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Association Between Diet Quality and Central Obesity in Female Students

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Abstract

Introduction: Central obesity can be the root cause of a number of diseases, including diabetes, hypertension and cardiovascular disease. Therefore, it seems necessary to study the factors affecting it to prevent such diseases. Previous studies have suggested a possible relationship between a healthy eating pattern and lower levels of central obesity, but studies to support this issue in the Iranian population are limited. The purpose of this study was to determine the association between Alternative Healthy Eating Index (AHEI-2010) and central obesity among the female students of the Science and Research Branch, Islamic Azad University, Tehran, Iran.

Methods: A total of 168 female students from the Science and Research Branch, Islamic Azad University, Tehran, Iran, participated in this cross-sectional study. The Food Frequency Questionnaire (FFQ), was used to assess the participants' dietary intake. To determine central obesity, the waist circumference index was utilized and the threshold was considered to be 88 cm. Binary logistic regression was applied to examine the relationship between the variables. The acceptable probability of error for the significance of the results was considered to be less than 0.05 ($P<0.05$) and the data was analyzed using the SPSS software.

Discussion: The frequency of central obesity was 32.7%, among the study participants. After adjusting the confounding variables, a significant inverse relation was found between the AHEI score and central obesity (OR=0.915; CI 95%=0.855-0.979). Additionally, based on analysis of the components of AHEI, consumption of fruit and nuts was inversely associated with central obesity but consumption of red meat and processed meats was directly associated with central obesity ($P<0.05$).

Conclusion: The findings of this study suggest that there is an inverse relationship between AHEI and central obesity. Therefore, it may be effective to adopt a healthy eating pattern according to the AHEI to reduce the prevalence of central obesity.

Keywords: Alternative healthy eating index; Central obesity; Female students; Healthy eating pattern; Waist circumference.

Abbreviations: AHEI: Alternative Healthy Eating Index; BMI: Body Mass Index; CVD: Cardiovascular Diseases; FFQ: Food Frequency Questionnaire; HEI: Healthy Eating Index; IPAQ-SF: International Physical Activity Questionnaire's Shortened Form; MeDS: Mediterranean Diet; MetS: Metabolic Syndrome; MKHEI: Modified Korean Healthy Eating Index; WC: Waist Circumference; WHO: World Health Organization; WHR: Waist-to-Hip Ratio.

Introduction

Body Mass Index (BMI) is generally used to determine overall obesity, while Waist Circumference (WC) indicates central obesity and is used to assess health risks [1]. For men, central obesity is defined as a waist circumference of more than 102 cm, and for women, more than 88 cm [2]. It is well established that central obesity is a more accurate predictor of the risk of cardiometabolic illnesses compared to the overall obesity [3]. The estimated frequency of central obesity among individuals over 15 years of age was 41.5% according to a 2020 meta-analysis of more than 280 population-based researches conducted across the globe. In that study, more prevalence was seen in Caucasian and African populations, those over the age of 40, women, people residing in cities and citizens of high-income nations [4]. Central obesity is a component of the Metabolic Syndrome (MetS) and, even in people of normal weight, it plays a significant role in the pathogenesis of Cardiovascular Diseases (CVD) and some cancers by promoting intermediary variables such as insulin resistance, dyslipidemia, and systemic inflammation [5]. According to a recent study, there is a progressive trend in the presence of MetS characteristics in about one-third of Iranian adults [6]. Additionally, as abdominal fat increases, the risk of these diseases rises [7]. Also, the prevalence of obesity and overweight was found to be high in a study that involved students from 22 different countries [8]. More than 59% of Iranian adults now suffer from central obesity, a sharp rise in prevalence that has been particularly seen among women [9]. According to previous studies, the people with central obesity but a healthy weight are at an equal or even higher risk compared to those who have central obesity but are also overweight or obese in terms of Body Mass Index (BMI) [10,11].

College enrollment is an important life event. Therefore, many students exhibit unhealthy eating habits due to lifestyle and dietary changes, such as skipping meals and consuming a lot of carbonated beverages [12], fast food, and high-fat foods while consuming fewer fruits and vegetables [13]. One lifestyle factor that has a significant impact on the onset and progression of central obesity is diet [14]. Because of the synergistic effects of various nutrients in causing or preventing diseases, epidemiological studies have shifted the emphasis from a specific nutrient to the quality of the diet as a whole and the type of diet that people consume [15,16]. One of the indices used to evaluate diet quality is the Alternative Healthy Eating Index (AHEI), which includes components that are related to predicting chronic disease risk [17].

Numerous studies have investigated the connection between dietary patterns and central obesity [18-20]. In a study, authors investigated the connection between central obesity and the Mediterranean Diet (MeDS) and AHEI-2010. According to that study, less central obesity in Puerto Rican adults was associated with greater adherence to the MeDS or AHEI [21]. In another study, Healthy Eating Index (HEI-2010) was used to analyze the diet quality and the impact of overall diet quality and its components on central obesity in Mexican-American men and women. The 12-component HEI-2010 data, which has a total score of 100, was gathered through a 24-hour recall interview. According to that study, Mexican Americans, particularly men, had lower odds of central obesity when they had a better diet quality [18].

The importance of the chosen topic is deeply felt, in light of the rising prevalence of unhealthy lifestyles, the high prevalence of central obesity among the Iranian women, and the effects of diet and eating habits on central obesity. Additionally, because dietary habits vary according to the race, culture, gender, and socioeconomic status, it is important to investigate the previous studies' findings in various populations.

The objective of this study was to determine the association between Alternative Healthy Eating Index and central obesity in female students at our university.

Materials and methods

This research was a cross-sectional study and female students at our university made up the study population. The Ethics Committee of the university approved this study in compliance with Helsinki Declaration. The sample size was computed using GPower software version 3.1.9.7 [22], based on Linear Multiple Regression, resulting in 172 individuals. The sample size was adjusted to 190 individuals, accounting for a 10% chance of dropout. Demographic information was collected from the participants by filling out a questionnaire manually, including age, marital status (single or married), and economic status (income per month: less than 200$, between 200$ and 400$, or more than 400$). Adjustment variables included age, marital status, economic status, energy intake, body mass index and physical activity. For each of the participants, the weight was measured using a digital scale and recorded with a precision of 0.1 Kg. Weight measurement was done, while people were wearing minimal clothes and no shoes. People's heights were measured in a standard position with a tape measure without shoes. Body mass index was calculated by dividing weight by the square of height (in meters). According to World Health Organization (WHO) recommendations, the waist circumference was measured with a non-stretch flexible tape measure at a distance of about 1 mm between the lowest rib and the iliac crest [23]. Central obesity was defined as WC ≥88 cm [2]. A valid 168-Item food frequency questionnaire [24], was used to collect data on energy intake and diet quality. Frequency of consumption for each food item was gathered on a daily, weekly, monthly, and annual basis, and then the average daily consumption was calculated from it. The average daily consumption was then analyzed with Excel software, and the results were used to calculate AHEI (AHEI-2010). With a score ranging from 0-110 and 11 food groups, the AHEI includes six nutrients for which the higher intake is recommended, including: 1. vegetables, 2. fruit, 3. whole grains, 4. nuts and legumes, 5. long-chain omega-3 fatty acids (docosahexaenoic acid and eicosapentaenoic acid), and 6. polyunsaturated fatty acids. On the other hand, it contains 5 items that should be avoided or consumed in moderation including: 1. red and processed meat, 2. sugar-sweetened beverages and fruit juice, 3. trans fats, 4. sodium, and 5. alcohol. However, alcohol was not considered in the questionnaire used for this research. Therefore, our AHEI included 10 components and a total score of 100. The International Physical Activity Questionnaire's shortened form (IPAQ-SF) was used to determine the level of physical activity [25]. Being pregnant, having thyroid conditions, following a diet, and smoking were the exclusion criteria. From the 190 participants, those who answered less than 70% of the questions in the questionnaires were excluded. Therefore, 168 students made up the final sample size for this research.

In the present study, statistical analysis of data was done by SPSS software version 26. Error probability (P) less than 0.05 was considered significant. Binary logistic regression model was used to analyze the relationship between the scores of AHEI and central obesity status. Furthermore, covariates like age, marital status, economic status, energy intake, body mass index

and physical activity were entered into the model as adjusting variables.

Results

The minimum, maximum, mean and standard deviation of the quantitative variables of the study are shown in Table 1. The mean of age, body mass index and waist circumference of the participants were 21.85 years, 24.23 kg/m^2 and 82 cm respectively. These people received an average of 2,392 calories of energy per day.

On the other hand, the descriptive statistics of the qualitative variables of the study is shown in Table 2, which shows that 32.7% of participants had central obesity.

By utilizing a binary logistic regression model, the relationship between central obesity status and the AHEI was examined. The results are shown in Table 3. In this model, the effects of age, body mass index, physical activity level, daily energy intake, marital status, and economic status were adjusted.

The results of this analysis indicate a significant inverse association between central obesity status and the AHEI score (P=0.010). In this model, the odds ratio was calculated to be 0.915, with a confidence interval of (0.855, 0.979), suggesting that on the average with an increase of one unit in the AHEI score, the likelihood of central obesity decreases by 8.5%. Furthermore, this analysis indicates that from the adjustment variables only BMI was positively associated with central obesity status (P=0.001), such that each unit of increase in BMI corresponds to a 49.4% increase in the likelihood of central obesity (OR=1.494). It's worth mentioning that if no adjustment variable was included in the model, the relationship between the AHEI score and central obesity status won't be significant (P=0.211).

Additionally, the relationship between each of the ten components of AHEI and the central obesity status was investigated. Adjustment variables were similar to the previous analysis. The results of this analysis are presented in Table 4.

Table 1: Descriptive statistics of quantitative study variables.

Variable	Minimum	Maximum	Mean	Standard Deviation
Age (year)	18	47	21.98	3.53
BMI kg/m^2	14.17	39.11	24.23	5.31
IPAQ Score	1.00	7998	1983.42	1749.20
Energy Intake (kcal)	888.95	6001.24	2392.48	822.71
Total AHEI Score	43.21	84.83	65.05	7.99
Waist circumference (cm)	57	124	82	12.15

Table 2: Descriptive statistics of qualitative study variables.

Variable	Status	Number	Percent
Marital Status	Single	151	89.9
	Married	17	10.1
Economic Status	income < 200$	50	29.8
	200$ < income < 400$	73	43.5
	income > 400$	45	26.7
WC Status	Normal	113	67.3
	Central Obese	55	32.7

Table 3: The association between central obesity status and AHEI score.

Variable		Central obesity		
		OR	Confidence interval (95%)	P
Age (year)		1.114	(0.958, 1.294)	0.160
BMI (kg/m^2)		1.494	(1.323, 1.687)	0.001
IPAQ Score		1.000	(1.000, 1.000)	0.358
Energy Intake (kcal)		1.001	(1.000, 1.001)	0.064
Matital Status		0.819	(0.150, 4.479)	0.818
Economic Status	income < 200$	1.000	(1.000, 1.000)	0.359
	200$ < income <400$	2.503	(0.700, 8.953)	0.158
	income >400$	1.519	(0.464, 4.968)	0.489
AHEI Score		0.915	(0.855, 0.979)	0.010

*Binary logistic regression model was used in this analysis. In the analysis of marital status single is considered as the reference group.

Table 4: The association between central obesity status and AHEI Components.

category	Variable		Central obesity		
			OR	Confidence interval (95%)	P
Confounding variables	Age (year)		1.132	(0.941,1.362)	0.189
	BMI (kg/m^2)		1.543	(1.344,1.772)	0.001
	IPAQ Score		1.000	(1.000, 1.000)	0.526
	Energy Intake (kcal)		1.001	(1.000, 1.002)	0.232
	Marital Status		0.865	(0.122,6.145)	0.885
	Economic Status	income < 200$	1.000	(1.000, 1.000)	0.115
		200$ < income < 400$	4.550	(1.051,19.688)	0.043
		income > 400$	1.861	(0.486,7.129)	0.364
AHEI Components	Vegetables		1.197	(0.914,1.567)	0.191
	Whole Fruit		0.795	(0.658,0.959)	0.017
	Whole grains		0.972	(0.824,1.146)	0.734
	Nuts and Legumes and vegetable proteins		0.818	(0.676,0.990)	0.039
	Long-chain (n-3) fats (EPA + DHA)		0.891	(0.723,1.098)	0.279
	PUFA		0.880	(0.656,1.181)	0.395
	Sugar sweetened beverages & juice		0.985	(0.809,1.201)	0.885
	Red/processed meat		0.749	(0.568,0.989)	0.041
	Trans-fat		8.855	(0.666,117.715)	0.099
	Sodium		1.225	(0.846,1.773)	0.283

*Binary logistic regression model was used in this analysis. In the analysis of marital status single is considered as the reference group.

According to Table 4 there was significant inverse associations between the central obesity status and three of the components of the AHEI: whole fruits (p=0.017, OR=0.795), nuts, legumes, and vegetable proteins (p=0.039, OR=0.818) and finally red or processed meat (p=0.041, OR=0.749). However, other components of the AHEI had no significant association with central obesity (p>0.05).

Discussion

Central obesity may contribute to the onset of numerous diseases. For instance, it poses a risk factor for conditions such as cardiovascular diseases, diabetes, high blood pressure, lipid disorders, and certain types of cancer [26,27]. To the best of our knowledge, this study represents the first investigation on the correlation between Alternative Healthy Eating Index and central obesity among the Iranian female students. The present study indicates an inverse relation between central obesity and AHEI such that on the average one unit increase of AHEI corresponds to 8.5% lower risk of central obesity. Likewise, a study conducted in Puerto Rico demonstrated that adherence to the AHEI shows a negative association with central obesity considering rather similar adjusting variables to our study [21]. Also, consistent with the current study, a 2016 research showed that higher diet quality was associated with a protective effect against an increase in waist circumference, such that every 10% higher score was associated with a 1.0-2.0 cm reduction in waist circumference [28]. That research was similarly a study on a population of women, collecting information using a dietary frequency questionnaire. On the other hand, in a study among 127 hospital employees, no association was found between AHEI and Waist-to-Hip Ratio (WHR). However, a significant reverse association was reported between WHR and the consumption of nuts, soybeans, and whole grains [29]. It is worth mentioning that the sample size in that study was smaller than our study, and a different index for diagnosing central obesity (WHR instead of WC) was utilized.

Given that not all components of the Alternative Healthy Eating Index exhibit equal predictive power for central obesity, we further investigated the individual relationships between each component of the profile and central obesity. This investigation indicates an inverse relation between central obesity and fruit consumption. Similarly, in a study, considering the Modified Korean Healthy Eating Index (MKHEI), this association was observed in females [30]. In another study in China, an association was found between the consumption of 5 servings of fruits and vegetables and a lower risk of central obesity in premenopausal women [31]. Fruits can exert a negative impact on energy homeostasis by providing less energy per meal and reducing daily food intake through increased satiety. Therefore, consistent fruit consumption can reduce central obesity and prevent weight gain [32-34]. On the other hand, Vitamins A, E, and C have an inverse relationship with lipid deposition or central obesity [35,36]. This effect of vitamins is attributed to reducing fat mass by resisting Leptin and decreasing genes involved in fat production and differentiation [37].

Furthermore, in this research, significant relations was observed between central obesity and the consumption of nuts, legumes, and vegetable protein sources. Likewise, in a study the intake of fiber from nuts was associated with lower BMI and WHR [38]. Also, another study showed that American adults who included legumes in their diet had considerably less weight gain, lower BMI, and smaller waist circumference compared to their counterparts over a period of 10 years [39]. Nuts are rich in unsaturated fatty acids, and evidence suggests that unsaturated fatty acids readily oxidize [40]. They also have a higher thermogenic effect compared to saturated fatty acids, which may lead to less fat accumulatio [41]. Due to its energy density and abundance of unsaturated fatty acids, fiber, and protein, nuts are highly satiating. Therefore, after consuming nuts, hunger is suppressed, and the intake of subsequent meals decreases [42]. The physical structure of nuts may also contribute to their satiating effect, as they need to be mechanically broken down into smaller pieces for swallowing. Chewing activates mechanical, brain, and sensory signaling systems that may alter appetite sensations [43]. Legumes contain a notable amount of plant protein and are considered by some experts as both vegetables and a protein source [44]. Multiple studies have shown that the consumption of vegetable protein sources reduces the risk of obesity [45,46]. Legumes are foods with a low glycemic index [47]. Some studies have demonstrated that dietary patterns focusing on low glycemic index foods like legumes reduce the risk of obesity and central obesity [48,49].

In This study, a significant direct association was observed between the consumption of red meat and processed meats such as sausages, salami, hamburgers, etc., and central obesity. Consistent with our findings, a study conducted in Costa Rica reported a direct association between the consumption of total meat (including unprocessed and processed red meat) and central obesity [50]. Additionally, another research revealed a significant positive association between the consumption of processed meats and central obesity [51]. In another study examining the relationship between meat consumption and metabolic syndrome components, a positive association was found between red meat consumption and central obesity, while no association was observed with white meat [52]. Presence of high levels of saturated fatty acids in red meat can lead to increased fat accumulation in the body [53]. This is because saturated fatty acids have a lower oxidation rate compared to other fatty acids [54].

This study meticulously addressed various confounding variables when exploring the correlation between the AHEI and central obesity, thereby offering novel insights into the subject. Secondly, the study's utilization of a food pattern approach instead of analyzing individual nutrients is noteworthy. This approach acknowledges that individuals consume a combination of nutrients as part of their dietary patterns. Thus, by examining food patterns, the study provides a more realistic and comprehensive assessment, offering a broader perspective on the issue at hand.

Researchers often face limitations in their studies, some apparent from the onset. Every research project, despite its uniqueness and strengths, has its own set of constraints. In the current study, we encountered specific limitations:

1. We used a questionnaire for data collection, and participants had to answer numerous questions themselves. The extensive questionnaire might have led to less careful responses, and some questions could have been beyond participants' tolerance, resulting in incomplete or inaccurate answers. Additionally, some participants may have declined to provide truthful responses.

2. Another limitation is associated with using a Food Frequency Questionnaire (FFQ) to assess food intake. Factors like under-reporting, over-reporting, and reliance on memory need consideration.

Conclusion

Results of the presented study show that there is a negative association between Alternative Healthy Eating Index and central obesity. Therefore, following a healthy eating pattern according to AHEI may decrease central obesity among the students. Also, it seems that consumption of fruits as well as nuts,

legumes and vegetable protein sources and avoiding consumption of red meat is more effective in reducing the risk of central obesity. However, further studies are needed to gain more information about these findings.

Declarations

Conflict of interests: The authors declare that they have no competing or conflict of interests.

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