, 95% CI 0.43-1.70). P trend was not significant in all of the models ($p \geq 0.05$).

DISCUSSION

The aim of this study was the survey the relationship between dietary quality indices such as HEI and the prevalence of metabolic syndrome. As acquired results, there was no significant relationship in this. There was no difference in odds of morbidity for metabolic syndrome regarding HEI, in quartile 4 (maximum score) comparison with quartile 1 (minimum score) but this chance decreased after adjustment for confounder variables (age, sex, dietary energy, education, income, job and marriage status). There was no significant difference ($p \geq 0.05$) in the procedure of odds ratio in quartiles and models (P trend) related to HEI. These results were in contrast to studies such as the study of Niazi *et al.*[26], Esmaillzadeh *et al.*[13],

Travido *et al*.[27] and Azadbakht *et al*.[28] that showed there was an inverse relationship between dietary quality and incidence of metabolic syndrome. In front, there are studies with the same results as this study. Drewnowsk *et al*.[20] revealed that there was a low relationship between the upper score of HEI and low body mass index or blood pressure in men. Frazier *et al*.[29] could not show a relationship between dietary quality and the risk of cardiovascular diseases in females. McCullough revealed in his studies[21] that better dietary quality has no significant effects on the prevention of chronic diseases. Several causes could be proposed for a fair connection between dietary quality and chronic diseases (such as metabolic syndrome). Dietary quality indices such as HEI cannot always show the nature of items of dietary quality because the same dietary scores may be obtained from different dietary patterns[21]. There is not always a relation between higher scores in dietary quality indices and improvement in biomarkers and reduction in risk of chronic diseases because other factors must be considered such as age, sex and others[21]. The HEI does not specifically follow the dietary recommendation of the dietary to approach stopping hypertension (DASH) diet, thus we should not expect a score of HEI affects blood pressure (as one of the items of metabolic syndrome)[29].

One of the causes that can consider for disconnection among HEI and incidence of MetS in this study is the presence of chronic diseases such as diabetes mellitus, hypertension or hyperlipidemia and the use of different drugs in subjects so these items are not considered and not excluded of study. These factors can affect dietary patterns and lifestyle in subjects before entrance into the study and can affect data because it is recorded dietary information related to their last year of them in FFQ. Thus it is hard to announce certainly there is a relationship between HEI (as dietary quality) and the incidence of metabolic syndrome.

CONCLUSION

This study revealed that there was no significant difference in the healthy eating index (as dietary quality) between metabolic syndrome patients and healthy subjects and thus there was no significant connection between this index and the incidence of metabolic syndrome. This study will help the researcher to uncover the relationship between dietary qualities and metabolic syndrome that many researchers were not able to explore. Thus, a new theory on risk factors of metabolic syndrome may be arrived at.

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