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Non-Alcoholic Fatty Liver Related to Diet and Body Composition: A Case Control Study

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ABSTRACT

Non-alcoholic fatty liver disease (NAFLD) has a common pathogenic background and shares many risk factors such as hypertension, metabolic syndrome and obesity. This study aimed to determine the relationship between dietary factors and body composition in NAFLD suffering patients. A case-control study designed, 250 patients (n = 125 in each group) were studied. Data was collected using a Body Impedance Analyzer and FFQ questionnaires. The data were analyzed in Stata-11 using the Mann-Whitney test, a t-test, and logistic regression. The Mean BMI was 30.41 ± 5.7 and 26.41 ± 3.8 kg/m2 in the case and control groups, respectively (p = 0.001). In patients with NAFLD, 44.7% showed a BMI over 30 (obese), and in the control group it was 12.5%. The amount of protein intake in the case and control groups was 87.74 ± 52.10 and 97.007 ± 75.55 g/d (P = 0.02), respectively. Fiber intake was 23.12 ± 14.57 g/d in the case group and 25.74 ± 34.71 g/d in the control group (P = 0.3). Vitamin E intake in 69.7% of NAFLD and 74.78% of control group was lower than the RDA recommended level. The study showed that NAFLD subjects have a higher BMI than healthy individuals. Obesity and the low intake of vitamin E, protein, and fiber can be a predicting factor of the incidence or progression of fatty liver.

Introduction

Non-alcoholic fatty liver disease (NAFLD) is characterized by fat accumulation within liver cells when no other etiologies for hepatic fat accumulation (*e.g.*, heavy alcohol consumption) are present (1). NAFLD refers to a wide spectrum of liver disorders ranging from simple steatosis (more than 5% hepatocytes showing fat accumulation) to non-alcoholic steatohepatitis (NASH), which increases the risk of liver cirrhosis and hepatocellular carcinoma (2). Its prevalence is thought to be approximately 20% in the general population and up to 70% in patients with type 2 diabetes mellitus(٣). In the US, an estimated one-third of the population has NAFLD and approximately 2–5% have NASH, with the number of affected people increasing (4). The prevalence of NAFLD and NASH in Iranians varies from 2.9%–7.1% in the general population (5-7). Due to a lack of evidence to support pharmacological treatment options for NAFLD, diet and physical activity play a key role in NAFLD management (8, 9). Several studies have suggested the associations of NAFLD with obesity, abdominal obesity, hyperglycemia, and other components of metabolic syndrome (4). Excess of body fat, and also abdominal fat, is related to NAFLD (10). The first-line treatment is currently the promotion of gradual weight loss through increased physical activity and reduced energy intake, with the aim of improving liver function tests (LFTs), insulin resistance (IR), fasting glucose, and lipid profiles (8, 9). The role of specific dietary nutrients and the influence of body composition on NAFLD pathogenesis remain uncertain. Nevertheless, results from previous studies have demonstrated a significant association between NAFLD and diet components. The association between reduced levels of carbohydrates in diets and NAFLD is demonstrated (11). Moreover, an increased level of fat and sucrose in specific diets has promoted NAFLD in the Torres et al study(12).However, due to the interaction among diet components, it is highly recommended by previous studies to investigate the association between whole diets and disorders to find better relationships and modify lifestyles practically (13). Although literature is emerging, it is not clear what type of diet is more likely to cause fatty liver. Since it is very difficult to reduce and maintain weight loss, it looks more feasible for someone to change the dietary composition of a particular diet as a more realistic method to treat NAFLD without the need of decreasing in Kcal intake.

The current study was conducted to assess the relationship between diet and body composition in NAFLD patients in the Kermanshah province, Iran.

Materials and Methods

This case-control study was conducted in Kermanshah (2015). The patients, people with NAFLD, were selected by convenience sampling from patients whose ultrasound results were positive for fatty liver. The control group was selected by simple random sampling from ultrasound negative reports, that is, without fatty liver. The sample size was determined as 125 for each group (total n = 250) based on previous studies, the prevalence of various factors (in the development of metabolic syndrome), and considering the sample loss. The study protocol was approved by the ethical committee of Kermanshah University of Medical Sciences (No: 92423).

The Evaluation of Food Habits

Food intake was assessed by food frequency questionnaire (FFQ) whose validity and reliability has been confirmed in Iran (14). The FFQ includes a list of 161 foods and their standard amount. Nutritional information obtained through FFQ was analyzed in a specific software program. The software was programmed by visual basic 6.0. Standard values for energy, folate, vitamin A, vitamin E, and calcium were considered based on recommended dietary allowances for different age groups. The recommended value for protein intake is 0.8 g/kg body weight and the recommended fiber intake was considered 25 g daily (15). Energy was calculated considering that each gram of protein, carbohydrate, and fat provides 4, 4, and 9 kilocalories of energy, respectively, and the total energy was obtained from the total energy produced by proteins, carbohydrates, and fats.

The Evaluation of body composition

The individual's body composition was measured by using a body analyzer (Jawon Medical Plus model Avis 333) in terms of weight, height, body fat mass (BFM), the percent of body mass index (BMI), soft lean mass (SLM), body fat (PBF), total body water (TBW), body impedance, body protein and mineral, lean body mass and waist-to-hip ratio (WHR). Height was measured in a standing position, without shoes, using a standiometer, while shoulders, heels, and hips were in contact with the wall, with the accuracy of 1centimeter. Women with a WHR 0.80–0.84 and men with a WHR 0.90–0.99 were classified as overweight, while women with a WHR ≥ 0.85 and men with a WHR ≥ 1.00 were classified as obese (16).

Data analysis

Finally, all of the data were coded and entered into Stata-11 and analyzed by descriptive statistics (mean, standard deviation, and percentage) and analytical statistics (t-test, Mann-Whitney, and logistic regression) (a p-value less 0.05 was considered significant).

Results

Of the total of 250 participants, 220 that provided full data entered analysis (a response rate of 88.8%). The case group consisted of 103 NAFLD patients, with steatohepatitis confirmed through ultrasound, and the control group included 119 healthy people, with a normal liver ultrasound. The youngest participant was 30 years old and the oldest was 65 years old. Mean weight was 82.1 ± 16.9 kg in participants with fatty livers, and 70.9 ± 12.2 kg in participants without fatty livers. The mean body mass index was significantly higher in participants with NAFLD compared to the control group (P = 0.001). The WHR was higher in participants with NAFLD compared to the control group (P = 0.001), and there were significant differences between the two groups in other components of body composition, including MBF, LBM, and TBW (Table 1).

The body mass index (BMI) was greater than 30 (obese) in 44.66% of participants in the NAFLD group and 12.45% of those in the control group, with a significant difference between the two groups (P = 0.001) (Table 2).

A logistic regression model was used to determine the independent effects of WHR and BMI on NAFLD, and after adjusting for other variables, WHR and BMI were found to be significantly related to NAFLD. WHR was higher than the normal range in 55.5% of participants with fatty livers. In other words, the odds of having fatty liver in people with a WHR higher than normal (greater than 0.85 in women and greater than 1 in men) was 2.7 times higher compared to people with a normal WHR. Moreover, BMI was higher than 30 in 74% of people with fatty livers. In other words, the odds of having fatty liver in people with a BMI > 30 was 2.4 time higher compared to people with a normal BMI, and the odds increased to 12.1 times after adjusting for confounding variables (Table 3).

The daily calorie intake was 2329.15 ± 13.19.38 Kcal in the case group and 2593.71 ± 1944.25 Kcal in the control groups. The daily protein intake was 87.74 ± 52.1 grams in patients and 97.007 ± 75.55 grams in healthy group, which was significantly higher in the healthy group (P = 0.02). Fiber intake was 23.12 ± 14.57 grams/day in the NAFLD group and 25.74 ± 34.71 grams/day in the healthy group (P = 0.3) (Table 4).

Compared to the Recommended Daily Allowance (RDA), protein intake was less than the RDA in 39 (39.39%) participants from the case group and 31 (26.96%) participants from the control group. Vitamin E intake was less than the RDA in 74.78% of participants with fatty livers and 69.70% of participants without fatty livers.

Table 1. Components of Body Composition in the two groups

Body Composition	Mean± S.D		P-value
	NAFLD (-)	NAFLD (+)	
Weight (kg)	82.1±16.9	70.9±12.2	0.01
BMI(kg/m2)	30.41±5.7	26.41±3.8	0.001
WHR	0.91±0.64	0.77±0.07	0.001
MBF(kg)	27.9±8.83	21.92±6.57	0.03
PBF (%)	33.8±6.86	30.73±6.56	0.001
LBM(kg)	54.2±11.9	49.01±9.23	0.02
SLM(kg)	49.53±11.1	44.97±8.6	0.04
TBW(kg)	39.02±8.61	35.29±6.64	0.001

Table 2. Comparison of body mass index in the two groups

	N (%)			
	Normal Weight	Over Weight	Obese	Total
NAFLD (+)	11(10.68)	46(44.66)	46(44.66)	103(100)
NAFLD (-)	44(36.07)	59(49.58)	16(12.45)	119(100)
Total	55(24.77)	105(47.30)	62(27.93)	222(100)

Table 3. The role WHR and BMI in terms of having fatty liver

	Variable	Fatty Liver/N Prevalence	Crude OR (95%CI)	adjusted OR (95%CI)*
WHR	No	25/79 (31.5%)	1	-
	Yes	76/137 (55.5%)	2.7 (1.5-4.8)	
BMI	18.5-24.9	11/55 (20%)	1	1
	25-29.9	46/105 (44%)	1.1 (0.3-1.9)	4.2 (1.7-10.4)
	>30	46/62 (74%)	2.4 (1.5-3.3)	12.1 (3.9-37.1)

* Confidence Interval

Discussion

The present study was conducted with the aim to determine the relationship between the body composition and NAFLD, and it showed that the odds of fatty liver were higher in people with higher than normal WHR and BMI compared to those with normal or below normal WHR and BMI.

Table 4. The mean of daily food intakes in case and control groups

Food intakes	Mean±SD			p-value*
	NAFLD (+)	NAFLD (-)	Total	
Energy (kcal)	2329.15±1319.38	2593.71±1944.25	2470.32±1685.69	0.5
Protein (gr)	87.74±52.10	97.007±74.55	92.72±65.76	0.02
Fat (gr)	93.44±60.51	107.32±87.12	100.90±76.13	0.2
Carbohydrate (gr)	285.34±157.44	309.46±234.09	298.30±202.31	0.8
Fiber (gr)	23.12±14.57	25.74±34.71	24.53±27.28	0.3
Vitamin A (µgr)	992.53±811.18	1011.74±940.84	1002.85±881.24	0.8
Vitamin E (Mgr)	14.86±17.25	17.33±35.02	16.19±28.19	0.04

* By using Mann-Whitney test

In other words, high WHR and BMI are among strong predictors of fatty liver. A study conducted by Radmard et al. also proposed WHR and BMI as factors predicting NAFLD (). Other similar studies also reported a positive relationship between BMI and NAFLD (۱۹ ,۱۸). In a study, liver enzymes, especially ALT, were twice the normal laboratory reference range in overweight people older than 50 years with a BMI of 28 kg/m^2 or higher (۲۰).

The present study results showed that diet is one of the important and influential factors for the incidence of fatty liver. Analysis of participants' food intake showed that intakes of protein, fiber, and vitamin E were higher in the control group compared to the NAFLD group. Previous studies have shown that the intake of vitamins E and C can dramatically improve the condition of NAFLD patients and prevent progress of this disease (۲۱). Several clinical studies have investigated the effect of nutritional proteins on NAFLD, and some have reported reduced or improved NAFLD due to intake of soy protein. Thus, there is still no definitive evidence about the effect of nutritional proteins on NAFLD (22, 23). A number of interventional studies have reported that weight loss resulting from diet is able to restore liver enzymes and also prevent and control fatty liver. Due to the resulting weight loss and balance in food intakes, diet-based interventions can improve liver enzymes and tissue (۲۴). Diet has a key role in the management of NAFLD, and quality and quantity of diet are highly effective in the onset and severity of fatty liver (۲). Diet, physical activity, and weight control can significantly affect the clinical picture of NAFLD, since most patients with NAFLD have excess body weight and other cardiometabolic risk factors, such as dyslipidemia, hypertension, and diabetes (22, 25). Although promising pharmacological treatments are emerging, only a significant and stable weight loss is the basis of any treatment plan for patients suffering from NAFLD (26).

Conclusions

In the present study, the odds of NAFLD increased with increasing WHR and BMI. The body composition, especially WHR and BMI as well as diet are strong predictors of NAFLD. Adequately consumed protein, fiber, and vitamin E can be effective in preventing and improving NAFLD. Weight loss is the most effective therapy for NAFLD. Lifestyle changes through improved diet and exercise is the basis of treatment programs for NAFLD patients. Thus, with the right quality and quantity of diet, the body composition can be maintained within the normal range, and the incidence of NAFLD can be significantly prevented.

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