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Relation of Healthy Eating Index with Body Composition Parameters in Iranian Adult

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ABSTRACT

Background: Obesity as the excessive accumulation of adipose in adipocytes has still remained equivocal. Since diets contain many components to prevent from or promote diseases, assessing effects of the whole diet on health can be more practical. The purpose of this study was to investigate the association between quality of diets through healthy eating index (HEI), and body composition parameters in Iranian adults. **Methods:** This cross-sectional study included a total of 138 participants in the age range of 20-55 years, who referred to Endocrinology Center of Tehran University of Medical Sciences to receive health care services and fulfilled the eligibility criteria to participate in this study. Food frequency questionnaire (FFQ) was used to calculate HEI scores. Body composition data included: Fat mass (FM), fat free mass (FFM), abdominal fat (AF), muscle mass (MM), and total body water (TBW) that were collected by bioelectrical impedance instrument. **Results:** In this study the mean HEI score was 55.26. Based on HEI-2010 values, diet quality was good in 0.7% of participants, needed improvement in 55.9%, and was poor in 43.4% of the cases. There were significant linear trends between quality of diets and body composition parameters ($P < 0.05$). **Conclusion:** According to our study poor diet quality can be related to FM and obesity in Iranian adults.

Keywords: *Body composition; Obesity; Body mass index*

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Introduction

Obesity is defined as the excessive accumulation of adipose in adipocyte which has happened as a result of imbalance adipose synthesis and degradation (Ko and Choi, 2013, Rashidi *et al.*, 2005). Recently, this phenomenon has reached epidemic proportions in both developed and developing countries (Ebbeling *et al.*, 2002, Kruger *et al.*, 2006, Veugelers and Fitzgerald, 2005). Approximately two-thirds of the population in north America are considered over weight (Deurenberg and Yap, 1999, Yanovski, 2000). Iran is also no exception, according to present evidences, prevalence of obesity in north of Iran is in the highest rates (Janghorbani *et al.*, 2007, Rashidi *et al.*, 2005, Veghari *et al.*, 2010). Obesity is the

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pacemaker of serious co-morbidities, including: metabolic syndrome (MetS), Type 2 diabetes mellitus, hypertension, hyperlipidemia, stroke, asthma, obstructive sleep apnea, cancer, and renal failure (Deurenberg and Yap, 1999, Eckel and Committee, 1997). With an alarming increase in the prevalence of obesity, more emphasis has been placed on identification of accurate therapeutic approaches. Although, obesity is a multi-factorial disorder (Barness *et al.*, 2007) and various treatment approaches are known for its treatment, healthy lifestyle, including dietary modifications and physical activity are considered as the optimal treatment in obese subjects (Deedwania and Gupta, 2006, Pacifico *et al.*, 2011).

Healthy eating index (HEI), like diet quality indices evaluates the relationship between total diet and chronic disease risk factor, this index provides a single and summary measurement of overall dietary quality (Ko and Choi, 2013).

To the best of our knowledge, there have been no studies on evaluation of the relationship between obesity and HEI. However, it seems that the definition of obesity is a more important issue than the body weight; obesity is the body fat and its distribution. Therefore, the evaluation of body fat distribution may be important to put participants at risk of MetS. So, this research is aimed to evaluate the relationship between diet quality, using the HEI-2010, and body composition component in Iranian adults.

Materials and Methods

Study design and participants: In this cross-sectional study we evaluated a consecutive sample of 138 participants in the age range of 20-55 years. These patients referred to the Endocrinology Center of Tehran University of Medical Sciences and fulfilled the eligibility criteria to participate in this study from 2012 to 2013. Written informed consent was then obtained from each participant.

Being in the age range of 20 to 55 years was considered as the inclusion criteria. However, the exclusion criteria included: having a history of coronary artery disease, acute or chronic renal failure, history of acute infection within the previous seven days, acute or chronic hepatic failure, hematological disorder, presence of any chronic inflammatory and autoimmune disease, any known malignancy, pregnancy, breast feeding, menopause, smoking, professional exercising, uncontrolled thyroid, use of medications for dyslipidemia or hypertension, hypnotics, sedatives and immunosuppressive, as well as having special diet for any reason under the supervision of dietitian.

Measurements: Body weight, height, and waist circumference (WC) were registered for each participant. To collect the above mentioned data, an electronic balance with stadiometer (SECA-Germany) was applied and weight and height measurements were recorded to the nearest 0.1 kg and 0.1 cm, respectively while participants were with their undergarments and without shoes. To calculate the body mass index (BMI) body weight was divided by height squared (kg/m^2). WC was determined at the midline between the lower rib margin and the iliac crest while participants were standing with their heels near together.

Several body composition parameters including the body weight, fat mass (FM), muscle mass (MM), and total body water (TBW) were evaluated using an 8-polar bioelectrical impedance instrument (model TANITA BC-418). The analysis was performed in the morning to confirm the following conditions; empty bladder, absence of intense physical activity and exercise 12 hours prior to the test, fasting for at least 12 hours, and after 15 min of rest. Participants were then asked to stand on metal footpads in bare feet and grasp a pair of electrodes fixed on a handle.

Dietary intake was determined by means of food frequency questionnaire (FFQ). The participants were instructed on how to record their average consumption of specific amount of foods over the past 12 months.

The HEI was used as the measurement tool for evaluation of diet quality. The HEI 2010 includes 9 adequacy (dietary components to increase) and 3 moderation components (dietary components to decrease) (**Table 1**). For the adequacy components, scoring is based on density, this means that individuals with an intake at the recommended level received the maximum score, whereas for the moderation components, increasing levels of intake received decreasingly lower scores. In other words, for all components, higher scores indicate closer conformance with dietary guidance. The composite HEI score can potentially range from a minimum of zero to a maximum score of 100. The highest score was 100, while the lowest score was 0. An HEI score over 80 implies a 'good' diet, an HEI score between 51 and 80 implies a diet that 'needs improvement', and an HEI score less than 51 implies a 'poor' diet.

Data analysis: Data were analyzed with the statistical package STATA, version 11. We used mean and standard deviation for descriptive data. Linear regression and quintile regression were also applied for assessing the association between diet HEI score and MetS component. Also, P-value for linear and quartile trends was applied for evaluating the association with HEI through quartiles of diet quality.

Results

Demographic characteristics and biochemistry parameters of the sample are presented in **Table 2**. The HEI mean score was 55.2 (**Table 3**). The HEI scores for 43.4% of participants were classified as "poor diet", 55.9% were "needs improvement" and only 0.7% of participants were classified as having a "good diet".

Table 4 shows the association between HEI quartile score and body composition parameters. There were significant linear trends between HEI score and body composition component (P < 0.05). Further, there were significant quartile trends between HEI score and body composition components (P < 0.001). With increasing HEI score, there was a significant linear decrease in FM (P < 0.001), AF (P < 0.001), and WC (P < 0.001). There was also a significant linear increase in FFM (P = 0.003), MM (P < 0.001), and TBW (P < 0.001).

Table 1. Healthy Eating Index-2010 and its components and standards for scoring

Components	Maximum points	Standard for maximum score	Standard for minimum score of zero
Total fruit	5	≥ 0.8 cup equiv. per 1,000 kcal	No Fruit
Whole fruit	5	≥ 0.4 cup equiv. per 1,000 kcal	No Whole Fruit
Total vegetables	5	≥ 1.1 cup equiv. per 1,000 kcal	No Vegetables
Greens and beans	5	≥ 0.2 cup equiv. per 1,000 kcal	No Dark Green Vegetables or Beans and Peas

Table 2. General characteristics and biochemistry parameters among subjects

Variables	Mean ± SD
Age (year)	35.7 ± 7.5
Height (cm)	172.1 ± 7.9
Weight (kg)	81.5 ± 14.7
Waist circumference (cm)	98.9 ± 11.2
Body mass index (Kg/m^2)	27.4 ± 4.3
Fat mass (%)	20.9 ± 7.0
Fat free mass (%)	79.2 ± 7.7
Muscle mass (%)	75.3 ± 6.8
Total body water (%)	57.8 ± 5.2
Abdominal fat (%)	22.7 ± 8.0

Table 5 shows the association between HEI quartile score and HEI components. As can see, a change in score in each individual food group resulted in a significant increase (P < 0.0001) in the total diet quality. For whole fruit, total vegetables, bean and green, whole grain, dairy, fatty acid, refined grain, as well as empty calories there was a ≥ 1-point change in HEI score for that food group (P < 0.0001).

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Table 3. Mean of healthy eating index

HEI components	Range of score	Mean ± SD	% Mean ± SD
Sodium	0-10	7.2 ± 2.7	72.2 ± 27.1
Total fruit	0-5	2.8 ± 1.6	80.9 ± 28.9
Whole fruit	0-5	3.8 ± 1.2	77.8 ± 24.6
Refined grain	0-10	1.2 ± 2.4	13.2 ± 24.5
Whole grain	0-10	1.5 ± 0.9	15.8 ± 9.4
Dairy	0-10	5.2 ± 3.0	53.4 ± 30.7
Seafood and plant protein	0-5	2.3 ± 1.7	48.2 ± 34.0
Total protein food	0-5	4.2 ± 0.5	85.8 ± 10.1
Total vegetables	0-5	2.9 ± 1.0	59.0 ± 20.1
Greens and bean	0-5	3.2 ± 1.4	64.4 ± 29.1
Fatty acid	0-10	4.6 ± 3.8	46.0 ± 38.3
Empty calories	0-20	15.6 ± 5.3	78.2 ± 26.5
HEI-2010	0-100	55.2 ± 12.1	55.2 ± 12.1

Table 4. Association between diet-quality quartiles and body composition components

Body composition variables	HEI quartile score				Linear trend		Quartile trend	
	1 (n = 38)	2 (n = 38)	3 (n = 38)	4 (n = 38)	β	P-value	β	P-value
Fat mass (%)	22.9 ± 1.2	23.0 ± 0.88	20.3 ± 1.3	17.8 ± 1.0	-0.57	< 0.001	-0.37	0.003
Fat free mass (%)	78.1 ± 1.6	76.6 ± 0.95	79.7 ± 1.3	82.2 ± 1.0	0.42	0.003	0.24	0.129
Muscle mass (%)	73.5 ± 1.1	73.2 ± 0.92	76.0 ± 1.3	78.5 ± 1.0	0.59	< 0.001	0.34	0.005
Total body water (%)	56.4 ± 0.8	56.2 ± 0.73	58.3 ± 1.0	60.2 ± 0.8	0.76	< 0.001	0.41	0.010
Abdominal fat (%)	25.08 ± 1.3	25.6 ± 1.09	21.3 ±1.4	19.1 ± 1.3	-0.52	< 0.001	-0.37	< 0.001
Waist circumference (cm)	102.6 ± 1.6	104.7 ± 1.50	94.6 ± 1.9	93.5 ± 1.5	-0.45	< 0.001	-0.41	< 0.001

Discussion

The present study provides evidence on existence of a significant correlation between body composition parameters (FM, FFM, MM, TBF, AF, BMI, and WC) and diet quality as HEI-2010. The achieved results were consistent with previous studies (Gao *et al.*, 2008, Guo *et al.*, 2004, Nicklas *et al.*, 2012). These results were also in accordance with a study conducted on a French population (Lassale *et al.*, 2013). In our study with increasing HEI score, there was a significant decrease in FM, AF, as well as WC and increase in FFM, MM, and TBW. This study by using the most recent measure of diet quality (HEI-2010), showed that diet quality was associated with obesity (according to FM percentage). Individuals with higher diet quality were less likely to have fat mass.

Higher HEI scores are representative of a healthy diet (Wardle *et al.*, 2004). Adherence to dietary guidelines and healthy diet are important strategies for the regulation of various biological processes associated with cardiovascular disease risk and body composition (Heitmann *et al.*, 2012). According to available evidence, high sodium and fat consumption are associated with higher risk for overweight/obesity.

In our study, the mean of HEI score was 55.2 (diet need improvement), which is consistent with the study conducted on people with diabetes living in north Cyprus and lower than US women with a mean HEI score of 66.6 (Basiotis *et al.*, 2002, Tardivo *et al.*, 2010).

In addition, in the present study HEI scores for 43.4% of subjects were classified as "poor diet", 55.9% were "needs improvement", and only 0.7% of participants were classified as having a "good diet. These proportions were similar to those reported by Tardivo et al., (Tardivo *et al.*, 2010).

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Considering the relation of diet quality as HEI and obesity, it may be necessary to achieve a better adherence to dietary guideline recommendations.

The small sample size and the cross-sectional study design, as the major limitations, need to be considered while interpreting the findings. However, to the best of our knowledge, this is the first study that assessed the relationship between diet quality by using the HEI and body composition parameter (using BIA) in Iranian adults.

Table 5. Association between diet-quality quartiles and HEI-2010 components

HEI components	HEI quartile score				Linear trend		Quartile trend	
	1 (n = 38)	2 (n = 38)	3 (n = 38)	4 (n = 38)	β	P-value[a]	β	P-value[a]
Total fruit	1.60 ± 0.13	1.80 ± 0.16	3.40 ± 0.24	4.60 ± 0.1	0.99	< 0.001	0.99	< 0.001
Whole fruit	2.98 ± 0.15	3.16 ± 0.20	4.30 ± 0.17	5.00 ± 0.0	1.00	< 0.001	1.00	< 0.001
Total vegetables	2.47 ± 0.11	2.85 ± 0.15	2.83 ± 0.13	3.63 ± 0.18	1.00	< 0.001	1.00	< 0.001
Greens and bean	2.18 ± 0.14	2.29 ± 0.17	3.71 ± 0.22	4.64 ± 0.11	1.00	< 0.001	1.00	< 0.001
Whole grain	1.48 ± 0.11	1.50 ± 0.12	2.00 ± 0.17	1.30 ± 0.16	1.00	< 0.001	1.00	< 0.001
Dairy	3.00 ± 0.24	3.60 ± 0.29	6.04 ± 0.47	8.50 ± 0.33	1.00	< 0.001	1.00	< 0.001
Total protein food	4.39 ± 0.04	4.33 ± 0.05	4.01 ± 0.08	4.44 ± 0.10	0.99	< 0.001	0.99	< 0.001
Seafood and plant Proteins	1.18 ± 0.16	1.53 ± 0.20	2.68 ± 0.25	4.14 ± 0.18	0.99	< 0.001	1.00	< 0.001
Fatty acid	3.65 ± 0.53	3.65 ± 0.60	4.91 ± 0.68	6.35 ± 0.55	1.00	< 0.001	1.00	< 0.001
Refined grain	0.14 ± 0.10	1.15 ± 0.28	1.90 ± 0.46	1.89 ± 0.50	1.00	< 0.001	1.00	< 0.001
Sodium	5.60 ± 0.44	7.40 ± 0.36	7.30 ± 0.50	8.50 ± 0.30	0.99	< 0.001	1.00	< 0.001
Empty calories	12.38 ± 0.86	15.77 ± 0.87	15.57 ± 0.89	18.98 ± 0.34	1.00	< 0.001	1.00	< 0.001

[a]: Linear regression

Conclusions

This study provides evidence on existence of an association between diet quality and body composition, it also introduces diet modification as an effective strategy to reduce obesity and FM.

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Authors' contributions

Erfani M Drafting the article, Hosseinzadeh Z Analysis and interpretation of data, Bazrafshan M Drafting the article and revising, Djafarian K Conception and design, Entezami N Analysis and interpretation of data, Alinavaz M Conception and drafting, Yosaee S Final approval of the version to be published.

Conflicts of interest

The authors declared no potential conflicts of interest with respect to the research, authorship, and/or publication of this article.

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