Original Article

The Prevalence of Nonalcoholic Fatty Liver Disease and its Association with Lifestyle/dietary Habits among University Faculty and Staff in Chengdu*

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Abstract

Objective To investigate the prevalence of nonalcoholic fatty liver disease (NAFLD) in different university categories and its association with lifestyle/dietary habits.

Methods A cross-sectional study was carried out on 9 378 faculty members and staff who participated in an annual health checkup at three universities selected by random cluster sampling. Demographic, anthropometric, biochemical indices and abdominal ultrasound measurements were collected. A nested case-control study was conducted with 200 NAFLD cases and 200 controls matched by gender, age (±3 years), and university.

Results The overall prevalence of NAFLD was 10.3% (13.7% in males and 6.8% in females). The prevalence was significantly higher in the science and engineering university (22.1%) than in the comprehensive universities with (6.4%) and without (10.9%) medical colleges. Obesity/overweight, hyperlipidemia, diabetes mellitus, and family history of NAFLD were independently associated with higher risk of NAFLD, as were frequent consumption of desserts and salty/spicy foods. Using nutritional supplements was a protective factor against NAFLD. Intake of coarse cereals, potatoes, vegetables, fruits, and milk was significantly lower, and intake of red meat, viscera, candies and pastries, cooking oil, and total energy was significantly higher in participants with NAFLD than in controls.

Conclusion Science and engineering university faculty and staff are key targets for NAFLD prevention. NAFLD is closely associated with age, gender, university type, metabolic diseases, and lifestyle/dietary habits.

Key words: NAFLD; Prevalence; Case-control study; Lifestyle/dietary habits

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INTRODUCTION

Nonalcoholic fatty liver disease (NAFLD) is an increasingly recognized clinical condition that includes a wide spectrum of clinical manifestations, ranging from simple steatosis to advanced fibrosis, cirrhosis, and eventually hepatoma. It represents the hepatic manifestation of the metabolic syndrome (MS) and could markedly increase the risk of cardiovascular

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diseases[1-2]. Many epidemiological studies have been conducted worldwide and have indicated that NAFLD affects 20% to 30% of the general population in Western countries[3] and 12% to 24% in Asian countries[4]. In the past twenty years, with the westernization of lifestyles, NAFLD has become highly prevalent in China and its associated morbidity has increased to 15%[5], which creates a heavy burden on individuals, families, and society.

NAFLD is a multifactorial disease that involves a complex interaction of genetics, age, gender, metabolic disorders, and lifestyle/dietary habits, all of which combine to form different NAFLD phenotypes that vary by population. Obesity is considered an independent risk factor for NAFLD. Therefore, weight reduction is recommended as the primary treatment for NAFLD. It is well-known that physical exercise and balanced diet are the two main measures used in the management of body weight. Recently, the effects of physical activity on NAFLD and nonalcoholic steatohepatitis (NASH) via improving insulin resistance have been documented [6-8]. However, to date, few studies have examined the effects of different lifestyle/dietary habits on NAFLD, and there are no specific dietary guidelines for patients with NAFLD. Therefore, further evidence is needed.

In recent years, several studies have indicated that the prevalence of NAFLD has been rapidly increasing among university faculty and staff, which may affect the quality of education. However, the prevalence of NAFLD in different types of universities, and the presence of NAFLD risk factors among university faculty and staff have not yet been examined.

In the present report, a cross-sectional study and a case-control study were combined to systematically investigate the prevalence of NAFLD and its association with lifestyle/dietary habits among university faculty and staff in Chengdu to provide scientific evidence that could be used for NAFLD prevention.

SUBJECTS AND METHODS

Cross-sectional Study

Subjects All universities in Chengdu were divided into three groups according to their category, including comprehensive university with medical colleges, comprehensive university without medical colleges, and science and engineering university. One university was randomly selected from each group. A total of 9 397 subjects aged 20-90 years took part in annual physical examinations from March 12, 2008, to January 20, 2009, and 9378 individuals were enrolled in the study.

Data Collection and Indices Measurement Each subject who participated in the physical examination was first asked to complete a form that included questions regarding name, age, gender, history of disease, drug or tobacco use, and alcohol consumption. Blood pressure was measured by two experienced physicians in each university. The fasting blood sample was taken before 10 AM to determine fasting plasma glucose (FPG), triglyceride (TG), and total cholesterol (TC) levels using an automatic biochemical analyzer (OLYMPUS AU400, Hamburg, Germany) in each university hospital. No significant differences in these indices for standard substance were found among the three hospitals. Finally, real-time ultrasonography of the upper abdominal organs was performed to determine liver fatty infiltration using a 3.5-MHz probe (HY3000, Jiangsu, China) by a physician specializing in ultrasonography in each university. All physicians and technicians involved in the physical examinations received training in advance.

Diagnostic Criteria According to the guidelines for NAFLD management formulated by the Chinese National Workshop on Fatty Liver Disease in 2010[9], NAFLD can be diagnosed with the following criteria: (1) ethanol consumption < 140 g/week for male adults and < 70 g/week for female adults; (2) absence of viral hepatitis (HBV/HCV), hepatolenticular degeneration, autoimmune diseases, a history of total parenteral nutrition, or intake of any hepatotoxic drugs (e.g., tamoxifen, amiodarone, sodium valproate, methotrexate, and glucocorticoid); (3) ultrasonographic examination suggesting fatty infiltration in liver. Definitions for other chronic diseases are as follows[10]: hypertension (systolic pressure ≥140 mmHg and/or diastolic pressure ≥ 90 mmHg); diabetes mellitus (FPG ≥ 7.0 mmol/L); impaired fasting glucose (6.1 mmol/L ≤ FPG < 7.0 mmol/L); hypertriglyceridemia (TG ≥1.7 mmol/L); hypercholesterolemia (TC ≥ 5.17 mmol/L).

Case-control Study

According to the formula for 1:1 matched case-control studies, α=0.05, β=0.1, $M\approx m/(p_0q_1+p_1q_0)$; and $m=[U_{\alpha}/2+U_{\beta}\sqrt{p(1-p)}\ ]^2/(p-1/2)^2$, 200 subjects diagnosed with NAFLD according to the foregoing criteria were randomly selected as cases from the cross-sectional study. When a NAFLD case was identified, a subject without NAFLD from the cross-sectional study was selected as control matched by gender, age (±3 years), and university. Finally, 148 males and 52 females were recruited in both case and control group. A 17-item questionnaire was designed according to the relevant literature and local lifestyle and dietary habits to study the differences in anthropometric indices (body weight, body height, waist circumference and blood pressure), health-related lifestyle/dietary habits, medical history, and family history of NAFLD between cases and controls. In addition, a food-frequency questionnaire (FFQ) was designed based on the food groupings in the Dietary Pagoda for Chinese 2007 to record the intake of all food categories consumed during the year before diagnosis (cases) or in the past year (controls).

Informed consent was obtained from each participant according to the requirement of the Medical Ethics Committee of Sichuan University.

Data Analysis

Data were input into Excel 2007 (Microsoft Corporation, Redmond, USA) or Epidata v.3.0 (The Epidata Association, Odense, Denmark). Statistical analysis was carried out by SPSS v.17.0 (SPSS Corporation, Chicago, USA). Percentages were used to express the prevalence of NAFLD, and Chi-squared and Fisher's exact tests were performed to determine statistical significance of differences in NAFLD prevalence between genders, age groups, and universities, and differences in chronic disease prevalence between subjects with and without NAFLD. Risk was estimated by odds ratios (OR) and their 95% confidence intervals (95% CI). Univariate and multivariate conditional logistic regression analyses were used to evaluate the lifestyle/dietary habit preventive and risk factors for NAFLD. A comparison of food consumption between the NAFLD case and control groups was performed by the rank-sum test. $P<0.05$ was considered statistically significant.

RESULTS

Cross-sectional Study

Age and Gender-specific Prevalence of NAFLD A total of 9 378 subjects (4 759 males and 4 619 females) were recruited. There were 968 subjects diagnosed with NAFLD; a prevalence of 10.3%. As shown in Table 1, the prevalence among females increased with age and was significantly lower than that in males (6.8% vs. 13.7%, χ^2=117.655, P<0.01). The prevalence of NAFLD among male subjects younger than 60 years was much higher than that among their female counterparts (14.7% vs. 4.8%, χ^2=160.796, P<0.01). No gender difference in prevalence was observed in the subjects aged 60 to 69 years (14.8% vs. 13.3%, χ^2=0.641, P>0.05). However, in subjects older than 70 years, the prevalence among males was significantly lower than that among females (9.7% vs. 13.5%, χ^2=5.125, P<0.05). An interesting intersection between the NAFLD prevalence curves for males and females was observed in the 60-79 age group.

Table 1. Prevalence of NAFLD among University Faculty and Staff by Age and Gender

Age (Years)	Male		Female		Total	
	n	*n* (%)	*n*	*n* (%)	*n*	*n* (%)
20-29	179	18(10.1)	326	1(0.3)[a]	505	19(3.8)
30-39	857	92(10.7)	1029	12(1.1)[a]	1886	104(5.5)
40-49	1057	178(16.8)	1379	70(5.1)[a]	2436	248(10.2)
50-59	949	158(16.6)	760	83(10.9)[a]	1709	241(14.1)
60-69	748	111(14.8)	601	80(13.3)	1349	191(14.2)
≥70	969	94(9.7)	524	71(13.5)[a]	1493	165(11.1)
Total	4759	651(13.7)	4619	317(6.8)[ab]	9378	968(10.3)

Note. [a]P<0.05, compared with males in the same age group. [b]P <0.01, test of trend for NAFLD in males and females.

Prevalence of NAFLD among Different Universities As shown in Figure 2, the prevalence of NAFLD in the comprehensive university with medical colleges (Univ. A) was the lowest (6.4%), followed by the comprehensive university without medical colleges (Univ. B, 10.9%). The prevalence in the science and engineering university (Univ. C) was the highest (22.1%), and significantly higher than that in both Univ. A (χ^2=435.97, P<0.01) and Univ. B (χ^2=103.56, P<0.01). The prevalence in the comprehensive university with medical colleges (Univ.A) was much lower than that in the comprehensive university without medical colleges (Univ. B) (χ^2=33.57, P<0.01).

Prevalence of Chronic Diseases As expected, the average age of subjects with NAFLD (54.5±13.0 years) was higher than that of subjects without NAFLD

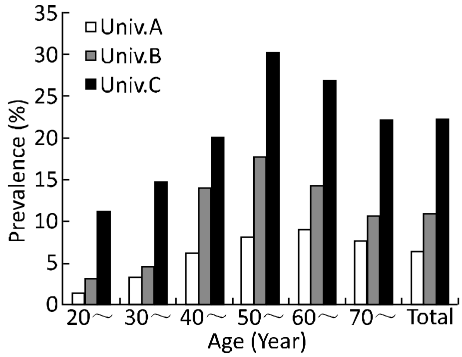

Figure 1. Comparison of NAFLD Prevalence among Different Universities. (Univ. A: a comprehensive university with medical colleges; Univ. B: a comprehensive university without medical colleges; Univ. C: a science and engineering university).

(50.7±15.2 years). The prevalence of hypertriglyceridemia (63.7%), hypertension (34.8%), hypercholesterolemia (20.2%), diabetes mellitus (11.6%) and impaired fasting glucose (10.6%) in subjects with NAFLD was significantly higher (P<0.01) than that in subjects without NAFLD (27.8%, 15.9%, 15.5%, 2.6%, and 3.5%, respectively). In the two groups, among chronic diseases, the prevalence of hypertriglyceridemia was the highest, while the prevalence of impaired fasting glucose and diabetes mellitus were the lowest (Table 2).

Table 2. Comparison of Age and Chronic Diseases between Subjects with and without NAFLD

	Total (n=9378)	With NAFLD (n=968)	Without NAFLD (n=8410)	P
Age (Years)	51.1±15.0	54.5±13.0	50.7±15.2	<0.05
Hypertension (n, %)	1692(18.0)	337(34.8)	1355(15.9)	<0.01
Impaired Fasting Glucose (n, %)	396(4.2)	103(10.6)	293(3.5)	<0.01
Diabetes Mellitus (n, %)	334(3.6)	112(11.6)	222(2.6)	<0.01
Hypertriglyceridemia (n, %)	2954(31.5)	617(63.7)	2337(27.8)	<0.01
Hypercholesterolemia (n, %)	1503(16.0)	196(20.2)	1307(15.5)	<0.01

Case-control Study

Univariate Conditional Logistic Regression Analysis The univariate conditional logistic regression analysis (Table 3) suggested that there were 15 factors associated with NAFLD, 14 of which were risk factors. Using nutritional supplements appeared to be a protective factor against NAFLD. Smoking and skipping breakfast exhibited no correlation with NAFLD.

Multivariate Conditional Logistic Regression Analysis All 15 variables from the univariate conditional logistic regression analysis were entered into the multivariate conditional logistic regression model, and the stepwise backwards selection procedure was used to identify the final model. As indicated in Table 4, obesity/overweight, family history of NAFLD, diabetes mellitus, hyperlipidemia, frequent consumption of desserts and salty/spicy foods, and using nutritional supplements were independently associated with NAFLD. The first seven variables were risk factors for NAFLD, of these, obesity was associated with the highest risk (OR=28.795; 95% CI=8.230-100.746), followed by overweight (OR=11.192; 95% CI=4.370-28.664). Using nutritional supplements was a protective factor against NAFLD (OR=0.328, 95% CI =0.125-0.862).

Food Intake As illustrated in Table 5, no significant differences between cases and controls were observed for average daily intake of rice and wheat, eggs, fish and shrimp, legumes and derived products, and nuts/seeds (P>0.05). Furthermore, consumption of cereals and potatoes, eggs, and fish and shrimp in both groups did not reach 80% of the recommended level in the Chinese Dietary Pagoda.

Intake of coarse cereals, potatoes, vegetables, and fruits among cases was significantly lower than the intake among controls (15.4 vs. 23.4 g/day; 21.0 *vs.* 25.6 g/day; 435.5 *vs.* 479.9 g/day; 89.4 vs. 109.3 g/day, P<0.05). Moreover, fruit consumption in the two groups was not sufficient when compared with RFIP. In terms of meat consumption, both groups exceeded the recommendation (75 g/day). Furthermore, red meat and viscera intake among NAFLD cases was significantly higher than the intake among controls (105.4 vs. 97.4 g/day; 9.7 vs. 3.4 g/day, respectively, P<0.05). However, the difference in consumption of white meat between the two groups was not significant. In addition, compared with the controls, intake of milk and derived products was significantly lower in the NAFLD group (137.6 vs. 194.1 mL/day). Conversely, cooking oil and candy and pastry consumption was significantly higher in the NAFLD group than in the controls (47.2 vs. 30.7 g/day; 11.6 vs. 7.4 mL/day, P<0.05).

The total energy intake of NAFLD cases was much higher than that of controls (2408.8 vs. 2195.8 kcal, P<0.05).

Table 3. Univariate Conditional Logistic Regression Analysis of Factors Influencing NAFLD[a]

Variables	Evaluation	β	Wald χ²	OR	95% CI	*P*
BMI [b]	BMI<24: 0		52.870			0.000
24 ≤ BMI < 28 (overweight)	24≤BMI<28: 1	2.169	36.894	8.848	4.345-17.613	0.000
BMI ≥ 28 (obesity)	BMI>28: 2	3.414	42.545	30.390	10.894-84.776	0.000
Waist circumference (WC)	Male: WC<85 cm: 0 WC≥85 cm: 1 Female: WC<80 cm: 0 WC ≥80 cm: 1	2.565	42.763	13.000	6.027-28.042	0.000
Frequent dessert consumption	Ofen:1, Seldom/no: 0	0.903	8.700	2.467	1.354-4.494	0.003
Frequent salty food consumption [c]	Ofen:1, Seldom/no: 0	0.879	14.724	2.407	1.537-3.771	0.000
Frequent spicy food consumption [d]	Ofen:1, Seldom/no: 0	0.967	18.286	2.630	1.688-4.096	0.000
Frequent fried food consumption	Ofen:1, Seldom/no: 0	1.609	8.634	5.000	1.709-14.628	0.003
Eating time for each meal	Ofen:1, Seldom/no: 0	0.560	7.972	1.750	1.187-2.581	0.005
Having a midnight snack [e]	<1 /week: 0,		4.963			0.084
5-7 /week	2-4 /week:1, 5-7 /week:2	0.888	3.131	2.430	0.909-6.498	0.077
Dining out (restaurant)	<1 /week: 0		11.090			0.004
2-4 /week	2-4 /week: 1	0.810	10.585	2.248	1.380-3.661	0.001
5-7 /week	5-7 /week: 2	0.675	2.731	1.964	0.882-4.371	0.098
Physical activity	<30min /day: 2		15.931			0.000
>60 min/day	30-60min /day:1, > 60min /day: 0	0.895	11.597	2.448	1.462-4.099	0.001
Nutritional supplements [f]	Yes: 0, No:1	-0.619	5.231	0.538	0.317-0.915	0.022
Hyperlipidemia	Yes: 1, No: 0	1.455	24.041	4.286	2.395-7.668	0.000
Hypertension	Yes: 1, No: 0	0.806	9.421	2.238	1.338-3.744	0.002
Diabetes mellitus	Yes: 1, No: 0	1.253	4.883	3.500	1.152-10.633	0.027
Family history of NAFLD	Yes: 1, No: 0	1.386	6.150	4.000	1.337-11.965	0.013

Note. [a]The dependent variable. NAFLD case: 1, Control: 0. [b]BMI: body mass index = body weight (kg)/ height (m)^2. [c]Salty food: pickle, preserved meat etc. [d]Spicy food: shallot, ginger, garlic, capsicum, etc. [e]Having a midnight snack: an additional meal after dinner. [f]Nutritional supplements: multi-vitamins, multi-minerals, fish oil, phytochemicals, etc. *P*<0.1 was considered statistically significant.

Table 4. Multivariate Conditional Logistic Regression Analysis of Factors Influencing NAFLD

Variables	β	Wald χ²	OR	95% CI	*P*
BMI		35.078			0.000
24≤BMI <28 (overweight)	2.415	25.339	11.192	4.370-28.664	0.000
BMI≥28 (obesity)	3.360	27.652	28.795	8.230-100.746	0.000
Diabetes mellitus	1.603	4.383	4.966	1.108-22.266	0.036
Hyperlipidemia	1.483	8.441	4.405	1.620-11.976	0.004
Family history of NAFLD	1.977	4.082	7.223	1.061-49.167	0.043
Frequent dessert consumption	1.509	6.480	4.524	1.415-14.462	0.011
Frequent salty food consumption	0.847	5.536	2.333	1.152-4.724	0.019
Frequent spicy food consumption	0.785	4.147	2.192	1.030-4.664	0.042
Nutritional supplements	-1.114	5.110	0.328	0.125-0.862	0.024

Table 5. Comparison of Average Daily Food Consumption between NAFLD Cases and Controls

Food	RFIP [a] (g/day)	Cases (*n*=200)		Controls (*n*=200)	
		Average Intake (g/day)	Percentage of Average Intake to RFIP (%)	Average Intake (g/day)	Percentage of Average Intake to RFIP (%)
Cereals and potatoes	400	286.9	71.7	289.6	72.4
Rice and wheat		250.5		240.6	
Coarse cereals		15.4		23.4[b]	
Potatoes		21.0		25.6[b]	
Vegetables	450	435.5	96.8	479.9[b]	106.6
Fruits	150	89.4	59.6	109.3[b]	72.9
Meats	75	184.1	245.5	123.8[b]	165.1
Pork, beef, mutton (red meat)		150.4		97.4[b]	
Chicken, duck, rabbit (white meat)		24		23.0	
Viscera		9.7		3.4[b]	
Eggs	40	30.5	76.3	32.2	80.5
Fish and shrimp	50	31.6	63.2	38.3	76.6
Legume and derived products (mL)	40	43.1	107.8	46.7	116.8
Milk and derived products (mL)	200	137.6	68.8	194.1[b]	97.1
Cooking oil	25	47.2	188.8	30.7[b]	122.8
Nuts and seeds		23.4		22.5	
Candies and pastries		11.6		7.4[b]	
Total energy intake (kcal)		2408.8		2195.8[b]	

Note. [a]RFIP: Recommendation of food intake in the Chinese Dietary Pagoda. [b]$P<0.05$, compared with NAFLD cases.

DISCUSSION

NAFLD Prevalence among Different University Categories

NAFLD has been recognized as the most common liver disease in recent years. Epidemiological evidence indicates that the prevalence of NAFLD in China has approximately doubled in the past decade, and that the average prevalence is approximately 15%[5]. In the present study, the prevalence was 10.3% among university faculty and staff in Chengdu. This was not only lower than the average prevalence in China and in Chengdu (12.2%)[11], but also lower than that among staff at Tsinghua University (24.3%)[12] and Lanzhou University of Technology (15.8%)[13]. This discrepancy may be the result of the subjects' higher education and better economic conditions, which may encourage them to pay close attention to their heath. The findings also suggest that faculty and staff in the science and engineering university had a higher likelihood of having NAFLD than those in the comprehensive universities. This may be attributed to the high proportion of males in the science and engineering university (64.3%; the proportion in the other two universities was 47.7% and 38.2%, respectively), as it is well-known that male gender is a risk factor for NAFLD. On the other hand, faculty and staff in medical colleges, who have a great deal of medical knowledge, may not only have strong self-health care consciousness, but may also encourage others in the non-medical colleges of the same university to stay healthy, which may partly explain why the prevalence of NAFLD in the comprehensive university with medical colleges was much lower than that in the comprehensive university without medical colleges.

Age and Gender-specific Prevalence of NAFLD

Previous studies indicated that the progress of NAFLD is closely associated with age and gender. Daryani et al.[14] reported that age may influence the severity of steatohepatitis, as well as portal and lobar inflammation in patients suffering from NASH, while gender may independently contribute to the level of steatohepatitis. In this study, there was an intersection of NAFLD prevalence in males and females during the ages of 60-69 years. Similar results were reported by Li[15]. This may be attributed to higher levels of pressure from work, family, and society among males until retirement (60 years of age). Prolonged exposure to stress, which may directly affect the autonomic nervous system and neuroendocrine activity, is a demonstrated risk factor for metabolism-related diseases[16]. Meanwhile, decreasing levels of estrogen after menopause can lead to higher prevalence of metabolic disorders in females older than 50 years[17-18]. Moreover, declining physical activity and basal metabolism with age could also increase the possibility of having NAFLD.

The Relationship of NAFLD with Chronic Diseases

The results suggested that NAFLD was strongly linked with chronic disease, in particular, obesity/overweight and hyperlipidemia, in agreement with previous studies[19,4-5]. The relationship between NAFLD and MS is becoming increasingly recognized. Hyperinsulinemia and insulin resistance are common mechanisms of NAFLD, obesity, diabetes, dyslipidemia, and hypertension. In fact, NAFLD is presently considered to be the hepatic presentation of MS[20-22]. In addition, MS is also involved in the pathogenesis of "two hits" in NAFLD. The first "hit," hepatic steatosis, is induced by impaired mitochondrial function, insulin resistance (a major mechanism of MS), and elevated hepatic *de novo* lipogenesis, which subsequently leads to NAFLD. Inflammation and oxidative stress, the second "hit," which plays a major role in the development of MS, are thought to promote NAFLD to NASH, fibrosis, and necrosis. Therefore, it may be considered that MS and NAFLD are interactive and mutually causal[23].

The Relationship of NAFLD with Dietary Habits and Lifestyles

The conditional logistic regression analysis indicated that individuals who frequently eat salty/spicy foods and desserts were liable to have NAFLD. It is well-known that taste is the most important characteristic of Sichuan cuisine, which commonly includes spices such as salt, capsicum, garlic, and ginger, especially in popular local foods, pickles, hotpots, griddles, and preserved meat. However, most of these are also rich in energy and fat. This may directly stimulate the appetite and lead to excessive calorie intake, and consequently, metabolic disorders. Interestingly, nutritional supplements showed a protective effect against NAFLD. Although many supplements (e.g., fish oil[17], antioxidants[15], and multi-vitamins) have shown beneficial effects on slowing the progression of NAFLD, their safety is still controversial and more evidence is needed from human trials.

The Relationship of NAFLD with Dietary Pattern

Dietary pattern was strongly correlated with NAFLD in the present study. The intake of coarse cereals, most of which are rich in fiber and low-glycemic index foods, was lower in the diet of NAFLD cases than that of controls. Several trials[24-25] have shown that dietary fiber could be helpful in maintaining glucose, insulin, and free fatty acid concentrations in individuals with NAFLD by increasing satiety and regulating metabolism-related gene expression in the liver. Vegetable and fruit consumption were also much lower in NAFLD cases than in controls. It is likely that the anti-oxidative vitamins, minerals, and phytochemicals that are rich in vegetables and fruits inhibited the progression of hepatic steatosis. Evidence suggests that oxidative stress may play a pivotal role in the development of NAFLD (the second "hit")[26-28]. In human trials, antioxidants such as vitamin E[29], betaine[30], and zinc[31] displayed beneficial effects on normalizing serum aminotransferase levels and suppressing fat accumulation in patients with NAFLD.

Compared with the controls, the NAFLD cases ingested more meat, cooking oil, and energy. Red meat/viscera and cooking oils, which are high in saturated fatty acid (SFA) and cholesterol, are closely associated with the development of NAFLD/NASH. Musso et al[32] reported that patients with NASH consumed higher amounts of SFA, at 14% of total energy, compared with 10% in controls. Wang et al.[33-34] demonstrated that saturated fat, which is usually present in red meat, could induce endoplasmic reticulum stress and apoptosis by augmenting trans-10, cis-12 conjugated linoleic acid in liver cells. Recently, studies in animal models and clinical trials have demonstrated that n-3 polyunsaturated fatty acid (PUFA) has beneficial effects on NAFLD through activation of the peroxisome proliferators-activated receptor mediated pathways[35-36] and down-regulating *de novo* lipogenesis via the sterol regulatory element-binding protein pathway[37-38]. However, neither the cases nor the controls met the recommendation for consumption of marine products, which are rich in n-3 PUFAs.

In conclusion, this study first compared the prevalence of NAFLD among faculty and staff in various universities. NAFLD was most prevalent in the science and engineering university in Chengdu. Therefore, we should focus on the health of faculty and staff in this type of university. Males, females >50 years of age, people with obesity/overweight, hyperlipidemia, family history of NAFLD, and frequent consumption of desserts and salty/spicy foods are more likely to have NAFLD. Patients with NAFLD should be recommended to decrease their consumption of red meat/viscera, cooking oils, and candies and pastries, and to increase their consumption of coarse cereals, fruits and vegetables, and seafood.

There are some limitations in this study. First, obesity (BMI and waistline) was not examined as an independent risk factor for NAFLD in the cross-sectional study. Second, ultrasonography could not identify fatty infiltration of the liver below a certain threshold. Therefore, this study probably underestimated the prevalence of NAFLD. Third, the FFQ was only designed to investigate the differences in dietary pattern between NAFLD cases and controls. Further studies are needed to combine other dietary surveys (e.g., 24-h dietary recall) and analyze the correlation between nutrients and NAFLD. In addition, although investigators involved in the questionnaire survey were well-trained to assure the quality of the results, there might have some underling bias, e.g. selection, recall or investigator bias.

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