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The Lifestyle Characteristics in Non-Alcoholic Fatty Liver Disease in the PERSIAN Guilan Cohort Study

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Abstract

BACKGROUND: Non-Alcoholic Fatty Liver Disease (NAFLD) is the most common cause of chronic liver disease worldwide. Since the effect and safety of pharmacotherapy for NAFLD are unknown, the proper management of lifestyle is crucial.

AIM: The present study was conducted to determine the status of food, Physical Activity (PA), and sleep in patients with and without NAFLD.

METHODS: In this analytical- cross-sectional study, 630 clients with 36-60 years old who referred to the PERSIAN Guilan cohort study were included through simple non-random sampling. The developed questionnaire and lifestyle characteristics, including the status of nutrition, physical activity, and sleep, were completed for all samples. BMI was also calculated by determining weight and height, and fatty liver was confirmed based on abdominal ultrasound.

RESULTS: The prevalence of NAFLD in this study was by 43.7% (275 / 630). Smoking, alcohol consumption, BMI, and weight loss over the past six months, regular exercise and exercise intensity, sedentary living, speed of eating, consuming fatty food, red meat, sweets beverages, and use of saturated fatty acid (SFA), and consuming fruits and vegetables were associated with presence of NAFLD (all $p < 0.05$). However, no significant relationship was observed between the parameters of sleep duration, the interval between dinner and night sleep, consuming breakfast and snack during the day and NAFLD (All $p > 0.05$).

CONCLUSION: The onset and progression of NAFLD are associated with lifestyle. Therefore, dietary therapy solutions, physical activity, and sleep and rest situations should be paid attention for people with or at risk of NAFLD.

Introduction

Non-Alcoholic Fatty Liver Disease (NAFLD) is the most common cause of chronic liver disease in worldwide, which is characterised by the accumulation of fat in the liver of patients with no alcohol abuse, and with clinical signs of simple steatosis, steatohepatitis, advanced fibrosis, and cirrhosis [1], [2]. Fatty liver is common in industrial countries, and the prevalence of NAFLD has been grown in the Asia-Pacific Ocean region over the past two decades given the Western lifestyle and increased incidence of obesity [3]. The global prevalence of NAFLD has been reported as around 25.24%, 31%, 32%, and 27%, respectively in the adult population, southern America, Middle East, and Asia. [4], [5] Prevalence of NAFLD in the south and north of Iran has been reported as 21.5% [6] and 43.8%, [7] respectively, and it has been generally reported as 33.9% [8].

The exact NAFLD pathogenesis has remained unknown, though it seems to be multifactorial [9]. There is no consensus for the pharmacotherapy of NAFLD. Nevertheless, management of Diet and Physical Activity (PA) is an indispensable component of any therapeutic strategy for weight loss, and it may play a significant role in preventing NAFLD [10], [11]. Currently, the initial treatment involves gradual weight loss through reducing caloric consumption and enhancing physical activity to improve Liver Function Tests (LFT), Insulin Resistance (IR), fasting glucose levels, and lipid profiles. [12] Precise evaluation of extra energy consumption is required by the individual to obtain

better results in the nutritional treatment of NAFLD [13]. Generally, diets with high-calorie content, high carbohydrate, high saturated fatty acid, cholesterol, and soft drinks may increase the accumulation of fat in the liver, aggravate the clinical conditions of NAFLD, and cause its progression [9], [14]. On the other hand, restricting the calorie intake and increasing consumption of soy protein, Mono Unsaturated Fatty Acid (MUFA) supplements, omega-3 fatty acid, and probiotics are effective in preventing and treating NAFLD [9]. Also, it has been believed that PA is one of the determinant factors for controlling metabolic state. NAFLD patients are recommended to have physical activity alongside losing weight and modifying diet [15], [16]. Since the elevation of PA has a protective role against NAFLD-associated risk factors such as obesity, type II diabetes, blood pressure, and dyslipidemia, thus it seems that enhancing PA is effective in preventing NAFLD [17], [18], [19], [20].

Most studies have discussed various aspects of lifestyle such as nutrition, diet, and PA and the relationship with NAFLD, but other aspects such as sleep habits have remained understudied. Therefore, the present study was conducted to determine the relationship between lifestyle characteristics such as consumed food, physical activity, and sleep habits and NAFLD.

Methods

In this study, 630 subjects with 35-60 years old (from April 2017 to July 2017) among the clients referring to the PERSIAN Guilan cohort study (PGCS) part of the PERSIAN cohort study [21] were included in this analytical cross-sectional study through sequential sampling. The exclusion criteria included not having chronic or acute liver disease including viral hepatitis B and C, chronic and acute renal disease, cancers, and alcohol consumption (men above 20 g/d and women above 10 g/d), pregnancy, consuming medications affecting the liver such as steroids, amiodarone and tamoxifen, and patients with established hemochromatosis. Identification of the subjects was performed based on the PERSIAN cohort profile [21].

The information of this study was collected through a questionnaire which has been developed by the research group and as face-to-face. This questionnaire consisted of two sections: the first section captured demographic information (age, gender, marital status, occupation, level of education, and place of residence), while the second section involved typical lifestyle characteristics over the past six months.

These characteristics included questions such as weight loss over the past six months, alcohol consumption and smoking, dietary habits (being used to consuming breakfast, consuming snacks during the day, speed of eating, type of consumed bread, consuming fatty food, fruits and vegetables, milk and dairies, sweet beverages, type of consumed oil, type of the main consumed meat), physical activity (regular exercise, exercise intensity, daily walking, type of activity during daily living), and sleep (duration of daily sleep, interval between dinner and night sleep) of the subjects. Trovato et al. defined lifestyle according to dietary habits, exercise and physical activity, and sleep [22]. Based on Kim et al.'s study [23], the sleep duration was categorised as 5 ≥, > 5-6, > 6-7, and > 7 in this study.

The height (cm) was measured without shoes (by wall stadiometer device seca206, Hamburg, Germany) and weight (kg) was measured with light clothing and without shoes (by seca755 scale, Hamburg, Germany) by a trained person. Body mass index (BMI; kg/m2) was obtained by dividing the weight (kg) by the height squared (m2) for all subjects. BMI < 25 was considered normal, while BMI ≥ 25 was regarded as overweight [24].

To determine fatty liver, in the presence and with confirmation of two radiologists who deployed in the cohort centre, abdominal ultrasound was performed using the ultrasonic device (sonixSP series) using a 3.5-5 MHz deep probe. Echogenicity was increased in the liver parenchyma compared to kidney parenchyma or spleen in abdominal ultrasound [25] was recorded as fatty liver.

The data were expressed as frequency (percentage) and mean (standard deviation). Chi-square test, t-test, and chance ratio were calculated by univariate logistic regression to compare the variables, where $p < 0.05$ was considered significant. All analyses were performed by SPSS 18.

This study has been registered in the research and ethics committee of the Research Center of Gastroenterology and Hepatology and Guilan University of medical sciences with the number of IR.GUMS.REC.1394.499. Written informed consent form was taken from all participants to participate in the study. Further, they were free to quit this study at any stage they wished.

Results

Out of the 630 subjects, 275 (43.7%) had NAFLD, that 330 (52.4%) were male, whose age range was 35-60. The mean age was 46.99 ± 7.33 (47.10 ± 7.10 in women and 47.76 ± 7.57 in men). The demographic information of the subjects is presented in Table 1.

Table 1: Demographic characteristics of participants

Variables	Total N (%)	non- NAFLD N (%)	NAFLD* N (%)
Age (years)			
35-44	244 (38.7)	142 (58.2)	102 (41.8)
45-54	241 (38.3)	133 (55.2)	108 (44.8)
55-60	145 (23.0)	80 (55.2)	65 (44.8)
Gender			
Male	330 (52.4)	183 (55.5)	147 (44.5)
Female	300 (47.6)	172 (57.3)	128(42.7)
Marital status			
Single	20 (3.2)	12 (60)	8 (40)
Married	610 (98.8)	343 (56.2)	267 (43.8)
Job			
Farmer	66 (10.5)	39 (59.1)	27 (40.9)
Housewife	252 (40)	138 (54.8)	114 (45.2)
Employed	90 (14.3)	54 (60)	36 (40.0)
Worker	97 (15.4)	49 (50.5)	48 (49.5)
Self-employed	125 (19.8)	75 (60)	50 (40)
Education			
Illiterate	42 (6.7)	19 (45.2)	23 (54.8)
Elementary	138 (21.9)	73 (52.9)	65 (47.1)
High school	368 (58.4)	212 (57.6)	156 (42.4)
Academic	82 (13)	51 (62.2)	31 (37.8)
Residence			
City	454 (72.1)	259 (57)	195 (43)
Village	176 (27.9)	96 (54.5)	80 (45.5)

*NAFLD non-alcoholic fatty liver disease.

The results of this study indicated a significant relationship between smoking (p = 0.036, OR 95%CI = 1.47: 1.02-2.13), alcohol consumption (p = 0.030, OR 95%CI = 1.70: 1.05-2.75), and BMI ≥ 25 (p < 0.001, OR 95%CI = 7.98: 4.53-14.07) between NAFLD and non-NAFLD group. Also, weight loss was significant between the groups over the past six months (p = 0.006, OR 95%CI = 0.59: 0.41-0.86).

In this study, a significant relationship was observed between weight loss over the past six months as well as average BMI based on t-test and NAFLD (p = 0.005 and p < 0.001, respectively). However, there was no significant relationship between the duration of daily sleep (p = 0.61) and the interval between dinner and night sleep (p = 0.39) (Table 2).

Table 2: Participants in non-NAFLD and NAFLD

Variables	non-NAFLD	NAFLD	P-value*
Age (year)	47.08 ± 7.42	47.92 ± 7.23	0.15
BMI (kg/m^2)	26.56 ± 3.74	30.81 ± 4.47	< 0.001
Weight loss (Last 6 months) (kg)	1.15 ± 2.47	0.68 ± 1.75	0.005
Sleep duration(h/day)	7.22 ± 1.32	7.17 ± 1.33	0.61
Dinner-to-night sleep interval (h)	2.65 ± 1.06	2.58 ± 0.97	0.39

NAFLD non-alcoholic fatty liver disease; Body mass index (BMI); Data are presented as mean ± SD; P-value as derived by Independent sample t-test; * p < 0.05 is significant.

Similarly, according to the sleep duration categorisation, no significant relationship was observed between NAFLD and non-NAFLD group (Table 3).

Table 3: Comparison of sleep duration and physical activity between non-NAFLD and NAFLD

Variables	non-NAFLD N (%)	NAFLD N (%)	P-value*	OR (CI 95%)
Sleep duration (h/day)				
≤ 5	27 (51.9)	25 (48.1)	0.77	1.09 (0.60-1.97)
> 5-6	56 (54.4)	47 (45.6)	0.95	0.98 (0.62-1.55)
> 6-7	119 (62)	73 (38)	0.08	0.72 (0.49-1.04)
> 7	153 (54.1)	130 (45.9)	-	(ref)
Regular exercise				
Yes	97 (65.1)	52 (34.9)	0.014	0.62 (0.42-0.90)
No	258 (53.6)	223 (46.4)		(ref)
Exercise intensity				
Intense	16 (84.2)	3 (15.8)	0.007	0.15 (0.04-0.59)
Moderate	56(65.1)	30 (34.9)	0.022	0.44 (0.22-0.89)
Light	25 (45.5)	30 (54.5)	-	(ref)
Daily walking (min/day)				
≤ 30 min	180 (59.4)	123 (40.6)	0.137	0.78 (0.57-1.07)
> 30 min	175 (53.5)	152 (46.5)		(ref)
Daily Activity				
Sedentary	73 (47.4)	81 (52.6)	0.010	1.61 (1.11-2.00)
Active	282 (59.2)	194 (40.8)		(ref)

NAFLD non-alcoholic fatty liver disease; *p < 0.05 is significant.

The results of this study indicated that the chance of developing NAFLD was less in those who had regular exercise over the past six months. (p = 0.014, OR 95%CI = 0.62: 0.42-0.90). On the other hand, sedentary daily activity enhances the chance of developing NAFLD (p = 0.010, OR 95%CI = 1.61: 1.11-2.00). PA comparison between the groups is reported in Table 2.

In investigating the dietary habits of individuals with NAFLD, a significant relationship was observed with speed of eating (p = 0.03), consuming fatty food (p = 0.04), consuming fruits and vegetables (p = 0.03), daily consumption of sweet beverages (p = 0.042), use of SFA (p = 0.039), and consuming red meat (p = 0.01) (Table 4).

Table 4: Comparison of nutrient patterns between non-NAFLD and NAFLD

Variables	non-NAFLD N (%)	NAFLD N (%)	P-value*	OR (CI 95%)
Breakfast consumption				
Yes	343 (55.9)	271 (44.1)	0.13	0.42(0.13- 1.32)
No	12 (75)	4 (25)		(ref)
Snacks consumption				
Yes	312 (57)	235 (43)	0.37	0.81 (0.51- 1.28)
No	43 (51.8)	40 (48.2)		(ref)
Speed of eating				
Yes	178 (52.5)	161 (47.5)	0.036	1.40 (1.02-1.92)
No	177 (60.8)	114 (39.2)		(ref)
Bread consumption				
bran-rich	298 (56.4)	230 (43.6)	0.91	0.97 (0.63-1.49)
no bran	57 (55.9)	45 (44.1)		(ref)
Fatty food consumption				
Yes	315 (55.1)	257 (44.9)	0.04	1.81 (1.01-3.23)
No	40 (69)	18 (31)		(ref)
Meat consumption				
Red meat	32 (40.5%)	47 (59.5%)	0.01	2.42 (1.22- 4.81)
Poultry	285 (58.2%)	205 (41.8)	0.53	1.18 (0.68- 2.05)
Fish	38 (62.3%)	23 (37.7%)	-	(ref)
Fruits & vegetables				
(serv./day) 3-4	46 (67.6)	22 (32.4)	0.03	0.55 (0.32 -0.96)
2	116 (56.9)	88 (43.1)	0.49	0.88 (0.62- 1.25)
< 1	193 (53.9)	165 (46.1)	-	(ref)
Milk&dairies(glass /day)				
≥ 2	60 (55.6)	48 (44.4)	0.18	1.42(0.84-2.38)
1	208 (53.9)	178 (46.1)	0.04	1.51 (1.01 -2.27)
< 1	87 (64)	49 (36)	-	(ref)
Sweet beverages (day)				
Yes	200 (53.1)	177 (46.9)	0.042	1.400(1.01-1.93)
No	155 (61.3)	98(38.7)		(ref)
Oil consumption				
SFA	37 (45.7)	44 (54.3)	0.039	1.63 (1.02-2.61)
UFA	318 (57.9)	231 (42.1)		(ref)

NAFLD non-alcoholic fatty liver disease; SFA Saturated fatty acid; UFA Unsaturated fatty acid; *p < 0.05 is significant.

Discussion

The increase in the incidence of non-communicable worldwide diseases has changed NAFLD into a new challenge for public health. Prevalence of NAFLD in the world, Eastern countries, and Asia has been reported as 10-30% [26], 20-30%, and 15-20%, respectively [27]. In Iran, the prevalence in the north and south of the country has been reported as 43.8% [6] and 15.3% [28]. In this study, the NAFLD prevalence was 43.7%.

Lifestyle is an important factor for metabolic syndrome, and it is associated with NAFLD [29]. Further, exercising to lose weight is an indispensable

part of lifestyle interventions, and it is proposed as a useful independent item for NAFLD [22]. According to the results of the present study, PA is associated with the probability of NAFLD reduction, where individuals with less daily physical activity are at higher risk.

Hallsworth, [16] Gerber [15], and Trovato [22] stated that those with NAFLD spend more time resting and have less physical activity compared to the control group. Long-term sitting predisposes individuals further to the risk of NAFLD by increasing the fat mass or reducing the musculoskeletal mass. Thus, by reducing sitting and increasing PA, one can decrease the risk of NAFLD [25].

In this study, smoking and alcohol consumption along with high BMI were associated with NAFLD, which is consistent with the results of previous studies on the relationship between smoking, [30,31] alcohol [4], [22] and BMI [1], [6], [22], [32] and NAFLD. The onset and progression of NAFLD, apart from the quantity and quality of food and exercise, are also associated with other aspects of lifestyle, including alcohol consumption less than 20 g/day [22].

The fat quality of the diet also seems to have a significant role in the progression of NAFLD. In this regard, consuming a diet with saturated fatty acid (SFA) may cause fat accumulation in the liver. In contrast, a diet containing Poly Unsaturated Fatty Acid (PUFA) has a negative effect on the extent of accumulation of triglyceride inside the liver [33]. Our study indicated that the individuals who have SFA-containing diet are more at risk of developing NAFLD. Further, in this study, the probability of risk of NAFLD was higher for those consuming fatty food, drinking sweet beverages, consuming red meat, and eating food faster. However, the probability was lower with consuming fruits and vegetables.

Nevertheless, no relationship was observed between consuming breakfast and snack. Previous studies have been reported that skipping breakfast is associated with obesity, [34] and might be associated with the onset of NAFLD. On the other hand, the study by Imaizumi [28] did not report the relationship between skipping breakfast and NAFLD, which is in line with our study. Various studies have been reported a positive relationship between consuming carbohydrate as well as sweets and NAFLD [1], [30], [35].

When investigating dietary habits, it is important that the subjects are evaluated individually about overusing food and even proper eating behaviours. A number of nutritional patterns such as increasing food volume (eating out frequently, huge food volume per one meal, eating any kind of food), high energy diet (fast foods, outside food, and fried food), consuming suitable food and the manner of eating (being used to eating a load of food in the afternoon, eating in the evening, skipping breakfast, and eating fast) and over-consuming special nutrients have been shown to be associated with NAFLD [13]. Previous studies have considered a vegan diet and they have replaced red and fish meat with soybean and substituted refined carbohydrates with whole grains as effective for preventing fatty liver [36].

In the present study, although the subjects in the NAFLD group had shorter average sleep, no relationship was found between duration of sleep and NAFLD, which is consistent with the findings of the study by Trovato [22] and Katsagoni [29]. However, some studies have suggested that sleep duration has an inverse relationship with NAFLD, where short sleep duration is associated with increased risk of NAFLD [23], [29], [37], [38]. Sleep is an important factor for maintaining health, and short sleep duration is associated with obesity, diabetes, and fatty liver [39]. Generally, it is expected that improving lifestyle is important for preventing and treating NAFLD.

Since the onset and progression of NAFLD are associated with lifestyle, thus nutritional therapeutic solutions, PA, and sleep and rest status are required for those with or at risk of NAFLD. Increasing physical activity and a healthy diet is a therapeutic target which may prevent progression of the metabolic status and weight gain in those with NAFLD, which should be taken into account in clinical care.

Among the limitations of this study was using ultrasonography for diagnosing NAFLD. However, liver biopsy is the golden standard for fatty liver, but it is invasive and costly and is not recommended for the general population. Therefore, abdominal ultrasound was used in this study. The comments of two radiologists were used simultaneously to control this limitation. In comparison to histology, sonography is more reliable and accurate. Due to being inexpensive, safe, and available, it is the method of choice for screening fatty liver in clinical conditions and population settings [40].

On the other hand, the information related to diet, PA, and sleep of individuals was collected as self-reporting. In this method, under-reporting especially regarding diet in obese individuals might be a problem. To control it at least to some extent, attempts were made to provide sufficient explanation about the importance of correct reporting. Eventually, the cross-sectional nature of this study is a limitation which cannot determine causal relations, and the results should be confirmed in prospective studies.

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