

Interactions between Dietary Patterns with the Age of Onset of Obesity and Body Composition Among Obese and Overweight Female: A Cross –Sectional Study

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Research

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Abstract

Back ground: Obesity is associated to dietary factors, mostly those related to nutrients and energy. The aim of the present study was to explore the interaction of dietary patterns and the age of onset of obesity on anthropometric indicators among Iranian women.

Methods: A cross-sectional study was conducted on 266 obese and overweight Iranian females who were between 18 and 48 years old with BMI > 25 (kg/m²). Dietary intake was assessed using a semi-quantitative Food Frequency Questionnaire (FFQ) was calculated for all participants. Three dietary patterns principle component analysis (PCA) was used as a factor score for each of the three dietary patterns. Anthropometric evaluation was performed for participants.

Results: A significant inverse relationship ($p < 0.05$) was found between DASH score and the age of onset of obesity under 18 years old, fat-free mass, and weight in women. Conversely it was observed that higher weight and body mass index (BMI) were associated with the age of onset of obesity under 18 years old compared to participants more than 18 years old ($p < 0.05$). Moreover, it was observed that higher adherence to DASH dietary pattern has a positive correlation with lower BMI ($P = 0.07$), visceral fat ($P = 0.03$), and body fat mass (BFM) ($P = 0.07$). A significant interaction between DASH pattern and onset obesity under 18 years old on weight observed in women ($P = 0.001$).

Conclusions: This study suggested that DASH dietary pattern is a good choice for weight management and a healthier body in general and may decrease the development of obesity-related diseases.

It was suggested that higher adherence to DASH pattern may reduce the obesity markers and decrease the development of obesity-related diseases.

Introduction

Obesity is one of the most prevalent chronic diseases in the world. According to WHO, it is estimated that more than 1.9 billion individuals aged over 18 years old are overweight, of these over 650 million individuals are obese and this number is growing (1, 2). Middle East alone has an obesity prevalence of 24.5% (3). It should be noted that the prevalence of obesity has also been significantly increased (17.4%) in Iran as one of the Middle Eastern countries between 1992 and 2010 (4, 5). There is a relationship between obesity and progression of several chronic diseases such as cancer, cardiovascular diseases, and diabetes (6). Therefore, understanding the risk factors that contribute to the increasing incidence and prevalence of obesity could help us in reducing its growth. These risk factors may fall under environmental impact, age, social factors, lifestyle, and nutritional statue (7, 8).

Early onset of obesity may be an important factor contributing to the risk of developing weight-related chronic diseases. It also may be a predictive factor of a higher BMI, body fat mass (BFM), and body fat percentage among patients. Interestingly, it is reported that the dynamic modifications of weight over time is strongly connected to the risk of obesity-related complications rather than BMI alone (9–11)(12). In this context, previous studies showed that an early onset of obesity in adults is related to an increase in the size

and the number of adipose cells and then, it may induce a higher risk of diabetes. Excess calories in overweight and obese people lead to the accumulation of fat in the insulin target tissue, such as the liver and muscle, which leads to insulin resistance (13, 14). On the other hand, obesity can also be modified or prevented by some behavior changes, increased physical activity, and proper diet (15, 16). Earlier studies have indicated that the age of onset of obesity is an important factor determining the risk of progressing weight-related disorders and it is possible that those with early onset obesity show a different response to diet changes or lifestyle interventions (17, 18). It should be noted that today, weight loss programs do not take into account whether the person has been obese over his lifetime or only currently (19–21). In this manner, it is tempting to speculate that information regarding the age of onset of obesity along with BMI may predict the risk of health issues related to obesity for further interventions (22).

Previous studies have mainly surveyed only the association of nutrients with the risks of obesity and its related diseases, such as study on the high consumption of sugar-added beverages with prevalence of obesity in children (23, 24) and the assessment of the relationship between protein intake and obesity (25, 26). However, focusing on dietary patterns will be more beneficial and informative because all aspects of individuals' diet, and the combined effects can be assessed (27). In this manner, culture as an important variable is included into the overall evaluation when dietary patterns are used as assessment tools (28). Hence, considering the burden of obesity prevalence and the importance of dietary patterns, there are a growing challenge for evaluating their association (10, 29, 30).

To further explanation, previous literature showed that dietary patterns are associated with central adiposity in adult women (31, 32). Indeed, dietary pattern is related to body composition, wherein the fiber and carbohydrate intake are associated with Waist–Hip Ratio (WHR) (33). Remarkably, studies on obesity introduced body composition as one of the important methods for evaluating general and visceral obesity (34). Furthermore, the relation of body composition with disorders related to obesity has been reported too (35)(36). Therefore, the evaluation of body composition along with dietary patterns can be used for predicting any modification of health and disease condition (37, 38).

It is shown that a dietary pattern with lower energy density or a low-fat and low-carbohydrate diet lead to weight management and positive result in body composition (39). The existing literature highlights that the traditional and western dietary patterns are positively associated with obesity and may negatively affect the body composition resulting in higher percentages of body fat (40, 41).

To the best of our knowledge, no research has been carried out regarding the dietary pattern interactions and obesity and body composition. Due to high prevalence of adolescence and childhood obesity among Iranian participants, this study was conducted to scrutinize whether there is an interaction of dietary patterns with age of onset of obesity.

Material And Methods

Study population

A total of 266 healthy women with BMI of 25–40 kg /m², who were 18–48 years old Participants were, selected from the Tehran University of Medical Science's (TUMS) Health Clinics. The study protocol was approved by the Ethics Commission of Tehran University of Medical Sciences (Approval No. IR.TUMS.VCR.REC.1395.1234), and all participants signed written informed consent. The General Health Questionnaire of all participants was completed using a self-administered questionnaire.

The exclusion criteria included subjects with any history of illness, acute or chronic inflammatory disease or regular use of medication like birth control pills, history of hypertension, cardiovascular disease, diabetes mellitus, impaired renal and liver function, consumption of alcohol or drug abuse, smoking, thyroid disease, malignancy, pregnancy, and in the lactation period. We also excluded participants who reported any chronic diseases which affected their diet from the current investigation as well as those who had followed an arbitrary special dietary regimen or had any body weight fluctuations over the past year.

Assessment of dietary intake

Dietary intake information was collected by completing a reliable and semi-quantitative Food Frequency Questionnaire (FFQ). We used the information gathered from the FFQ, which had 147 items with a standard serving size for each food. During the past year, according to the pattern of consumption per day, week, month, or year, frequency of use was reported for any type of food. This study used the FFQ to compare the dietary intake of adults in Tehran based on recent dietary guidelines for Americans. The validity of this FFQ was examined, (42) and the FFQ data were analyzed using Nutritionist – 4 software.

Anthropometric measurements

An impedance fat analyzer (Inbody 720, Korea) was utilized to obtain the weight values.

We used Body Composition Analyzers for assessing body composition including Body Fat Mass (BFM), Fat-free mass (FFM) and Fat Mass (FM), .Body cell mass (BCM) explains all the metabolically active tissues of the body(43, 44). Body fat percentage (%) indicates a significant percentage of the body mass. The percentage of the body that is not fat is "fat-free mass. Visceral fat area (VFA) was assessment by fat stored in the abdominal cavity. The weight measured with minimum coverage and light clothing without shoes closest to 0/1 kg (Seca 711; Seca, Hamburg, Germany). Height closest to 0.1 cm was measured for each participant, using a wall stadiometer (Seca 711; Seca, Hamburg, Germany). BMI was calculated by dividing weight (kg) by square of the body height (m²) to assess the obesity and overweight (45). Waist circumference was used the widest part surround of hips in participates besides was considered ideal waist circumferences than 35 inches for woman (46) .Anthropometric measurements were carried out according to the study standards.

Statistical Analysis:

The data without normal distribution that could not be transformed suitably for normal distribution were utilized for z-scores. The quantitative and qualitative variables were described by mean \pm SD and percentage, respectively. Major dietary patterns were identified based on the 21 food groups using (PCA).

Independent sampling t test and ANOVA were used to compare the quantitative variables between dietary patterns and body composition and ANCOVA was employed to make adjustments for the confounding.

Based on the previous studies and due to data nature and correlations, the items of each food pattern were determined considering values with a load factor of > 0.3 . Factor loadings are referred to as the coefficients of correlation between food groups and dietary patterns. Positive loading in a factor shows a direct correlation with the factor, while negative loading demonstrates an inverse correlation between food and the factor. Similar to other studies, the dietary patterns were labeled according to the data interpretation of the researchers. Participants were categorized based on healthy, unhealthy, and western dietary pattern scores converted into low first quartile and other groups.

Categories of dietary pattern scores and body composition were compared in terms of demographic characteristics, such as age, anthropometry, by Independent t-test. Quintiles were assessed for the distribution of qualitative variables applying the Chi-square test. Adjustments were made for age, BMI, and total EI. In all multivariate models, the low adherence of dietary patterns score was regarded as the reference. All statistical analyses were performed using the SPSS software version 23 (SPSS Inc., Chicago, IL). The values less than 0.1 were considered significant for the interaction tests and values less than 0.05 were contemplated for all the tests. We employed the generalized linear model (GLM) analysis method to assess the interaction between dietary patterns and obesity and anthropometric measurements.

Results

The mean \pm SD of age, weight, BMI, BFM ,fat free mass of participates were (36.49 ± 8.38) years, (80.89 ± 12.45) kg, (31.04 ± 4.31) kg/m², (34.04 ± 8.69) and, (5.64 ± 46) kg, respectively Table 1.

Table 1
General characteristics of study participants

Variable	Mean ± SD	Minimum	Maximum
Age(Y)	36.49 ± 8.38	17	48
Weight(kg)	80.89 ± 12.45	59.5	136.6
BFM(kg)	34.04 ± 8.69	19.4	74.2
FFM(kg)	5.64 ± 46.8	35.3	67.7
BMI(kg/m ²)	31.04 ± 4.31	24.2	49.6
PBF (%)	41.53 ± 5.48	15	54.3
WC(cm)	99.01 ± 10.05	80	136
VFA(cm)	168.30 ± 103.11	20	1817
Data are reported as mean ± SD, otherwise explained.SD: standard deviation.			
Abbreviation: BFM: Body Fat Mass, BMI: body mass index, WC: Waist circumference .VFA: visceral fat area .FFM :fat free mass .PBF: percentage body fat.			

Following the analysis of the participants' food intake, three dietary patterns were recognized. We used PCA method and according to Scree Plot chart review included; pattern 1 which mainly involves a high intake of beans and nuts, olives, low-fat dairy products, vegetables, fruit, starchy vegetables, poultry and aquatic, which is denoted as the "DASH dietary pattern." The second dietary pattern declared unhealthy dietary patterns relying mainly on low proportions of unhealthy food, starchy vegetables, energy drinks, processed foods, junk food, mayonnaise sauces, sweets and desserts. Finally, the third dietary pattern, also known as the western pattern, comprised of red meat, high-fat dairy products, solid oil, tea and coffee(47). These are all shown in Table 2.

Table 2
Factor loadings of the food groups in the main dietary patterns extracted

Food groups	DASH dietary pattern	Western dietary pattern	Unhealthy dietary pattern
Vegetables	0.74	-	-
Fruit	0.58	-	-
Beans and nuts	0.57	-	-
Olive	0.56	-	-
Low-fat dairy	0.56	-	-
Poultry and aquatic	0.52	-	-
Starchy vegetables	0.40	0.34	-
Spices and Seasonings	-	-	-
Salt	-	0.68	-
Processed foods	-	0.64	-
Energy drinks	-	0.63	-
Junk Food	-	0.57	-
mayonnaise sauce	-	0.52	-
Sweets and desserts	-	0.36	-
Cereals	-	-	-
Liquid oil	-	-	0.54
Solid oil	-	-	0.60
High fat dairy	-	-	0.41
Red Meat	-	-	0.36
Tea and coffee	-	-	0.32
Gut	-	-	0.40
Percentage of variance (%)	%13.33	%11.9	%7.8
Percentage of cumulative variance	%33.04		
A factor below 0.3 was omitted to name the dietary pattern.			

Table 3 defines the relationship between the general characteristics and the three mentioned dietary patterns. A significant diversity was observed between FFM ($P = 0.001$), weight ($P = 0.005$), and DASH

dietary pattern .study also mentioned age as an indicator of interaction according to the western dietary pattern (P = 0.00). We controlled age (year), BMI (kg/m²), energy intake (kcal/day).

Table 3
Correlations between general characteristics and dietary pattern

Variables	Dietary patterns								
	DASH dietary pattern			Unhealthy dietary pattern			Western dietary pattern		
	High intake	Low intake	p-value	High intake	Low intake	p-value	High intake	Low intake	p-value
Age(y)	36.51± 8.41	36.035 ± 8.69	0.67	36.51 ± 8.69	36.03 ± 8.41	0.51	34.38 ± 8.80	38.15 ± 7.86	0.001
Weight(kg)	81.11 ± 10.98	77.25 ± 9.53	0.005	79.28 ± 10.99	79.12 ± 9.91	0.91	78.87 ± 9.99	79.52 ± 10.91	0.63
BFM(kg)	33.58 ± 7.60	32.16 ± 6.80	0.13	32.81 ± 7.63	32.97 ± 6.85	0.86	32.86 ± 7.41	32.91 ± 7.10	0.59
FFM(Kg)	47.59 ± 5.40	45.28 ± 5.04	0.001	46.55 ± 5.30	46.35 ± 5.41	0.78	46.31 ± 5.06	46.6 ± 5.63	0.68.
BMI(kg/m ²)	30.89 ± 3.67	30.07 ± 3.44	0.84	30.33 ± 3.81	30.65 ± 3.32	0.50	30.24 ± 3.74	30.74 ± 3.39	0.29
PBF (%)	40.74 ± 4.62	41.15 ± 5.04	0.55	40.69 ± 5.47	41.20 ± 5.00	0.45	40.80 ± 5.80	41.09 ± 4.62	0.67
WC(cm)	99.18 ± 9.67	96.59 ± 8.39	0.31	98.13 ± 9.68	97.69 ± 8.59	0.72	2.97± 9.05	98.21 ± 9.26	0.62
VFA(cm)	161.60 ± 37.74	155.16 ± 35.48	0.18	157.55 ± 39.54	159.34 ± 33.74	0.71	157.32 ± 38.11	159.58 ± 35.36	0.64
All values of table are significantly different from P value < 0.05									
High intake : highest adherence according to dietary patterns									
Low intake : lowest adherence according to dietary patterns.									
Data are reported as Mean ± SD									
Abbreviation: BFM: Body Fat Mass. BMI: body mass index. WC: Waist circumference.VFA:visceral fat area.FFM:fat free mass.PBF: percentage body fat.									

We examined the interaction between onset age of obesity and the related variables that are presented in Table 4. The onset age of obesity was divided into two subgroups that were evaluated as under 18 and over 18 years old participants. There was a significant interaction between the behaviors of these two groups. There was also a relationship between weight (P = 0.006) and BMI (P = 0 .07) with the onset age of obesity in the group of participants under 18 years of age.

Table 4

Relationship between general characteristics of study participants according to Mean \pm SD and onset age of obesity

Variable	> 18 (Y)	\leq 18(Y)	P -value
	Mean \pm SD	Mean \pm SD	
Age(y)	30.86 \pm 8.48	38.98 \pm 7.46	0.00
Weight(kg)	83.88 \pm 13.57	79.40 \pm 11.31	0.006
BFM(kg)	36.35 \pm 9.93	33.10 \pm 7.90	0.012
FFM(kg)	47.25 \pm 5.62	46.38 \pm 5.41	0.24
BMI(kg/m ²)	31.77 \pm 4.74	30.73 \pm 4.09	0.07
PBF (%)	42.85 \pm 5.88	41.11 \pm 5.33	0.06
WC(cm)	100.71 \pm 1.50	98.17 \pm 9.46	0.05
VFA(cm)	173.06 \pm 41.25	167.28 \pm 124.48	0.69
Data are reported as Mean \pm SD, otherwise explained.SD: standard deviation. P < 0.05 .P value from paired t-test.			
Abbreviation: BFM: Body Fat Mass. BMI: body mass index. WC: Waist circumference .VFA: visceral fat area .FFM :fat free mass .PBF: percentage body fat.			

The interaction of the DASH dietary pattern and onset age of obesity on anthropometric body composition, are presented below. In our research, the interaction onset age of obesity between the DASH dietary

Pattern and onset age of obesity with, BFM visceral fat and BMI was also identified in the participants (Fig. 1:a, b, c). This study provides some evidence that high adherence to the DASH dietary pattern has a positive correlate with BMI (P = 0.07), visceral fat (P = 0.03) and BFM (P = 0.07).

It was observed that the group of individuals with an onset age of obesity over 18 years followed the most unhealthy dietary pattern had a lower mean weight (P = 0.01) (Fig. 2:b). In this way, in women with an onset age of obesity under 18 had the highest adherence according to this dietary pattern observing a minor BFM (P = 0.02) than the reference group (Fig. 2:a). In individuals over the age of 18, consumption according to this pattern showed no significant difference compared to the reference group. (P = 0.57)

No significant interaction was found between the western dietary pattern and onset age of obesity related to body composition.

Discussion

To the best of our knowledge, the current study is the first study to investigate the interaction dietary patterns with the age of onset of obesity on body composition in Iranian women. Based on the principal components analysis, three main dietary patterns were extracted which included DASH, Unhealthy, and

Western dietary pattern. In summary, this study evaluates the significant interaction between the DASH dietary pattern and the age of onset of obesity for BMI. The present study revealed that participants who followed the high intake DASH dietary pattern had lower BMI, visceral fat, and BFM compared to participants using the low intake pattern. We investigated a significant interaction between the unhealthy pattern with the age of onset of obesity on weight in the participants. Our study showed that subjects with an onset of obesity under 18 years who had the highest adherence to the unhealthy dietary pattern weighed less. The higher consumption western dietary pattern had no significant interaction with the age of onset of obesity in relation to body composition.

Among previous studies various dietary patterns and obesity were examined. A systematic review study investigated increased fruit and vegetable consumption and DASH dietary pattern and its association with reduced body weight, and their findings corresponded to the findings of the present study. The positive effect of the DASH dietary pattern on obesity in adolescence was reported(48). Sahar Golpour et al. observed that a high intake the DASH dietary pattern controlled hypertension and decrease risk obesity and overweight in children(49, 50). Another study revealed that adherence to the DASH dietary pattern in adolescents may decrease weight gain over a period of 10 years (51).The intervention study associated the low-fat dietary pattern with reduced BMI and fat mass, which is consistent with the results in the DASH pattern and change of body composition(52). A cross-sectional study examined the association between dietary patterns and body composition in participants. The study found a significant relationship between consumption of fruits and vegetables in adults that were associated with changes in body composition and BMI, while it found no association between the dietary patterns and central adiposity. Our results are in line with the results of this study on women. Nonetheless, the results of our study did not observe an interaction between the western pattern and age of onset of obesity for body composition(53).

Observational study has also suggested that the western pattern comprises red meat, processed meat, refined grains, sweets, desserts, French fries, and high-fat dairy products which increased obesity and hypertension(54). Based on the results of an research performed on 664 volunteers and its report published in 2009, a positive association was demonstrated between the western dietary pattern and anthropometric indices, obesity and plasma lipid concentration(55). Although the results of our study regarding the interaction between the western pattern and age of onset of obesity for body composition were not observed.

An association in 2014 was found between a dietary intake composing of fiber, bread, and fruits and vegetables with body composition. This dietary pattern decreased fat mass gain in girls, Also, the study observed mass gain in boys using packed lunches(56). Likewise the information of this study can be cited in our study.

The review article studied 18 articles indicating that the unhealthy dietary pattern using processed and red meats, mayonnaise, soft drinks, sweets, refined grains, snacks, fruit juice, nuts, French fries, eggs, butter, full-fat dairy products had a positive association with increase overweight and obesity ; thus, the results of our study were consistent with the results of the mentioned study(57). The principled mechanisms for the favorable interaction between the DASH dietary pattern and obesity and body composition are not

completely understood. This dietary pattern which includes eating high quantities of fruits and vegetables and whole grains foods which have a rich source of fiber, potassium, magnesium, calcium, and phytochemicals may have utility effects on reducing obesity besides following DASH dietary pattern effect in satiety center in mind and lower glycemic index, in addition the mechanisms of DASH dietary pattern showed that consumption of fiber can effect on the secretion of insulin and glucagon reduced fat accumulation (58). The explanatory mechanism of the interaction effects of Unhealthy dietary pattern and obesity and anthropometric indicators suggests that the reverse effect of increasing intake high sugar content beverages, trans fat, saturated fat, high fat dairy can be due to high levels of insulin secreted after eating a meal, leading to an increase in obesity related indices. In women who followed this dietary pattern, it was discovered that the diet lead to increased appetite and increased energy intake. These mechanisms described a direct negative effect on obesity(59).

Numerous articles have studied the relationship between dietary patterns and body composition, but no study has been done on the interaction of different dietary patterns and the age of onset of obesity on body composition. Our findings suggest a complex interaction of the three main dietary patterns and the age of onset of obesity for body composition in the overweight and obese woman in our study and offer insight into how dietary pattern interactions may increase the indicators that are associated with obesity.

The present study has some limitations that should be considered. First, the use of FFQs includes self-reporting of dietary intake for dietary assessment which can lead to biases in the reports of dietary intake, therefore it is suggested a more comprehensive questionnaire be employed for further research on the topic. Second, our participants consisted of only women. Thirdly, obese women were used in our study it cannot be representative of the general population. Fourthly, the study design was cross-sectional, which cannot provide information about the cause-and-effect relationship and lastly, a larger sample size population is required for further study.

Conclusion

In summary, the study showed that high adherence to the DASH dietary pattern is inversely related to the onset of age of obesity among Iranian females. Furthermore, food intake of women, according to the unhealthy pattern, showed a significant difference with regard to weight and BFM and the age of onset of obesity. Our main finding was that lower adherence in the unhealthy pattern and higher adherence to the DASH dietary pattern resulted in a positive association with maintaining normal weight among participants and may prevent obesity and help in maintaining a healthy body. The results of this study may be useful and give a new perspective for future obesity studies besides it is hoped the prevention of obesity at an early age and decrease the rate of development of different disease related to obesity. Although, future prospective studies are required to confirm these findings.

Declarations

Ethical Approval and Consent to participate

Ethics approval and consent to participate Ethics approval for the study protocol was confirmed by The Human Ethics Committee of Tehran University of Medical Sciences (Ethics Number IR.TUMS.MEDICINE.REC.1399.636). All participants signed a written informed consent that was approved by the Ethics committee.

Consent for publication

Not applicable.

Availability of supporting data

Participants of this study did not agree for their data to be shared publicly, so supporting data is not available.

Competing interests

All authors declared that they have no competing interests.

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Authors' contributions

NKh and LS, Contributed to conception and design. AM and FS, Contributed to all experimental work. HY' Contributed to data and statistical analysis. KhM supervised the whole project. All authors meet the criteria listed above and have read and approve the submission, also participated in the finalization of the manuscript and approved the final draft.

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Figures

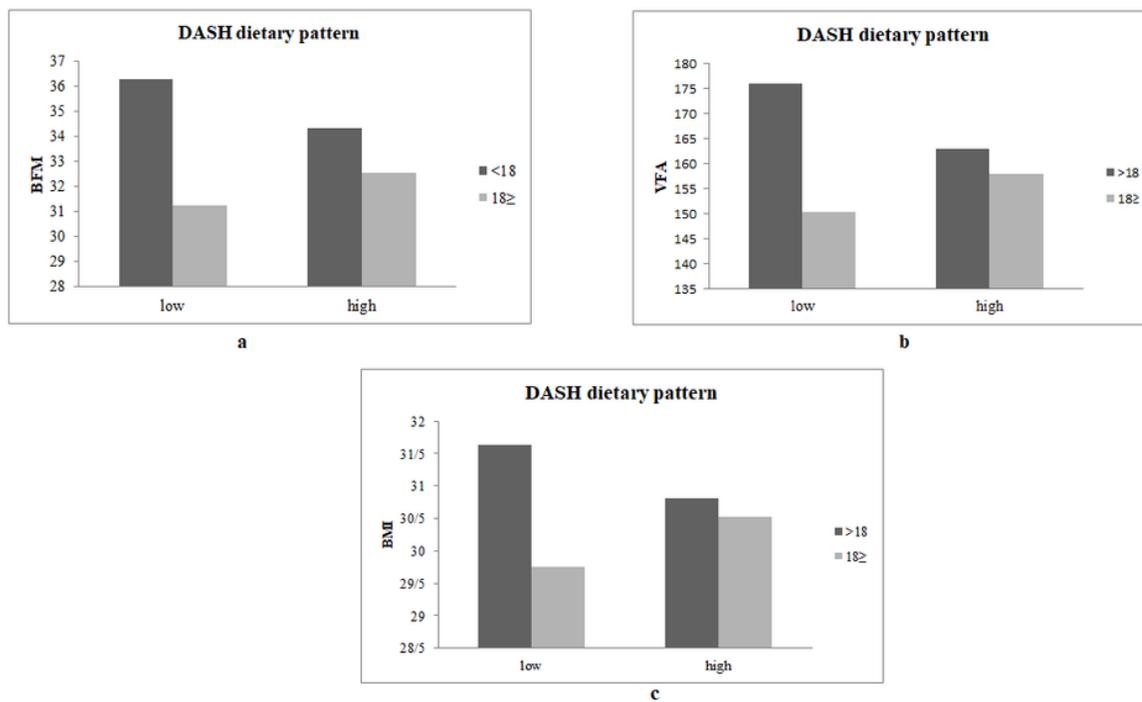


Figure 1

interaction between DASH dietary pattern and BFM,VFA,BMI a: Interaction DASH dietary pattern and BFM between under18 and upper18. (P interaction=0.07) b: Interaction DASH dietary pattern and visceral fat between under18 and upper18. (P interaction =0.03) c: Interaction DASH dietary pattern and BMI between under18 and upper18 (P interaction=0.07)

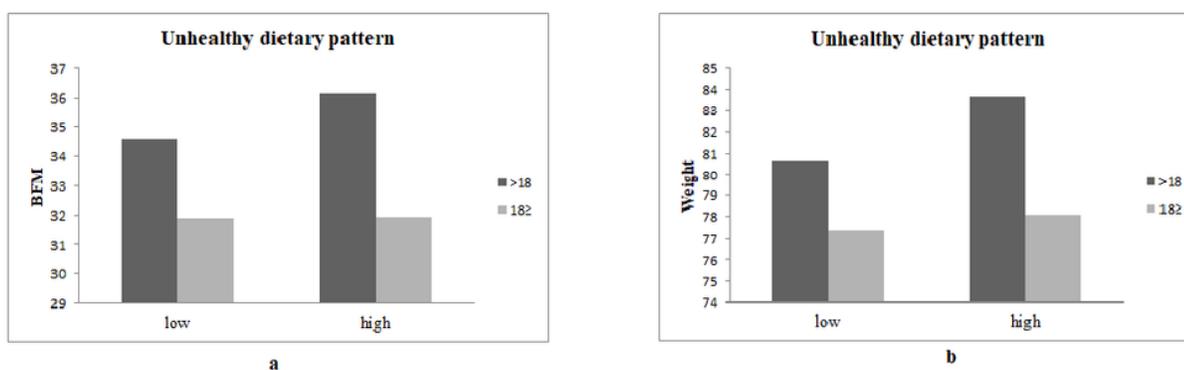


Figure 2

interaction between Unhealthy dietary pattern and BFM, weight a: Interaction Unhealthy dietary pattern and BFM between under18 and upper18 (P interaction=0.02) b: Interaction Unhealthy dietary pattern and Weight between under18 and upper18. (P interaction= 0.01)