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Original Article

Adherence to a healthy plant diet may reduce inflammatory factors in obese and overweight women—a cross-sectional study



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ABSTRACT

Objective: Obesity and overweight which are consequence of some interaction factor such as genetics and behavioral habit. Obesity as a metabolic disorder and chronic inflammation is a trigger to countless disease. The main goal of this study is to investigate the interaction of herbal diet on the levels of liver enzymes, inflammatory factors and adipocytes profile.

Materials and methods: A total of 240 adult women range of 18–48 years were included in the current comparative cross-sectional study. Body composition and dietary intake (using a validated semi-quantitative food frequency questionnaire (FFQ)) were assessed in all participants. In determining a plant based diet index (PDI), vegetarian foods were taken positive score and reverse points for animal foods. For determining a healthful plant based diet index (hPDI), healthy plant foods received positive scores, while less healthy plant foods and animal foods received reverse scores. To create an unhealthy plant-based diet index (uPDI), positive scores were assigned to less healthy plant foods and reverse scores to healthy plant foods and animal foods. For the measurement of serum liver enzymes and inflammatory factors, an enzyme-linked immunosorbent assay (ELISA) method was used.

Results: Healthy diet like whole grains, fruits, vegetables, cereals, and beverages such as tea and coffee, based on dietary guidelines, significantly reduced the amount of hs-CRP and TGF- β ($P < 0.0001$). Higher adhering to hPDI may as a result in higher intake of fiber intake, antioxidants, unsaturated fats, micro-nutrients, could reduce saturated fats and iron content, and finally weight loss, and reduce inflammation in the body.

Conclusion: Base on our finding, in those people who intake higher amounts of healthy plant foods, (vegetable types), instead of unhealthy herbal foods (sweets and desserts), might be useful to reduce inflammation factor like TGF- β and hs-CRP. Women with a higher compliance score in uPDI group (juices, refined grains, starches sweetened with sugar, sweets, and desserts) did not have significantly increase in inflammatory factors levels.

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1. Introduction

Obesity as a chronic disease causes many diseases such as liver disease, inflammatory disorders, high blood pressure, diabetes mellitus, heart disease, cancer, etc. [1]. Numerous reason like genetics, lifestyle and personal behavior manner might have major role in higher incidence of obesity in all over the world. Behavioral

manners, for instance physical activity and a diet which have influenced by social, cultural and environmental contexts. Dietary pattern and lifestyle have been changed rapidly by development of urbanization, industrialization of societies and increased economic growth, in last decades. So outcome of these dramatic change are higher prevalence of obesity, liver and inflammatory diseases among adults and the young population [1,2]. Eventually all of them will have negative effects on live expediency and economics situation [3]. Any condition which cause to damage liver that is important organ with huge function may increase release of some enzymes and they will secrete into bloodstream and induce abnormality in body balance. ALT and AST are two liver enzymes that

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the level of them in serum are the indicator marker of liver damage [4]. Various studies have shown, different intakes of dietary components and micronutrients maybe have an effective role on the level of liver enzymes. High fat diet, the amount of alcohol intake [5] and vitamin A [6] in nutritional factors have affected on secretion on enzymes. Although dietary components are important, the presence of many unknown compounds in foods and possible interactions between nutrients has led to a survey of patterns of food intake that generally recommends a component of the diet. To clarify this issue association of DASH diet on liver enzyme would be a good example [7].

CRP is known as one of the most prominent protein in acute phase protein group which concentrate in response to anomalies inflammation in increase of chronic inflammation (hs-CRP, IL-1 β , TGF- β). In addition studies showed these protein have increased in obese and overweight subjects [8,9], which have a key role in Inflammatory diseases such as atherosclerosis and type 2 diabetes [10–13]. Also weight gain and accumulate of adipocytes (1.5 m/s) (18 cm) could be a major risk factor for chronic disorder like diabetes and cardiovascular disease and metabolic syndromes, and liver dysfunction (fatty liver) [14–17]. Prevention and control of weight gain and fat accumulation are an important remedy for maintaining and improving the health condition in individuals. Receiving higher amounts of fruits, vegetables and herbs plays a protective role against weight gain and fat mass [18]. Fruits and vegetables are rich sources of phytochemicals, and numerous studies have shown that more fruits and vegetables have protective role in control of obesity and lower body fat and cardiovascular disease [19,20]. Fruit consumption, vegetables as a source of; phytochemicals play a main role in reducing appetite, regulating carbohydrate metabolism and lipid, and regulating the metabolism of adipocytes. Polyphenols in fruits and vegetables such as curcumin, nardinignin, routine, hesperidine, and resveratrol are able to inhibit the differentiation of per-adipocytes and apoptosis.

Studies clarify that vegetarian diet, healthy plant hPDI diet (whole grains, fruits, vegetables, nuts, legumes, oils and Tea and coffee) the positive influence on many chronic disorder. On the other unhealthy vegetable diet, uPDI, which include less healthy foods (juices, sweetened beans, refined grains, sweets and fried potatoes), as well as animal foods might have harmful effect [23,24]. Therefore, in attention those facts a diet based on a healthy vegetarian will reduce the incidence or progression of obesity as a chronic inflammation, both acute and chronic diseases ad adipocyte profile as well as liver enzymes.

Above all, there is no definitive and reliable outcome. In order to clarify the appropriate vegetarian diet for reducing liver enzymes and inflammatory factors in overweight and obese women, we conducted this study to investigate relationship rate of adherence herbal nutrition index with liver enzymes, inflammatory factors and adipocytes profile.

2. Materials and Methods

This is a cross-sectional study which conducted on randomly selected healthy women ranged between 17 and 69 years (after puberty and before menopause) who referred to health centers in Tehran. A total of 240 participants ($30 \leq \text{BMI} < 40$) were enrolled to the study. individuals were included with the following criteria: non-compliance a specific diet during and non-use of drugs affecting the levels of liver enzymes such as naproxen, statins, diclofenac, spinel and ibuprofen the past year, not having current weight loss programs, no take of weight loss supplements and not being recently pregnant. Participants were excluded if they had a history of T2D, CVDs, polycystic ovary syndrome (PCO), stroke, non-alcoholic fatty liver disease (NAFLD), inflammatory disease,

hypertension, cancer, thyroid diseases. Women were also excluded who did not respond to more than 70 food items in the food frequency questionnaire (FFQ), or who reported a total daily energy intake (EI) outside the range of 800–4200 kcal (3344–17556 kJ), as well as those taking medication that could affect plasma lipoproteins, blood pressure and carbohydrate metabolism. Each participant was informed completely regarding the study protocol and All participant completed written informed consent.

2.1. Anthropometric measurement

Height was measured by a wall-mounted studio meter to the nearest 0.5 cm while the individuals stand without shoes, heels together touching the wall and looking straight forward. The weight was measured using a Hamilton scale to the nearest 100 g with minimum dress and no shoes. Daily calibration was checked every morning, before and during the day, during measurement by using standard weights to prevent errors. The waist circumference of the subjects was measured at a point midway between the iliac crest and lower rib margin with anon-elastic tape to the nearest 0.5 cm. To prevent the individual error, all anthropometric measurements were performed by one trained expert. Body mass index (BMI) was calculated based on the weight (kg) divided by height squared (m^2).

2.2. Dietary assessment

A semi quantitative food frequency questionnaire (FFQ) was used to measure usual dietary intake during the past year. The FFQ consists of 147 items with a standard serving size usually consumed by Iranians. Items are defined based on a series of foods or beverages which are categorized into 9 major food groups. Food frequency categories “daily/weekly/monthly/were used in which participants would be asked to report their consumption frequency of each food item. Then, for each food item, the reported frequency was converted to a daily intake. Nutritionist 4 software was used to compute energy and nutrient content of foods which was based on United States Department of Agriculture (USDA) food composition table modified for Iranian foods. Validity and reliability of the FFQ have been assessed previously.

2.3. Blood sampling and biochemical assay

Fasted blood samples were taken and the serum was separated by centrifuged and stored at a temperature of -80°C until the analysis was carried out. All samples were analysed by using a single assay according to manufacturer's protocol. All measurements were taken at the Endocrinology & Metabolism Research Institute (EMRI) Bio nanotechnology laboratory of Tehran University of Medical Science. Measurement of liver enzymes and inflammatory factors were done by spectrophotometric-auto analyzer. Based on normal hepatic function (AST: 8–48 and ALT: 55–57) and abnormal liver function (ALT <7 ALT> 55 and AST <8, AST> 48), as well as normal and abnormal levels of inflammatory factors (hs-CRP, IL-1 β , TGF- β). (Low risk: less than 1.0 mg/L - Medium risk: 1.0–3.0 mg/L - high risk: more than 3.0 mg/L).

2.4. Scoring of PDI, (hPDI), (uPDI)

Vegetarian diet, the three criteria of the PDI (vegetarian diet index), healthy vegetarian diet (hPDI), and unhealthy vegetarian diet (uPDI) are defined. In the general vegetarian diet, the consumption of ganglia was divided into 5 groups, with the highest level of consumption of each meal with a vegetable base score of 5 and the lowest consumption rate of 1. On the other hand, the high

consumption of animal foods such as animal fat, dairy, eggs, fish and meat, points 1, and the lowest consumption rate was given 5 points. In healthy vegetarian diets, positive points were given to healthy plant foods such as whole grains, fruits, vegetables, cereals, and beverages, such as tea and coffee, and inverse rewards to unhealthy plant foods and animal foods. In the unhealthy vegetarian diet, unhealthy plant foods such as refined grains, juices, candy drinks, potatoes and desserts gave a positive rating and rewarded with healthy animal and plant foods.

Participants were categorized based on vegetarian diet score, and the association of individual's compliance with the above regimens in each quarry with liver enzymes and inflammatory factors and adipocytes' profile was investigated using regression equations. The amount of regular food intakes during the past year was evaluated by using the FFQ 147 frequency questionnaire (Half-bit). The feed frequency questionnaire includes 147 items of food intake plus the standard size of consumption of each food. The questionnaire is also available for ease of use, with 9 options related to the frequency of consuming the standard size of each food, from less than once a month to Consuming more than 1 time a day, people can choose the right option depending on the amount of it. Participants in the study will be required to list the frequency of food intake depending on the frequency of use in a day, week or month. Questionnaires were completed and collected by the nutrition expert after training. The reliability and reliability of the semi-food frequency questionnaire have been confirmed by Mir-miran et al.

Food items in the feed frequency questionnaire were grouped into 18 food groups. Unhealthy plant diet index(uPDI), Sample size

240, p-value <0.05 is significant. According to the results of the Tukey test in the above table, there was no significant relationship between the two groups of quarks in this group ($P > 0.001$).

2.5. Statistical analysis

The general characteristics of the participants in the quartiles of the Plant-Based Diet indices were compared using one-way analysis of variance (ANOVA) for quantitative variables. Binary logistic regression analysis in multiple models was used to test Adherence to Plant-based Diet quartiles of with nephropathy in the crude model, and was adjusted for different variables such as age, energy intake, duration of diabetes, BMI and physical activity. Statistical analysis was performed using SPSS version 20.0. The level of significance was set at a probability of ≤ 0.05 for all tests.

3. Result

The associations of healthful and unhealthful plant-based diets with T2D in three prospective cohort studies had examined by Ambika Satija in the United States.¹⁴ The 18 food groups were created within larger categories of animal foods, and healthy and less healthy plant foods. Details examples of food groups modified for local consumption traditions (Table 1).

3.1. Study population characteristics

The mean duration, age, BAI, BMI, Weight (kg), GOT, TGF- β , IL1 β , hs.CRP, and GPT of the study participants were 36.52 ± 8.32 years,

Table 1
Examples of food items constituting the 18 food groups.

Herbal Food	
Healthy	Food group
Grain	Whole grains
Grapes, Lemons, Grapefruits, Oranges, Lemons, Tangerines, Kiwi, Peaches, Schelly, Plums, Apricot, Persimmons, Dates, Fresh Figs, Pears, Apples, Pomegranates, Bananas, Green Tomatoes, Strawberries, Fresh Berries, Cherries, Melon, melon, cantaloupe, raisins, dried berries, dried figs, leaflets	Fruits
Vegetables, cooked vegetables, cooked spinach, cabbage, lettuce, celery, squash, green peppers, sweet peppers, raw onions, fried onions, red sauce, tomatoes, pumpkin sauce, eggplant, cooked carrot, raw carrots, cucumbers, Turnip, green olives, corn, potatoes, cooked mushrooms	Vegetables
Seeds, peanuts, almonds, walnuts, pistachios, hazelnuts	Brains
Baked Green Beans, Peas, Bean, Lentils, Beans, Sevilla, Chickpeas, Mushrooms, Chickpeas	Beans
Olive oil, Margarines	Vegetable Oils
Tea, coffee	Tea and Coffee
Less healthy	
Apple juice, orange juice, compote, apple, lemon juice, water melon	Fruit juices
Lavash, Berberi, Sangak, Taftoon, Baguette, Biscuits, Crackers, Macaroni, Soup, Rice, Puffka	Refined grains
Chips, Fries	Starchy
Cooladar or industrial beverages	Sweetened with sugar
Sweets, Cookies, Cakes, Sugar, Honey, Sugar, Jams, Giz, Souhan, Chocolate, Candy and Barnaby, Homemade Halvah, Halvah Shokri, Salted Cucumber, Salt, Pickles, Salted, Spices	Donuts and Desserts
Animal foods	
Solid Vegetable Oil, Animal Oil, Liquid Oil	Animal oils
Cheeses, Chocolate Yogurt, Whey, Highly Fat Yogurt, Normal Yogurt, Low-fat Milk, Fatty Milk, Cocoa Milk, Traditional Ice Cream, Non-Traditional Ice Cream, Butter, Cream and Cheese, Cream Cheese, Dough	Dairy
Eggplant	Egg
Fish except tone, tuna fish	Seafood
Sausage, sausage, beef or veal, lamb, minced meat, dill, liver, poison, chicken, chicken, hamburger, chicken and breast milk, tongue, brain, chaff, pancake	Meat
Pizza, mayonnaise	Other

After completing the consent form, the blood sample was taken immediately after 10–12 h and immediately divided and half of the whole blood was immediately centrifuged and the other half centrifuged and stored at -80°C . All samples were evaluated using the same method and conditions. Levels of liver enzymes and inflammatory factors were measured by ELISA method. Subjects based on normal hepatic function (AST: 8–48 and ALT: 55–55) and abnormal liver function (ALT <7 ALT> 55 and AST <8, AST> 48) as well as normal and abnormal inflammatory factors hs-CRP, IL-1 β , TGF- β) (low risk: less than 1.0 mg/L - moderate risk: 1.0–3.0 mg/L - high risk: more than 3.0 mg/L). Participants were categorized based on vegetarian diet score, and the association of individual's compliance with the above regimens in each quarry with liver enzymes and inflammatory factors and adipocytes' profile was investigated using regression equations.

36.55 ± 4.19 years, 1397.40 (SD ± 246.07) kcal, 30.02 ± 3.49 kg/m², (78.39 ± 10.65), (18.57 ± 8.180), (82.76 ± 30.67), (2.66 ± 0.96), (5.039 ± 3.87) and (18.98 ± 14.91) were respectively (Table 2).

The highest-lowest - the variance and standard deviation of the points of compliance with the vegetarian diet PDI-hPDI-uPDI, healthful plant based diet index (hPDI), plant based diet index (PDI), unhealthy plant-based diet index (uPDI) (52.51 ± 6.48), (51.84 ± 7.60) and (51.79 ± 6.99) were respectively (Table 3).

The results of ANOVA test indicate that compliance with plant diet in general is significantly related to adiposity profile ($P < 0.001$). In order to investigate the linear effect of PDI, polynomial test was used for BAI. According to the results, although there was a meaningful relationship between the plant based diet and the adipocytes profile, the two were not linearly linked. ($P < 0.169$). (Table 4).

In the PDI group, a Tukey follow up test was used to determine the difference between two quartiles in terms of BAI. According to the results, there was a significant correlation between the fourth and the fourth quartiles in this group ($P < 0.05$). By increasing the level of dietary intake in the fourth quartile, compared to the second quartile, the vegetarian dietary compliance score was seen to increase in the size of the adipocyte profile. Significant relationship was found to be two-to-one between the other quartine subspecies The regime was not seen in this group. Tukey follow-up test, to compare two to two groups of meanings Significant level ($P < 0.05$). (Table 5).

According to the results of ANOVA, there is a meaningful relationship between the compliance of a healthy herbal diet and the TGF ($P < 0.0001$) and hs-CRP ($P < 0.0001$). A polynomial test was used to investigate the linear effect of hPDI on the amount of TGF and hs.CRP inflammatory factors. According to the results obtained

by increasing the diet based on a healthy plant, the inflammatory factors of hs-CRP ($P < 0.0001$) and TGF ($P < 0.0001$) decreased significantly (Table 6).

Regression model was done to investigate the relationship between the index of adherence to healthy vegetarian diet and inflammatory factor TGF- β . The results of model 1 and 2 show that individuals in the first quartile are compared to the fourth quartile (reference quark) The healthy diet had an average of 14.36–51.38 mg/L TGF- β , on average. Likewise, people in the third quartile, compared to the fourth quartile (reference quartile), followed a healthy vegetarian diet On average, they had a greater TGF- β value of 10.20–24.25 mg/L. (Table 7)

Regression model was done to examine the relationship between the index of compliance with the healthy vegetable diet and the hs-CRP inflammatory factor. The results of models 1 and 2 show that the people in the first quartile are compared to the fourth quartile (reference quark) The healthy diet had an average of 86.3–93.3 mg/L hs.CRP on average. Similarly, people in the third quartile, compared to the fourth quartile (reference quartile), followed the healthy vegetable diet On average, there were more than 1.05–1.8 mg/L more hs.CRP (Table 8).

Table 9 shoes the mean and standard deviation of the quantitative variables studied in this study in each of the vegetation food quartiles. The results of one-way ANOVA indicated that following unhealthy herbal diet had a significant relationship with adipocytes profile ($P < 0.001$). it's related to. In order to investigate the linear effect of uPDI polynomial test, BAI was used. According to the results, although there was a significant relationship between the unhealthy herbal diet and the Adipocytic profile, the two were not linearly linked. ($P < 0.459$).

Tukey test was performed to compare two quartiles with BAI,

Table 2
Study population characteristics.

Demography and anthropometric variable				
Parameters	Minimum	Maximum	Variance	Mean ± SD
Age (years)	18.00	50.00	69.273	36.52 ± 8.32
BAI	28.18	52.26	17.577	36.55 ± 4.19
BMI(kg/m ²)	25.10	40.20	12.190	30.02 ± 3.49
Hip circumference (centimeter)	95.00	153.00	64.397	111.79 ± 8.02
Waist (centimeter)	74.00	121.50	94.651	94.30 ± 9.72
height (centimeter)	147.50	176.00	31.301	161.42 ± 5.59
Weight (kg)	57.75	119.50	113.430	78.39 ± 10.65
GOT(U/L)	8.00	70.00	66.916	18.57 ± 8.180
TGF- β (mg/L)	32.92	173.55	941.038	82.76 ± 30.67
IL1 β (mg/L)	0.92	5.23	.939	2.66 ± .96
hs.CRP (mg/L)	.75	17.73	14.991	5.039 ± 3.87
GPT(U/L)	4.00	121.00	222.588	18.98 ± 14.91

Quantitative variables (biochemical) in this study, with mean and standard deviation, as well as the smallest and most significant variables. above table shows the mean and standard deviation and the lowest and most biochemical data. Glutamate-Oxaloacetate Transaminase (GOT), glutamate-pyruvate transaminase (GPT), Highsensitivity C - reactive protein (hs. CRP), Interleukin 1 beta (IL1b), Transforming growth factor beta (TGF- β), Body adiposity index(BAI),Sample size 240,p-value <0.05 is significant. Quantitative variables (biochemical) in this study, along with the mean and standard deviation, as well as the lowest and maximum values.

Table 3
Means-most-lowest - Variance and standard deviation of compliance score for a vegetarian diet PDI-hPDI-uPDI.

Diet Scores				
Name	Minimum	Maximum	Variance	Mean ± SD
PDI	36.00	70.00	42.14	52.51 ± 6.48
hPDI	27.00	76.00	57.84	51.84 ± 7.60
uPDI	36.00	71.00	48.92	51.79 ± 6.99

The above-table is the highest-lowest - the variance and standard deviation of the points of compliance with the vegetarian diet PDI-hPDI-uPDI, healthful plant based diet index (hPDI), plant based diet index (PDI), unhealthy plant-based diet index (uPDI).

Table 4

Comparison of frequency and percentage of quantitative variables among the Subsidiarity of the Vegetation Food Model (PDI).

Name	Q ₁ Mean ± SD	Q ₂ Mean ± SD	Q ₃ Mean ± SD	Q ₄ Mean ± SD	P ₋ value*	P ₋ value**
Biochemical variable						
GOT (U/L)	17.60 ± 6.25	18.48 ± 6.79	18.33 ± 7.96	20.00 ± 10.89	0.346	0.101
GPT (U/L)	18.28 ± 12.65	18.60 ± 13.24	18.28 ± 13.65	20.70 ± 19.30	0.738	0.383
hs.CRP (mg/L)	4.58 ± 4.53	3.23 ± 4.55	3.66 ± 4.235	4.75 ± 4.78	0.945	0.622
IL1β (mg/L)	2.45 ± 0.87	2.67 ± 1.00	2.83 ± 1.02	2.75 ± 1.05	0.678	0.335
TGF-β (mg/L)	85/89 ± 31.62	85.65 ± 36.92	84.76 ± 31.50	74.16 ± 19.71	0.294	0.094
Anthropometric variable						
BAI	36.78 ± 3.79	35.28 ± 3.41	36.13 ± 4.59	37.59 ± 4.39	0.033	0.169

Glutamate-Oxaloacetate Transaminase (GOT), glutamate-pyruvate transaminase (GPT), High sensitivity C - reactive protein (hs.CRP), Interleukin 1 beta (IL1b), Transforming growth factor beta (TGF-β), Body adiposity index(BAI),Sample size 240,p-value <0.05 is significant.The results of ANOVA test indicate that compliance with plant diet in general is significantly related to adiposity profile (P < 0.001). In order to investigate the linear effect of PDI, polynomial test was used for BAI. According to the results, although there was a meaningful relationship between the plant based diet and the adipocytes profile, the two were not linearly linked. (P < 0.169).

*One-way analysis of variance (ANOVA).

**ANOVA ANALYSIS, POLYNOMIAL.

Table 5

Vegetarian dietary compliance score in quartiles.

test Post Hoc Tukey		
Dependent variable(BAI)		
PDI(I)	PDI(J)	P ₋ value*
Q₁ <= 48.00	Q ₂	0.247
	Q ₃	0.818
	Q ₄	0.697
	Q ₄	0.247
Q₂ 49.00–52.00	Q ₃	0.722
	Q ₄	0.025
	Q ₁	0.818
	Q ₂	0.722
Q₃ 53.00–56.00	Q ₄	0.213
	Q ₁	0.697
	Q ₂	0.025
	Q ₃	0.213
Q₄ 57.00+	Q ₁	0.697
	Q ₂	0.025
	Q ₃	0.213

In the PDI group, a Tukey follow up test was used to determine the difference between two quartiles in terms of BAI. According to the results in the above table, there was a significant correlation between the fourth and the fourth quartiles in this group (P < 0.05). By increasing the level of dietary intake in the fourth quartile, compared to the second quartile, the vegetarian dietary compliance score was seen to increase in the size of the adipocyte profile. Significant relationship was found to be two-to-one between the other quarantine subspecies The regime was not seen in this group.

*Tukey follow-up test, to compare two to two groups of meanings Significant level (P < 0.05).

there was no significant relationship between two groups of people in this group. In order to investigate the linear effect of PDI, polynomial test was used to determine the level of adipocyte BAI index. To test the relationship between two quarks in the PDI group, with the size of the adipocyte profile of the Tukey test and according to the results, there was no significant relationship between two groups of people in this group (Table 10).

A polynomial test was used to evaluate the linear effect of hPDI on the amount of TGF and hs.CRP inflammatory factors. According to the results obtained by increasing the regimen based on a healthy plant, the inflammatory factors from the first quartile to the fourth quartile, hs.CRP and TGF Significantly decreased. The results of the regression model by modifying the effect of age and size of the waist and hip circumference to determine the relationship between the index of compliance with the healthy vegetarian diet and the hs-CRP inflammatory factor showed that the subjects in the first quartile were compared to the fourth quartile (reference quartile) The index of compliance with a healthy vegetable diet, on average, was 3.86–3.93 mg/L hs.CRP more. Also, the subjects in the third quartile, compared to the fourth quartile (reference quartile), the index of compliance with a healthy vegetable diet, Had an average of 1.05–1.28 mg/L hs.CRP. In addition, the results of the regression model to investigate the relationship between the index of compliance with healthy vegetarian diet and inflammatory factor TGF-β show that the subjects in the first quartile, compared to the fourth quartile (reference quartile), the index of compliance

Table 6

Comparison of frequency of quantitative variables among compliance with healthy food patterns (hPDI).

Name	Q ₁ Mean ± SD	Q ₂ Mean ± SD	Q ₃ Mean ± SD	Q ₄ Mean ± SD	P ₋ value*	P ₋ value**
Biochemical variable						
GOT (U/L)	18.91 ± 7.96	19.19 ± 9.57	18.52 ± 7.92	17.50 ± 6.91	0.654	0.263
GPT (U/L)	18.44 ± 12.90	20.54 ± 18.40	19.18 ± 14.78	17.50 ± 12.77	0.690	0.587
hs.CRP (mg/L)	7.27 ± 4.33	4.73 ± 3.22	4.46 ± 3.67	3.41 ± 3.010	.00001	0.0001
IL1β (mg/L)	2.65 ± 1.08	2.73 ± 0.926	2.39 ± 1.00	2/95 ± 0.880	0.533	0.661
TGF-β (mg/L)	70.82 ± 28.30	67.58 ± 26.73	88.69 ± 42.32	96.78 ± 83.35	0.0001	0.0001
Anthropometric variable						
BAI	36.69 ± 4.10	36.05 ± 3.95	35.97 ± 4.08	37.39 ± 4.44	0.237	0.414

Glutamate-Oxaloacetate Transaminase (GOT), glutamate-pyruvate transaminase (GPT), High sensitivity C - reactive protein (hs.CRP), Interleukin 1 beta (IL1b), Transforming growth factor beta (TGF-β), Body adiposity index(BAI),Sample size 240,p-value <0.05 is significant.According to the results of ANOVA, there is a meaningful relationship between the compliance of a healthy herbal diet and the TGF (P < 0.0001) and hs-CRP (P < 0.0001). A polynomial test was used to investigate the linear effect of hPDI on the amount of TGF and hs.CRP inflammatory factors. According to the results obtained by increasing the diet based on a healthy plant, the inflammatory factors of hs-CRP (P < 0.0001) And TGF (P < 0.0001) decreased significantly.

* One-way analysis of variance (ANOVA).

** ANOVA ANALYSIS, POLYNOMIAL.

Table 7
Regression model to investigate the relationship between healthy diet (hPDI) and inflammatory factor TGF- β

Variable TGF- β (95% confidence interval)	The regression coefficient	P-Value
Model 1 ^a		
Compliance Index of Healthy Diet (hPDI)		
Q ₁ (23.913–48.375)	36/14	<0/001
Q ₂ (-2/72–21/87)	9/57	0/127
Q ₃ (7/65–32/54)	20/10	0/002
Q ₄ Reference group		
Model 2 ^b		
Q ₁ (23/96–53/06)	38/51	<0/001
Q ₂ (-0/97–28/02)	13/52	0/067
Q ₃ (9/98–39/03)	24/51	0/001
Q ₄ Reference group		

The table above shows the results of the regression model to examine the relationship between the index of adherence to healthy vegetarian diet and inflammatory factor TGF- β . The results of model 1 and 2 show that individuals in the first quartile are compared to the fourth quartile (reference quartile). The healthy diet had an average of 14.36–51.38 mg/L TGF- β , on average. Likewise, people in the third quartile, compared to the fourth quartile (reference quartile), followed a healthy vegetarian diet. On average, they had a greater TGF- β value of 10.20–24.25 mg/L.

^a Model 1: In this model, the effect of any distortion has not been adjusted.

^b Model 2: In this model, the effect of age, waist circumference and hip are moderated.

Table 8
Regression model to investigate the relationship between healthy adolescent vegetarian diet (hPDI) and hs-CRP inflammatory factor.

Variable hs.CRP (95% confidence interval)	The regression coefficient	P-Value
Model 1 ^a		
Compliance Index of Healthy Diet (hPDI)		
Q ₁ (2/64–5/08)	3.86	<0/001
Q ₂ (0/10–2/55)	1.32	0/034
Q ₃ (-0/16–2/27)	1.05	0/090
Q ₄ Reference group		
Model 2 ^b		
Q ₁ (2.646–5/22)	3.934	<0/001
Q ₂ (-0/243–2/38)	1.071	0/110
Q ₃ (0/016–2/55)	1.288	0/047
Q ₄ Reference group		

The table above shows the results of the regression model to examine the relationship between the index of compliance with the healthy vegetable diet and the hs-CRP inflammatory factor. The results of models 1 and 2 show that the people in the first quartile are compared to the fourth quartile (reference quartile). The healthy diet had an average of 86.3–93.3 mg/L hs.CRP on average. Similarly, people in the third quartile, compared to the fourth quartile (reference quartile), followed the healthy vegetable diet. On average, there were more than 1.05–1.8 mg/L more hs.CRP.

^a Model 1: In this model, the effect of any distortion has not been adjusted.

^b Model 2: In this model, the effect of age, waist circumference and hip are moderated.

with a healthy vegetable diet, on average. The size of TGF- β was 36.14–38.51 mg/L. Similarly, people in the third quartile, compared to the fourth quartile (reference quartile), followed the healthy vegetable diet, an average of 20.10–24.51 mg/L TGF- β .

4. Discussion

Our study showed that an association between the adherence of unhealthy herbal model and the adipocyte profile in the primary analysis. According to the results, although there was a significant relationship between the unhealthy herbal diet and the Adipocytes profile, were not linearly linked. Another conclusion according to the results is, there was no significant relationship between two groups of people in this group. In addition, in the PDI group, the adipocyte BAI index was significantly correlated with the degree of compliance with the vegetarian diet. Also, despite the significance

of the relationship between the vegetative diet and the adipocyte profile, these two were not linearly related. The fourth quartets in this group were found to be meaningful. It was found that only the second and fourth quartets of the index corresponded to the PDI vegetable diet and the level of adipocytes profile, and the adipocyte profile in the fourth quarter was significantly higher than the second quartile. Generally, according to assumptions, this study failed to establish a robust relationship between the compliance rate of a vegetarian diet and an unhealthy herbal diet with inflammatory factors, liver factors and adipocytes profile. In the hPDI group, a significant association was found between the compliance of healthy hPDI plant diet, liver enzymes and inflammatory factors, and the adipocyte profile of ANOVA. In this test, there was a meaningful relationship between adherence to healthy vegetarian diet and the TGF and hs-CRP inflammatory factor. According to the results of this study, the higher intake of healthy plant foods can prevent the increased inflammatory factors of TGF- β and hs-CRP and reduce inflammation and its effects in the body.

Human C Reactive Protein (CRP) is a circular pentameric protein that is produced by the liver during inflammation and is released a few hours after tissue injury, the onset of infection, and other causes of inflammation in the bloodstream. This protein is an acute phase protein that increases the amount of interleukin 6 secretion from macrophages and T cells. The main role of this protein is to bind to lysophosphatidyl choline on the surface of the dead cells to activate the complement system via C1q.

Satija et al. [23], in 2017, aimed at investigating the relationship between healthy vegetable diet (whole grains, fruits, vegetables, seeds and brains - tea and coffee) and unhealthy herbs (refined grains, fruit juices, artificial sweets, sweetened beverages). With cardiovascular disease, they designed a study in which 73,000 women and 43,000 men participated and concluded that a vegetarian diet could be effective in preventing cardiovascular disease, but not any vegetable diet, a healthy vegetarian diet. Like whole grains, fruits, vegetables, cereals, and beverages such as tea and coffee can be inversely related to cardiovascular disease.

A study recently conducted by Baden et al. In the study of II Nurse's Health Study concluded that the follow-up of a healthy vegetarian diet reduced the amount of obesity and inflammatory biomarkers and insulin resistance in women under study [27]. The primary hypothesis of this study, based on the available evidence, was that liver factors and inflammatory factors and the adipocyte profile decreased in overweight and overweight women with a higher healthy vegetarian diet score. The results of the analysis in this study on plant nutrition patterns, healthy plants and unhealthy herbs were partly consistent with the assumptions of the design. The results showed that following the unhealthy herb diet would increase the amount of fat in the body, but healthier plant foods did not show significant correlation with body fat and liver factors. Flavonoids also contribute to the reduction of adipogenicity and lipolytic stimulation of peroxiditis. Some other phytochemicals also act as the natural ligand of peroxisome proliferator-activated receptors (PPARs) and by regulating the metabolism of lipids in the liver, increasing lipid peroxidation, fatty acid catabolism and fatty acid mitochondrial beta-oxidation in reducing aggregation fat plays a role in the body [21,22].

Difference in observed results can be attributed to differences in design and population participation in studies as well as differences in dietary composition of unhealthy dietary patterns. While in the study of Nurse's Health Study, the Western food pattern was completely unhealthy in the pattern of eating, but in other studies, the unhealthy pattern was associated with the relatively high levels of fish and seafood and low-fat dairy products that could have a positive effect on inflammatory and liver factors, and Body fat. Another hypothesis was that reducing GOT and GPT hepatocytes

Table 9
Comparison of the frequency of quantitative variables among the compliance rate of healthy dietary patterns (uPDI).

Name	Q ₁ Mean ± SD	Q ₂ Mean ± SD	Q ₃ Mean ± SD	Q ₄ Mean ± SD	P_ value*	P_ value**
Biochemical variable						
GOT (U/L)	19.68 ± 10.48	17.60 ± 7.01	19.11 ± 7.98	17.72 ± 6.04	0.337	3220.
GPT (U/L)	20.37 ± 18.63	17.25 ± 12.77	20.00 ± 14.43	18.11 ± 12.41	0.544	0.616
hs.CRP (mg/L)	5.04 ± 3.65	4.82 ± 3.55	4.55 ± 4.17	5.80 ± 4.10	0.322	0.335
IL1β (mg/L)	2.82 ± 0.995	2.76 ± 1.18	2.78 ± 0.85	2/23 ± 0.800	0.331	0.123
TGF-β (mg/L)	76.87 ± 23.48	89.51 ± 35.08	79.39 ± 30.48	86.17 ± 32.23	0.221	0.410
Anthropometric variable						
BAI	37.42 ± 4.41	36.00 ± 4.40	35.47 ± 3.43	36.99 ± 4.01	0.049	0.459

Glutamate-Oxaloacetate Transaminase (GOT), glutamate-pyruvate transaminase (GPT), High sensitivity C - reactive protein (hs.CRP), Interleukin 1 beta (IL1b), Transforming growth factor beta (TGF-β), Body adiposity index(BAI), Sample size 240, p-value <0.05 is significant. The table, mean and standard deviation of the quantitative variables studied in this study in each of the vegetation food quartiles. The results of one-way ANOVA indicated that following unhealthy herbal diet had a significant relationship with adipocytic profile (P < 0.001). it's related to. In order to investigate the linear effect of uPDI polynomial test, BAI was used. According to the results, although there was a significant relationship between the unhealthy herbal diet and the Adipocytic profile, the two were not linearly linked. (P < 0.459).

* One-way analysis of variance (ANOVA).

** ANOVA ANALYSIS, POLYNOMIAL.

Table 10
Test Post Hoc Tukey.

Dependent variable(BAI)		
PDI(I)	PDI(J)	P_ value*
Q₁ <= 48.00	Q ₂	0.224
	Q ₃	0.060
	Q ₄	0.060
Q₂ 49.00–52.00	Q ₁	0.224
	Q ₃	0.909
	Q ₄	0.583
Q₃ 53.00–56.00	Q ₁	0.060
	Q ₂	0.909
	Q ₄	0.245
Q₄ 57.00+	Q ₁	0.945
	Q ₂	0.583
	Q ₃	0.245

*Tukey follow-up test, to compare two to two groups of meanings. Significant level (P < 0.05).

with a higher compliance with healthy vegetarian diets, it was observed that these variables were not significantly reduced in people who used a healthier vegetarian diet compared to unhealthy dieters; which it didn't match with the assumptions. But these changes were seen in the case of the hs-CRP inflammatory factor. The research showed that UPDI consumption, which is associated with increasing consumption of snacks, sweets, fast food and animal fat-rich foods, has a negative effect on inflammatory factors and fat accumulation in the body Which ultimately increases the risk of diseases associated with obesity and inflammation, such as cardiovascular disease, diabetes and cancer.

Relationship between healthy plant health (hPDI) and unhealthy herbal diet (uPDI) was investigated. After controlling the statistical characteristics, socioeconomic factors and health behaviors in the general sample, it was found among individuals with a hPDI score higher than Meanwhile, a 10-fold increase in hPDI was associated with a 5% lower risk of cardiovascular deaths in the entire population of the study [19]. It seems that receiving a healthy vegetarian diet reduces liver enzymes and reduces liver inflammation, and as a result Improving liver health also helps.

Also, using healthy herbal diets as compared to unhealthy diets did not change the adipocyte profile and liver factors. But the higher consumption of unhealthy herbs such as confectionery and syrups, and ... increased the amount of fat and inflammation of the body. Satija et al. [23], in 2017, aimed at investigating the relationship between healthy vegetable diet (whole grains, fruits, vegetables, seeds and brains - tea and coffee) and unhealthy herbs (refined grains, fruit juices, artificial sweets, sweetened beverages)

with cardiovascular disease, they designed a study in which 73,000 women and 43,000 men participated and concluded that a vegetarian diet could be effective in preventing cardiovascular disease, but not any vegetable diet, a healthy vegetarian diet It can be inversely associated with cardiovascular disease. Freestyle et al. [25-27] studied the effect of DASH on liver inflammation and liver function in type 2 diabetic patients. In this study, 31 diabetic patients after receiving a control regimen (the usual diabetic diet) and the blood pressure control regimen. The results of this study showed the effect of receiving a blood pressure monitor diet on the reduction of liver enzymes.

It is a novel study which first has been examined hPDI as a diet quality and its association with inflammation factor in Iranian dietary habit. Moreover, we examined the relation between hPDI and inflammatory markers status. Furthermore, results were roused after adjustment for many potential confounders in sensitivity analyses. As limitation we can mention the causative implication in this cross-sectional study and small sample size and using a questionnaire and self-reported data for sleep quality and food intake might be over- or underestimated depending on the subject's memory and desirability biases. This is the first study that considered LLDS as a diet quality tool measurement, more studies are needed for this issue.

To sum up the result, the highest compliance with hPDI results in increased fiber intake, antioxidants, unsaturated fats, micronutrients, reduced saturated fats and iron content, all of which contribute to weight loss, improve lipid profiles, lower blood pressure and reduce inflammation. Also, the highest compliance with uPDI results in an increase in glycemic index, increased sugar intake, decreased dietary fiber, unsaturated fats, micronutrients and antioxidants, which can increase the risk of inflammatory and liver disease and, obesity and diabetes. The use of hPDI strongly reduces the profile of dietary fat and has a positive correlation with carbohydrate regimen, while uPDI consumption significantly increases the amount of dietary fat and simple carbohydrate intake. In other hand none of the three patterns of consumption have a meaning You have not had enough GOT and GPT liver enzymes. In the present study, unhealthy vegetarian food patterns were also associated with high levels of potatoes, refined grains, sugar, prepared foods and artificial beverages.

5. Conclusion

The results showed that following a healthy herbal diet like whole grains, fruits, vegetables, cereals, and beverages such as tea

and coffee and higher adhering to this diet based on recommendations and guidelines, it may reduce the inflammatory factor of hs-CRP and TGF- β .

Conflicts of interest

There are no competing financial interests in relation to the current study.

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