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Knowledge, attitude, and practice on dietary management among patients with non-alcoholic fatty liver disease: a cross-sectional study in Sichuan

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Abstract

Background Appropriate dietary measures can be pivotal in ensuring optimal outcomes for individuals with non-alcoholic fatty liver disease (NAFLD). However, limited data are available regarding the knowledge, attitude, and practice (KAP) of dietary management of NAFLD. This study assessed the KAP of dietary management of NAFLD in patients diagnosed with NAFLD.

Methods This cross-sectional study was conducted in Southwest China between July and November 2023. Participants diagnosed with NAFLD were enrolled using convenience sampling. The self-designed questionnaire demonstrated good internal consistency (Cronbach's $\alpha = 0.896$) and covered demographic characteristics and KAP of dietary management of NAFLD.

Results A total of 357 valid questionnaires were analyzed. The mean knowledge score was 19.75 ± 10.45 (possible range: 0–35), the mean attitude score was 51.21 ± 6.86 (possible range: 12–60), and the mean practice score was 6.58 ± 1.66 (possible range: 0–16, 41.13%), indicating poor knowledge, positive attitudes, and poor practice. The knowledge scores weakly correlated with attitude ($r = 0.488$, $P < 0.001$) and practice (r=-0.207, $P < 0.001$) scores. The attitude scores were weakly correlated with the practice scores (r=-0.305, $P < 0.001$). The path analysis revealed that knowledge positively influenced attitude ($\beta = 0.33$, $P < 0.001$), while attitude negatively influenced practice (β=-0.06, $P < 0.001$). However, knowledge does not directly influence practice.

Conclusion Patients with NAFLD in Sichuan exhibited poor knowledge, positive attitudes, and poor practice toward dietary management of NAFLD. Educational interventions should be designed to enhance their KAP of dietary management in NAFLD.

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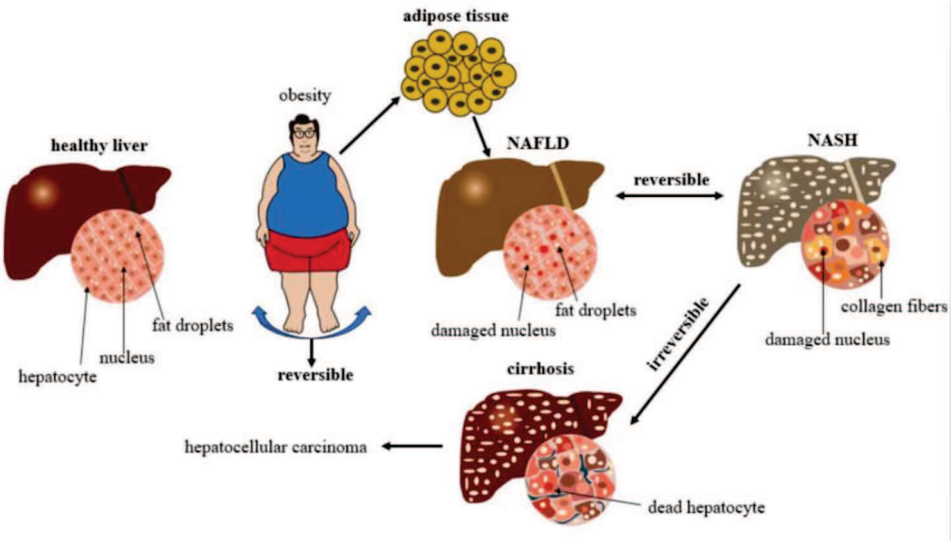
Keywords Knowledge, attitudes, practices, Non-alcoholic fatty liver disease, Dietary management, Cross-sectional study

Graphical Abstract



Introduction

Non-alcoholic fatty liver disease (NAFLD) arises from pathophysiological macrovesicular fatty liver changes unrelated to alcohol intake [1]. The histologic progression from steatosis to non-alcoholic steatohepatitis (NASH), fibrosis, and cirrhosis does not consistently correlate with clinical progression, especially in the early stages [2, 3]. NAFLD is the most common cause of elevated liver enzymes in adults in the United States of America (USA), with a prevalence ranging from 24% to 45% [1]. Notably, the prevalence of NAFLD is as high as 76% in patients with type 2 diabetes mellitus [1]. NAFLD is closely associated with insulin resistance, obesity, weight gain, and diabetes [4, 5]. Fatigue, although the most common symptom, does not necessarily align with the severity of histologic NAFLD lesions. Other symptoms of NAFLD include right upper quadrant abdominal fullness or pain and muscle weakness [1, 6]. While the progression from NAFLD to cirrhosis may be infrequent [4, 7], the risk of progression can be heightened by obesity and diabetes [6]. Furthermore, NAFLD is associated with an increasing risk of developing diabetes [8], chronic kidney disease [9], and surgical complications [10]. Notably, NASH, as an advanced form of the disease, is associated with a higher mortality rate than steatosis in patients with NAFLD [11].

Emphasizing the importance of correct NAFLD management is crucial to ensure optimal outcomes. The management of NAFLD includes lifestyle modifications, medications (liver-directed, thyroid hormone receptor β-selective agonists, insulin and/or glucose-altering medications, lipid-altering medications, and antioxidants), and procedures (e.g., bariatric surgery and liver transplantation) [12–17]. Weight reduction is the principal goal of lifestyle modifications [13]. A consensus among guideline recommendations is encouraging patient weight loss and avoiding liver damage. Reducing dietary calories, improving the selection of healthy diet components, increasing patient exercise, and avoiding excessive alcohol consumption should be emphasized [13, 14]. The patients perform Lifestyle modifications at home, daily, and without direct supervision. Hence, a poor knowledge of the proper lifestyle habits to maintain could influence NAFLD progression. Hence, understanding and implementing appropriate dietary measures can be pivotal in ensuring optimal outcomes for individuals with NAFLD [12–14].

Patients with NAFLD who lack evidence of fibrosis or NASH should undergo counseling for physical activity and adopt a healthy diet without resorting to pharmacotherapy for NAFLD [4, 10, 13, 14], as also supported by Chinese guidelines [15–17]. For individuals with NAFLD, adhering to a hypocaloric diet (targeting 1200–1500 kcal/day or a reduction of 500–1000 kcal/day from baseline) is recommended. This diet should exclude high fructose, processed foods, alcohol, and beverages containing components that promote NAFLD. Additionally, patients in many countries are advised to adjust the macronutrient content to align with the Mediterranean diet, engage in regular (150–300 min of moderate-intensity or 75–150 min of vigorous-intensity aerobic exercise per week), and strive for weight loss (3%–5% or 7%–10%) [4, 10, 13, 14,

18]. Pharmacotherapy is only recommended for patients with NASH or those at a higher risk of disease progression [4, 10, 13, 14, 18]. Behavioral weight-loss interventions have demonstrated efficacy in reducing body weight and liver steatosis in patients with NAFLD [12]. Intensive lifestyle interventions have shown promise in reducing weight, hepatic steatosis, and NAFLD in patients with type 2 diabetes [19]. Notably, the Mediterranean diet is associated with comparable improvements in hepatic steatosis at 12 weeks compared to a low-fat diet in patients with NAFLD [20]. Notably, there is growing interest in the Mediterranean diet among people in China, driven by increasing awareness of its health benefits, including reduced risks of obesity, cardiovascular disease, type 2 diabetes, and even depression [21, 22].

Implementing lifestyle changes to prevent NAFLD necessitates consistent and persistent efforts and a comprehensive understanding of what needs to be changed and how [23, 24]. This knowledge can vary significantly among individuals, leading to gaps, misconceptions, and misunderstandings that may impede the correct implementation of necessary actions. Knowledge, Attitude, and Practice (KAP) surveys serve as valuable tools for assessing these knowledge gaps and identifying barriers to the proper execution of related actions [25, 26]. Furthermore, KAP studies can pinpoint specific areas targeted by educational interventions [25, 26]. A study conducted in India revealed a poor KAP regarding NAFLD among patients with type 2 diabetes mellitus [27]. Similarly, various studies have highlighted inadequate KAP levels among individuals with NAFLD risk factors and patients diagnosed with NAFLD [28–31]. In the USA, a study demonstrated that, despite the awareness that lifestyle modifications constitute the primary therapy for NAFLD, KAP levels were low among patients [32]. Another study in Sri Lanka revealed that physicians exhibited a poor KAP toward NAFLD [33].

NAFLD is a significant and growing public health problem across China, with prevalence rates rising rapidly in recent years [34–36]. While national data highlight certain regions (such as northwest China and Taiwan) as having especially high burdens, Sichuan is also emerging as an area of concern, with a prevalence of NAFLD of 10.3%–47.2% [37, 38], particularly due to its changing lifestyle patterns and the presence of major research and clinical centers focused on metabolic diseases [34, 39]. The relationship between liver fat accumulation and cardiovascular disease risk is being investigated in the Sichuan population, indicating both the prevalence and clinical importance of NAFLD in the region [39]. More granular, region-specific data are needed to quantify the burden in Sichuan compared to other provinces [34, 39]. In China, the KAP of NAFLD also appears to be low [40–42], but no data are available for Sichuan. The KAP toward a specific topic is indeed highly dependent on several region-specific characteristics. Research consistently demonstrates that KAP levels can vary significantly across different geographic areas due to factors such as local culture, socioeconomic status, access to health information, educational resources, and even health system infrastructure [43, 44]. It is essential to consider potential regional disparities within the country. Furthermore, the available evidence is from various countries and populations and is based on different standards.

Therefore, this study aimed to evaluate the KAP of NAFLD among patients with NAFLD in Sichuan.

Methods

Study design and participants

This cross-sectional study was conducted in Sichuan, Southwest China, between July 3 and November 30, 2023, and included patients with NAFLD by convenience sampling. The participants were enrolled if it was convenient for them to participate and if it was convenient for the study personnel to enroll them. All patients were approached for participation if a study staff member was available. No discrimination was done.

The inclusion criteria were 1) patients with NAFLD, as diagnosed according to the Guidelines for the prevention and treatment of metabolic dysfunction-associated (non-alcoholic) fatty liver disease [17], 2) >18 years old, and 3) voluntary participation. The exclusion criteria were (1) any difficulties completing the questionnaire or (2) refusing to participate. Ethical approval has been obtained from the medical ethics committee of the Sichuan Academy of Medical Sciences, Sichuan People's Hospital. All participants provided written informed consent before starting the survey.

Questionnaire and data collection

The questionnaire was designed based on the previous studies [4, 10, 12–14, 18, 31, 33] and *"The Chinese Dietary Guidelines"* [45]. After the initial design, the questionnaire was modified based on comments from three physicians with senior professional titles in hepatology to ensure content validity. The patients for the pilot testing were enrolled through convenience sampling over a period of 3 weeks, during which 48 patients accepted to participate in the study. Cronbach's α was 0.896, indicating good internal consistency.

The final questionnaire (Supplementary Material; the questionnaire was developed and administered in Chinese, and the English version is a non-validated translation provided for indicative purposes only) was in Chinese and encompassed four dimensions: demographic characteristics, knowledge, attitude, and practice. For the knowledge dimension, items K1, K2, K4.2, K4.3, K5.1, and K5.2 were scored 1 point for a correct response

and 0 points for an incorrect or unclear answer. Items K3.1, K6.1, and K6.2 were scored 1 point for "know" and 0 points for "do not know". For the remaining items, the participants received 2, 1, or 0 points for "understand," "heard of", or "do not understand," respectively. The score of each item was added, and the total knowledge score ranged from 0 to 35 points. The attitude section comprised 12 questions employing a 5-point Likert scale. Questions A4, A5, A7, and A8 were reverse scored, with responses ranging from "strongly agree" (5 points) to "strongly disagree" (1 point); the other items were scored from "strongly agree" (1 point) to "strongly disagree" (5 points). The score for each item was added, and the total attitude score ranged from 12 to 60 points. The practice dimension involved eight questions. Questions P2, P3, P5, and P8 pertained to dietary habits with a negative impact on the disease; higher scores (2 – 0 points) were awarded for lower frequencies. For the remaining questions, which related to dietary habits with a positive impact on the disease, higher scores (0–2 points) were given for higher frequencies. The score for each item was added, and the total practice score ranged from 0 to 16 points. The participants' overall knowledge, attitude, and practice scores were categorized using a modified Bloom's criteria cutoff point [46]. The participants who scored 80%–100% were considered to have good knowledge, positive attitude, and appropriate practice, respectively, while scores < 80% were considered poor knowledge, negative attitude, and inappropriate practice, respectively.

The questionnaire was administered to the study participants through a WeChat group for patients with NAFLD and on posters in the waiting rooms and the clinics. The participants could scan the QR code and complete the questionnaires through the Wenjuanxing platform. A response to all items was mandatory for submission. A given IP address could be used only once to submit a questionnaire. All questionnaires were compared among themselves, and no exact duplicates were found. An incentive of 20 CNY (about USD 2.75) was provided for completing questionnaires.

Sample size

The sample size was estimated using the method for quantitative surveys, i.e., 5–10 times the number of KAP items in the questionnaire [47]. Since there were 51 KAP items, the required sample size was 255–510.

Statistical analysis

R 4.3.1 was used for Statistical analysis. The continuous variables were described using means ± standard deviation (SD) and compared by the Mann-Whitney U-test and the Kruskal-Wallis H-test, as the Kolmogorov-Smirnov test showed that the data distribution was skewed. Categorical data were described using n (%). Spearman analysis was used to assess the correlation among KAP scores. A path analysis was used to explore the interaction among KAP dimensions. A multivariable analysis was used to examine the factors influencing the KAP dimension scores. Variables with $P<0.05$ in the univariable analyses were included in the multivariable analysis. All statistical analyses were two-sided, and a p-value < 0.05 was considered significant.

Age 40 was selected as a cutoff because it appears to be a hinge point for the development of complications like liver fibrosis [48]. Normal BMI in Chinese is 18.5–23.9 kg/m^2 [49]. The alcohol score was calculated to quantify alcohol drinking based on self-reported habits. For each alcoholic beverage category, 1 point was given for < 50 ml, 2 points for 50–99 ml, 3 points for 100–199 ml, 4 points for 200–299 ml, and 5 points for ≥ 300 ml. The total score was classified into "almost no alcohol consumption" (≤ 4 points), "low alcohol consumption" (5–11 points), and "high alcohol consumption" (≥ 12 points). Smoking, waist circumference, comorbidities, and insurance were self-reported.

Results

Characteristics of the participants

A total of 365 questionnaires were distributed, but eight participants finally refused to respond. Therefore, 357 valid questionnaires were included for analysis. The participants were 41.89 ± 12.17 years of age. Most participants were ≤ 40 years old (55.46%), male (60.50%), married (81.23%), living in urban areas (92.16%), with associate/bachelor's degree (61.62%), working full-time (62.46%), earning 5000–9999 CNY/month (33.61%), with medical insurance (98.04%), with a normal body mass index (BMI) (39.78%), with a waist circumference < 90 cm (54.62%), with omnivorous dietary habits (48.46%), nonsmoker (77.59%), rarely consuming alcohol (61.90%), diagnosed with NAFLD for < 6 months (46.50%), and without comorbidities (70.31%) (Table 1). Most participants cooked all three meals at home and drank small amounts of alcohol (Supplementary Tables S1-S2). The most common comorbidities (self-reported) included hypertension (14.57%), liver disease (12.32%), diabetes (5.04%), heart disease (2.80%), and cerebrovascular disease (1.68%) (Supplementary Table S3).

Knowledge, attitude, and practice

The mean knowledge, attitude, and practice scores were 19.75 ± 10.45 (possible range: 0–35), 51.21 ± 6.86 (possible range: 12–60), and 6.58 ± 1.66 (possible range: 0–16), respectively, indicating poor knowledge, positive attitudes, and poor practice (Table 1).

Table 1 Characteristics of the participants and KAP scores

		Knowledge		Attitude		Practice	
		Score	*P*	Score	*P*	Score	*P*
Total	357 (100)	19.75 ± 10.45		51.21 ± 6.86		6.583 ± 1.66	
Age, years	41.89 ± 12.17		0.073		0.999		< 0.001
≤ 40	198 (55.46)	20.86 ± 10.33		51.21 ± 6.96		6.98 ± 1.79	
> 40	159 (44.54)	18.36 ± 10.47		51.21 ± 6.75		6.09 ± 1.33	
Gender			0.678		0.953		0.577
Male	216 (60.50)	19.53 ± 10.43		51.18 ± 6.86		6.62 ± 1.68	
Female	141 (39.50)	20.09 ± 10.52		51.26 ± 6.87		6.53 ± 1.62	
Marital status			0.327		0.092		< 0.001
Other	67 (18.77)	18.69 ± 11.35		49.73 ± 7.43		7.34 ± 1.98	
Married	290 (81.23)	20.00 ± 10.24		51.55 ± 6.68		6.41 ± 1.52	
Residence			< 0.001		< 0.001		0.138
Urban	329 (92.16)	20.54 ± 10.19		51.63 ± 6.79		6.54 ± 1.65	
Non-urban	28 (7.84)	10.43 ± 9.00		46.32 ± 5.77		7.04 ± 1.69	
Education			< 0.001		< 0.001		0.162
Middle school and below	49 (13.73)	10.14 ± 8.56		47.71 ± 6.72		6.65 ± 1.47	
High school/technical school	55 (15.41)	14.33 ± 8.42		49.45 ± 7.42		6.13 ± 1.23	
Associate/bachelor	220 (61.62)	22.05 ± 9.72		51.95 ± 6.40		6.62 ± 1.71	
Master and above	33 (9.24)	27.70 ± 6.74		54.39 ± 6.61		6.97 ± 2.02	
Employment			< 0.001		0.007		< 0.001
Full-time	223 (62.46)	22.39 ± 9.44		52.00 ± 6.63		6.64 ± 1.62	
Part-time/self-employed/freelance	57 (15.97)	12.77 ± 9.50		49.30 ± 7.27		6.90 ± 1.64	
Retired	59 (16.53)	18.27 ± 10.43		51.19 ± 6.92		5.76 ± 1.38	
Other*	18 (5.04)	14.06 ± 12.65		47.56 ± 6.16		7.61 ± 2.00	
Monthly income, Yuan			< 0.001		< 0.001		0.590
< 5000	103 (28.85)	14.88 ± 9.89		48.29 ± 6.69		6.77 ± 1.62	
5000–9999	120 (33.61)	21.09 ± 9.39		51.48 ± 6.03		6.51 ± 1.68	
10,000–19,999	88 (24.65)	22.07 ± 10.82		52.78 ± 7.18		6.40 ± 1.48	
≥ 20,000	46 (12.89)	22.72 ± 10.21		54.02 ± 6.49		6.72 ± 1.96	
Social medical insurance			0.006		< 0.001		0.067
None	7 (1.96)	9.00 ± 6.33		41.14 ± 4.18		8.00 ± 2.31	
Yes	350 (98.04)	19.97 ± 10.41		51.41 ± 6.75		6.55 ± 1.63	
Commercial medical insurance			< 0.001		0.002		0.114
None	236 (66.11)	18.39 ± 10.77		50.38 ± 7.00		6.68 ± 1.67	
Yes	121 (33.89)	22.40 ± 9.28		52.83 ± 6.29		6.39 ± 1.61	
Body mass index			0.551		0.088		0.147
Underweight	10 (2.80)	17.90 ± 9.42		48.80 ± 7.48		7.70 ± 1.89	
Normal	142 (39.78)	19.44 ± 11.23		50.57 ± 6.93		6.56 ± 1.71	
Overweight	139 (38.94)	20.65 ± 9.72		52.35 ± 6.54		6.48 ± 1.65	
Obesity	66 (18.49)	18.82 ± 10.44		50.56 ± 7.05		6.67 ± 1.49	
Waist circumference			0.03		0.01		0.906
Normal (40–90 cm)	195 (54.62)	20.82 ± 10.45		51.51 ± 6.77		6.57 ± 1.73	
Abdominal obesity (> 90 cm)	49 (13.73)	19.56 ± 10.13		52.26 ± 6.48		6.63 ± 1.64	
Uncertain	113 (31.65)	16.71 ± 10.53		48.56 ± 7.14		6.53 ± 1.47	
Dietary habits			0.874		0.486		0.021
Predominantly vegetarian	35 (9.80)	19.00 ± 12.12		50.54 ± 7.01		6.34 ± 1.49	
Predominantly meat-based	149 (41.74)	19.93 ± 10.42		51.68 ± 6.69		6.83 ± 1.65	
Balanced omnivorous	173 (48.46)	19.75 ± 10.17		50.94 ± 6.98		6.42 ± 1.67	
Smoking status			< 0.001		0.016		0.373
Non-smoker	277 (77.59)	21.05 ± 10.09		51.79 ± 6.44		6.56 ± 1.67	
Smoker	80 (22.41)	15.25 ± 10.51		49.19 ± 7.84		6.66 ± 1.61	

Table 1 (continued)

		Knowledge		Attitude		Practice	
		Score	*P*	Score	*P*	Score	*P*
Alcohol consumption			0.019		0.049		0.008
Approximately once in 1–2 days	31 (8.68)	14.61 ± 11.57		47.97 ± 6.56		7.32 ± 1.83	
Approximately once in 3–7 days	42 (11.76)	19.55 ± 9.98		51.00 ± 6.56		6.71 ± 1.49	
Approximately once in 8–15 days	36 (10.08)	22.97 ± 8.93		51.06 ± 7.61		7.03 ± 1.30	
Approximately once in 16–30 days	27 (7.56)	21.56 ± 9.29		53.30 ± 6.06		6.63 ± 1.64	
Once a month or less	221 (61.90)	19.76 ± 10.55		51.48 ± 6.82		6.38 ± 1.68	
Time since diagnosis of non-alcoholic liver disease			0.141		0.003		0.106
< 6 months	166 (46.50)	18.70 ± 11.04		49.98 ± 6.64		6.65 ± 1.65	
6–11.9.9 months	21 (5.88)	23.62 ± 8.23		49.90 ± 7.34		6.86 ± 1.35	
1–1.9.9 years	36 (10.08)	22.28 ± 10.00		53.44 ± 6.17		6.44 ± 2.08	
2–2.9.9 years	30 (8.40)	19.90 ± 9.40		51.33 ± 6.84		7.07 ± 1.39	
≥ 3 years	104 (29.13)	19.72 ± 10.17		52.63 ± 6.98		6.33 ± 1.62	
Chronic condition			0.035		0.404		0.980
None	251 (70.31)	20.48 ± 10.53		51.41 ± 6.80		6.60 ± 1.65	
Yes	106 (29.69)	18.03 ± 10.10		50.73 ± 7.00		6.55 ± 1.67	

* includes statues other than full time, part-time, self-employed, freelance, or retired

Higher knowledge scores were observed in urban dwellers ($P < 0.001$), with higher education ($P < 0.001$), full-time workers ($P < 0.001$), with a higher income ($P < 0.001$), with medical insurance ($P < 0.001$), with a normal waist circumference ($P = 0.030$), non-smokers ($P < 0.001$), drinking smaller amounts of alcohol ($P = 0.019$), and without comorbidities ($P = 0.035$) (Table 1). All knowledge items scored < 80% (Supplementary Table S4).

Higher attitude scores were observed in urban dwellers ($P < 0.001$), with higher education ($P < 0.001$), full-time workers ($P = 0.007$), with a higher income ($P < 0.001$), with medical insurance ($P < 0.001$), with a normal waist circumference ($P = 0.010$), non-smokers ($P = 0.016$), drinking smaller amounts of alcohol ($P = 0.049$), and with a longer duration of NAFLD ($P = 0.003$) (Table 1). The items with the lowest attitude scores were A4 (32.77%; *"Do you believe that NAFLD can only be treated with medication, and dietary adjustments and lifestyle management cannot fundamentally solve the problem?"*) and A5 (48.46%; *"Do you believe that currently being in good health, you do not need to pay special attention to your diet?"*) (Supplementary Table S5).

Higher practice scores were observed in younger participants ($P < 0.001$), other than married status ($P < 0.001$), part-time workers ($P < 0.001$), predominant meat-based diet ($P = 0.021$), and drinking higher amounts of alcohol ($P = 0.008$) (Table 1). Supplementary Table S6 presents the frequencies of specific practices.

Correlation and interaction among KAP dimensions

The correlation analysis showed the knowledge scores were weakly correlated to the attitude ($r = 0.488$, $P < 0.001$) and practice ($r = -0.207$, $P < 0.001$) scores. The attitude scores were weakly correlated to the practice scores ($r = -0.305$, $P < 0.001$) (Table 2). The path analysis (Fig. 1) showed that knowledge positively influenced attitude ($\beta = 0.33$, $P < 0.001$), while attitude negatively influenced practice ($\beta = -0.06$, $P < 0.001$). However, knowledge did not directly influence practice (Table 3).

Table 2 Correlation analysis

	Knowledge	Attitude	Practice
Knowledge	1.000		
Attitude	0.488 ($P < 0.001$)	1.000	
Practice	−0.207 ($P < 0.001$)	−0.305 ($P < 0.001$)	1.000

Multivariable analysis

Alcohol consumption of once every 16–30 days (OR = 2.83, 95%CI: 1.08–7.39, $P = 0.033$), associate/bachelor's degree (OR = 9.60, 95%CI: 2.33–39.50, $P = 0.002$), master's degree or above (OR = 30.10, 95%CI: 5.20–174.00, $P < 0.001$), monthly income of 5000–9999 (OR = 3.05, 95%CI: 1.50–6.42, $P = 0.002$), monthly income of 10,000–19,999 (OR = 4.55, 95%CI: 1.88–10.90, $P = 0.001$), monthly income of ≥ 20,000 (OR = 2.74, 95%CI: 1.00–7.48.00.48, $P = 0.048$), smoking (OR = 0.32, 95%CI: 0.15–0.69), with commercial insurance (OR = 0.33, 95%CI: 0.15–0.72, $P = 0.005$), and diagnosed with NAFLD for 6–12 months (OR = 6.16, 95%CI: 1.45–26.10, $P = 0.014$) were independently associated with the knowledge scores (Table 4).

The knowledge scores (OR = 1.11, 95%CI: 1.07–1.14, $P < 0.001$), non-urban residence (OR = 0.16, 95%CI: 0.03–0.90, $P = 0.038$), monthly income of 5000–9999 (OR = 2.70, 95%CI: 1.27–5.76, $P = 0.010$), monthly

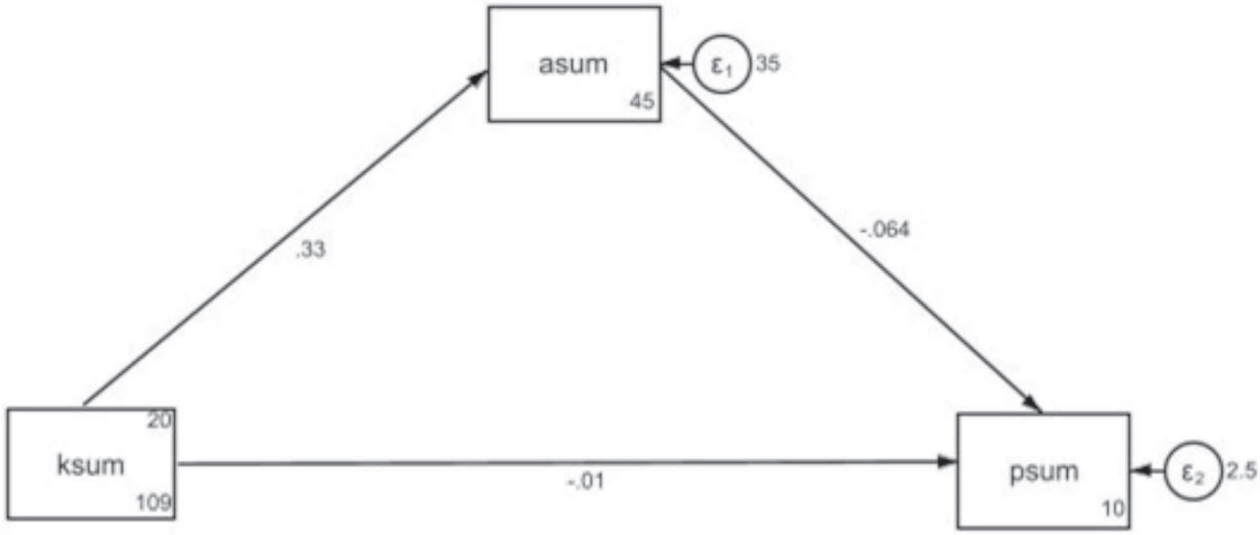


Fig. 1 Path analysis

Table 3 Path analysis

		Estimate	*P*
A <-			
	K	0.33	< 0.001
P<-			
	A	−0.06	< 0.001
	K	−0.01	0.281

income of 10,000–19,999 (OR = 4.20, 95%CI: 1.74–10.10, *P* = 0.001), monthly income of ≥ 20,000 (OR = 4.59, 95%CI: 1.61–13.00.61.00, *P* = 0.004), and diagnosed with NAFLD for 1–2 years (OR = 3.09, 95%CI: 1.21–7.88, *P* = 0.018) were independently associated with the attitude scores (Table 5).

The attitude scores (OR = 1.05, 95%CI: 1.01–1.10, *P* = 0.006) and retired (OR = 4.04, 95%CI: 1.21–13.40, *P* = 0.023) were independently associated with the practice scores (Table 6).

Discussion

Based on the KAP scores, this study suggests that patients with NAFLD in Sichuan had poor knowledge scores, positive attitudes scores, and poor practice scores toward dietary management of NAFLD. The results underscore the need for targeted educational interventions to enhance understanding and promote better practices in the dietary management of NAFLD among this population.

The lifestyle changes required to manage NAFLD require the active participation of the patients at home, work, and every aspect of their lives, but such changes also require the proper knowledge [23, 24]. The previous studies in various countries showed that the KAP of NAFLD was poor, either among patients with NAFLD or individuals at high risk of NAFLD [27–31], including in China [40–42, 50]. Of note, the three previous Chinese studies were performed in Beijing [40, 41], Hangzhou [42], and Shanghai [50], which are regions that enjoy a better socioeconomic status and better access to healthcare services than Sichuan [51]. A study from the USA revealed that although many patients are aware that lifestyle modifications are the primary therapy for NAFLD, KAP was low [32]. The challenge of altering lifestyle habits, often entailing the relinquishment of familiar comfort foods, can evoke reluctance among many patients. Nevertheless, our present study highlights that while knowledge and practice scores were suboptimal, attitude scores were positive. It suggests a willingness among patients to cultivate healthier lifestyle habits for the sake of their health. However, the deficiency in knowledge impedes the translation of positive attitudes into actual practice. All knowledge-related items received poor scores, indicating a need for comprehensive improvement across all facets of NAFLD understanding and management. The exact reasons behind the observed negative correlations between practice, knowledge, and attitude remain unclear based on the available data. It could be

Table 4 Multivariable regression for knowledge (cutoff of 21; 156 participants above the cutoff)

Knowledge	Univariable					Multivariable				
	β	S.E	Z	*P*	OR (95%CI)	β	S.E	Z	*P*	OR (95%CI)
Gender										
Male					1.00 (Reference)					
Female	−0.22	0.22	−1.01	0.314	0.80 (0.52–1.23)					
Residence										
Urban					1.00 (Reference)					
Non-urban	−1.36	0.51	−2.69	**0.007**	0.26 (0.10–0.69)	−0.48	0.66	−0.73	0.464	0.61 (0.17–2.23)
Waist circumference										
Normal (40–90 cm)					1.00 (Reference)					
Abdominal obesity (> 90 cm)	−0.24	0.32	−0.73	0.463	0.79 (0.42–1.48)	−0.15	0.40	−0.36	0.718	0.86 (0.39–1.90)
Uncertain	−0.55	0.24	−2.26	**0.024**	0.58 (0.36–0.93)	−0.22	0.31	−0.72	0.47	0.79 (0.43–1.46)
Dietary habits										
Predominantly vegetarian					1.00 (Reference)					
Predominantly meat-based	0.56	0.39	1.42	0.156	1.74 (0.81–3.76)					
Balanced omnivorous	0.34	0.39	0.87	0.387	1.40 (0.65–2.99)					
Alcohol consumption										
Approximately once in 1–2 days										
Approximately once in 3–7 days	−0.61	0.42	−1.46	0.144	0.54 (0.23–1.23)	−0.30	0.55	−0.55	0.584	0.73 (0.24–2.18)
Approximately once in 8–15 days	−0.20	0.35	−0.59	0.557	0.81 (0.41–1.60)	−0.65	0.45	−1.44	0.149	0.52 (0.21–1.26)
Approximately once in 16–30 days	0.85	0.37	2.29	**0.022**	2.34 (1.13–4.87)	1.04	0.49	2.13	**0.033**	2.83 (1.08–7.39)
Once a month or less	0.21	0.41	0.51	0.61	1.23 (0.55–2.74)	−0.70	0.49	−1.44	0.149	0.49 (0.19–1.28)
Age, years										
≤ 40					1.00 (Reference)					
> 40	−0.53	0.22	−2.46	0.014	0.59 (0.38–0.90)	0.13	0.33	0.4	0.688	1.14 (0.59–2.17)
Marriage										
Other					1.00 (Reference)					
Married	0.40	0.28	1.44	0.151	1.50 (0.86–2.60)					
Education										
Middle school and below					1.00 (Reference)					
High school/technical school	1.10	0.70	1.57	0.116	3.00 (0.76–11.79)	0.93	0.79	1.17	0.241	2.53 (0.53–11.9)
Associate/bachelor	2.86	0.61	4.68	< **0.001**	17.42 (5.26–57.69)	2.26	0.72	3.13	**0.002**	9.60 (2.33–39.5)
Master and above	4.23	0.75	5.66	< **0.001**	69.00 (15.94–298.63.94.63)	3.41	0.90	3.8	<**0.001**	30.1 (5.20–174.)
Job										
Full-time					1.00 (Reference)					
Part-time/self-employed/freelance	−1.74	0.37	−4.65	< **0.001**	0.18 (0.08–0.37)	−0.66	0.47	−1.39	0.164	0.51 (0.20–1.30)
Retired	−0.86	0.31	−2.80	**0.005**	0.42 (0.23–0.77)	0.12	0.46	0.27	0.786	1.13 (0.46–2.77)
Other	−1.44	0.58	−2.47	**0.013**	0.24 (0.08–0.74)	−0.14	0.76	−0.19	0.852	0.86 (0.19–3.83)
Monthly income, Yuan										
< 5000					1.00 (Reference)					
5000–9999	1.36	0.31	4.39	<**0.001**	3.88 (2.12–7.11)	1.13	0.37	3.05	**0.002**	3.10 (1.50–6.42)
10,000–19,999	1.79	0.33	5.42	< **0.001**	5.99 (3.14–11.45)	1.52	0.45	3.38	**0.001**	4.55 (1.88–10.9)
≥ 20,000	1.69	0.39	4.34	< **0.001**	5.39 (2.52–11.54)	1.01	0.51	1.97	**0.048**	2.74 (1.00–7.48.00.48)
BMI										
Normal or underweight										
Overweight	0.38	0.24	1.62	0.11	1.46 (0.922-)					
Obesity	0.12	0.30	0.41	0.68	1.12 (0.628-)					
Smoking										
No					1.00 (Reference)					
Yes	−0.90	0.28	−3.26	**0.001**	0.40 (0.23–0.70)	−1.13	0.39	−2.92	**0.004**	0.32 (0.15–0.69)

Table 4 (continued)

Knowledge	Univariable					Multivariable				
	β	S.E	Z	*P*	OR (95%CI)	β	S.E	Z	*P*	OR (95%CI)
Chronic condition										
No					1.00 (Reference)					
Yes	−0.46	0.24	−1.94	0.053	0.63 (0.39–1.01)					
Social Insurance										
No					1.00 (Reference)					
Yes	15.35	550.09	0.03	0.978	4629993.82 (0.00-Inf)					
Commercial Insurance										
No					1.00 (Reference)					
Yes	0.82	0.23	3.60	< **0.001**	2.27 (1.45–3.55)	−1.08	0.39	−2.8	**0.005**	0.33 (0.15–0.72)
Drink amount										
1					1.00 (Reference)					
2	−0.18	0.27	−0.67	0.503	0.83 (0.49–1.42)					
3	0.10	0.29	0.34	0.733	1.10 (0.62–1.96)					
Time since diagnosis of non-alcoholic liver disease										
<6 months										
6–11.9.9 months	1.60	0.54	2.99	**0.003**	4.97 (1.73–14.2)	1.82	0.74	2.47	**0.014**	6.16 (1.45–26.1)
1–1.9.9 years	0.44	0.37	1.19	0.233	1.55 (0.75–3.20)	0.23	0.47	0.48	0.628	1.25 (0.49–3.15)
2–2.9.9 years	0.31	0.40	0.77	0.441	1.35 (0.62–2.97)	−0.28	0.45	−0.61	0.541	0.75 (0.31–1.84)
≥3 years	0.09	0.25	0.36	0.721	1.09 (0.66–1.80)	0.04	0.32	0.13	0.895	1.04 (0.55–1.94)

OR Odds Ratio, *CI* Confidence Interval

hypothesized that a heightened awareness of the lifestyle changes necessary for NAFLD management might instill reluctance in patients to implement them. However, a thorough exploration of these reasons is warranted in future studies to gain deeper insights into this relationship.

Consuming alcohol occasionally, having a higher education, a higher income, not smoking, having public insurance, and having a short NAFLD history had higher knowledge scores. Higher knowledge scores, urban residence, higher income, and a short history of NAFLD were associated with higher attitude scores. Higher attitude scores and being retired were associated with higher practice scores. Alcohol is associated with liver diseases. Whether the high knowledge scores were related to low alcohol consumption and not smoking or vice versa could not be determined in the present study. The patients with a higher socioeconomic status (which includes income, education, employment, and medical insurance) generally showed higher KAP scores. This finding aligns with existing literature indicating a positive correlation between higher socioeconomic status and elevated health literacy levels [52]. Given this association, it was imperative for educational interventions to prioritize and specifically target patients with a lower socioeconomic status. Efforts should also focus on developing accessible and culturally sensitive educational materials, employing varied teaching methods, and establishing community-based initiatives to bridge the health literacy gap, especially for vulnerable groups. A shorter history of NAFLD could cause knowledge to be fresher and less influenced by external confounding sources. In addition, the patients could be more motivated to follow medical advice to prevent disease progression. Retired people also have more time to adopt proper lifestyle habits. A randomized controlled trial showed that the knowledge and awareness of NAFLD among Chinese young adults can be improved using pamphlets and videos [53], highlighting that such interventions can be beneficial. Whether it could translate into improved NAFLD prevalence and outcomes remains to be investigated.

This study is subject to certain limitations. It was performed at a single center, limiting the geographic representativeness and generalizability of the results and resulting in a relatively small sample size. Convenience sampling is a non-probability sampling method where participants are selected based on their easy availability and willingness to take part. While this approach is often quick, inexpensive, and practical, it can lead to several types of bias: selection bias (the sample may not accurately represent the broader population because it

Table 5 Multivariable regression for attitude (cutoff of 36; 145 participants above the cutoff)

Attitude	Univariable					Multivariable				
	β	S.E	Z	*P*	OR (95%CI)	β	S.E	Z	*P*	OR (95%CI)
Knowledge	0.11	0.01	7.71	**< 0.001**	1.11 (1.08,1.14)	0.11	0.02	6.33	**< 0.001**	1.11 (1.07,1.14)
Gender										
Male										
Female	−0.11	0.22	−0.5	0.617	0.89 (0.58,1.38)					
Residence										
Urban										
Non-urban	−2.30	0.74	−3.1	**0.002**	0.10 (0.02,0.42)	−1.77	0.85	−2.07	**0.038**	0.16 (0.03,0.90)
Waist circumference										
Normal (40–90 cm)										
Abdominal obesity (> 90 cm)	−0.13	0.32	−0.41	0.678	0.87 (0.46,1.65)					
Uncertain	−0.40	0.24	−1.65	0.099	0.66 (0.41,1.07)					
Dietary habits										
Predominantly vegetarian										
Predominantly meat-based	0.39	0.39	1	0.315	1.48 (0.68,3.20)					
Balanced omnivorous	0.22	0.39	0.56	0.578	1.24 (0.57,2.65)					
Alcohol consumption										
Approximately once in 1–2 days										
Approximately once in 3–7 days	−0.74	0.43	−1.7	0.089	0.47 (0.20,1.11)					
Approximately once in 8–15 days	0.03	0.34	0.09	0.926	1.03 (0.52,2.01)					
Approximately once in 16–30 days	−0.25	0.37	−0.67	0.501	0.77 (0.37,1.61)					
Once a month or less	0.25	0.41	0.6	0.548	1.27 (0.57,2.84)					
Age, years										
≤ 40										
> 40	−0.07	0.22	−0.34	0.732	0.92 (0.60,1.42)					
Marriage										
Other										
Married	0.25	0.28	0.89	0.376	1.28 (0.73,2.22)					
Education										
Middle school and below										
High school/technical school	0.74	0.49	1.52	0.127	2.10 (0.80,5.46)	−0.09	0.61	−0.14	0.885	0.91 (0.27,3.03)
Associate/bachelor	1.49	0.41	3.63	**< 0.001**	4.43 (1.98,9.88)	−0.23	0.57	−0.4	0.691	0.79 (0.26,2.43)
Master and above	1.94	0.52	3.71	**< 0.001**	6.95 (2.49,19.3)	−0.56	0.74	−0.76	0.45	0.57 (0.13,2.42)
Job										
Full-time										
Part-time/self-employed/freelance	−0.62	0.32	−1.97	**0.049**	0.53 (0.29,0.99)	0.31	0.45	0.7	0.482	1.37 (0.56,3.29)
Retired	−0.37	0.30	−1.22	0.222	0.69 (0.38,1.24)	0.41	0.41	0.99	0.321	1.50 (0.67,3.37)
Other	−1.93	0.76	−2.53	**0.011**	0.14 (0.03,0.64)	−1.69	0.99	−1.7	0.089	0.18 (0.02,1.29)
Monthly income, Yuan										
< 5000										
5000–9999	1.28	0.32	4.04	**< 0.001**	3.61 (1.93,6.73)	1.00	0.39	2.58	**0.01**	2.70 (1.27,5.76)
10,000–19,999	1.78	0.34	5.29	**< 0.001**	5.93 (3.06,11.4)	1.44	0.45	3.2	**0.001**	4.20 (1.74,10.1)
≥ 20,000	1.81	0.39	4.6	**< 0.001**	6.13 (2.83,13.3)	1.52	0.53	2.86	**0.004**	4.59 (1.61,13.0)
BMI										
Normal or underweight										
Overweight	0.32	0.24	1.36	0.174	1.38 (0.86,2.20)					
Obesity	−0.14	0.31	−0.46	0.642	0.86 (0.47,1.58)					
Smoking										
No										
Yes	−0.45	0.27	−1.67	0.095	0.63 (0.37,1.08)					
Chronic condition										
No										
Yes	−0.28	0.24	−1.19	0.234	0.75 (0.47,1.20)					

Table 5 (continued)

Attitude	Univariable					Multivariable				
	β	S.E	Z	*P*	OR (95%CI)	β	S.E	Z	*P*	OR (95%CI)
Social Insurance										
No										
Yes										
Commercial Insurance										
No										
Yes	0.71	0.23	3.13	**0.002**	2.03 (1.30,3.18)	−0.02	0.30	−0.05	0.958	0.98 (0.54,1.78)
Drink amount										
1										
2	−0.02	0.27	−0.06	0.949	0.98 (0.57,1.68)					
3	−0.20	0.30	−0.68	0.497	0.81 (0.45,1.46)					
Time since diagnosis of non-alcoholic liver disease										
< 6 months										
6–11.9.9 months	−0.24	0.51	−0.47	0.636	0.78 (0.28,2.13)	−1.03	0.58	−1.77	0.077	0.35 (0.11,1.11)
1–1.9.9 years	1.13	0.38	2.97	**0.003**	3.08 (1.46,6.49)	1.13	0.48	2.37	**0.018**	3.09 (1.21,7.88)
2–2.9.9 years	0.54	0.40	1.35	0.177	1.71 (0.78,3.77)	0.35	0.48	0.73	0.465	1.41 (0.55,3.59)
≥ 3 years	0.48	0.26	1.88	0.06	1.61 (0.97,2.67)	0.51	0.31	1.65	0.098	1.65 (0.91,3.01)

OR Odds Ratio, *CI* Confidence Interval

is limited to those who are easiest to access), volunteer bias (individuals who choose to participate may differ systematically from those who do not, often being more interested or knowledgeable about the topic), generalizability issues (findings from a convenience sample may not be applicable to the wider population, limiting the external validity of the study), and over- or under-representation. The cross-sectional nature of the study prevents the exploration of causality and dynamic changes in KAP over time. Nevertheless, it could serve as a historical baseline for future studies. The questionnaire was developed by local investigators based on local practices, customs, policies, and habits, which limits its applicability to other centers and the generalizability of the results. The questionnaire did not undergo a formal validation process. In addition, the questionnaire was developed in Chinese, further restricting its applicability to other countries and regions. The alcohol consumption was estimated based on a score, but the exact alcohol consumption was not collected. Socioeconomic status was considered in general and was not quantified. Not all dietary patterns could be examined, considering that rice (or flour products) is the basic everyday food in China. In addition, the questions on the dietary patterns were general and coarse, lacking the granularity necessary for refined analyses, and were subjective, which should be addressed in future studies. Due to the characteristics of the Chinese language and culture, some questions appear to be leading questions, potentially resulting in an overestimation of participants' KAP. Many patients were enrolled when they were newly diagnosed because the study center is a referral center for NAFLD. Many patients were seen only for diagnosis and were returned to their local clinic or hospital for management. All KAP studies are subject to the social desirability bias, in which the participants can be tempted to answer what they should do instead of what they are doing [54, 55], but considering that the knowledge and practice scores were low, that bias is unlikely. Finally, social support is important in chronic disease management, especially involving lifestyle habit changes [56, 57], but social support was not explored in the present study.

In conclusion, patients with NAFLD in Sichuan had poor knowledge, positive attitudes, and poor practice toward dietary management of NAFLD. Educational interventions should be designed to address these gaps. Future research should explore specific findings and strategies for improving practice and assess the impact of interventions on patients' KAP and overall prognosis.

Table 6 Multivariable regression for practice (cutoff of 9; 159 participants above the cutoff)

Practice	Univariable					Multivariable				
	β	S.E	Z	*P*	OR (95%CI)	β	S.E	Z	*P*	OR (95%CI)
Knowledge	0.01	0.01	1.22	0.222	1.01 (0.99,1.03)					
Attitude	0.05	0.02	2.85	**0.004**	1.05 (1.01,1.09)	0.06	0.02	2.74	**0.006**	1.05 (1.01,1.10)
Gender										
Male	−0.37	0.22	−1.7	0.09	0.68 (0.44,1.05)					
Female										
Residence										
Urban	−0.57	0.42	−1.36	0.174	0.56 (0.24,1.28)					
Non-urban										
Waist circumference										
Normal (40–90 cm)	0.48	0.32	1.5	0.133	1.62 (0.86,3.04)					
Abdominal obesity (> 90 cm)	−0.02	0.24	−0.1	0.918	0.97 (0.61,1.55)					
Uncertain										
Dietary habits										
Predominantly vegetarian	0.76	0.39	1.95	0.051	2.12 (0.99,4.54)					
Predominantly meat-based	−0.03	0.38	−0.08	0.935	0.96 (0.45,2.05)					
Balanced omnivorous										
Alcohol consumption										
Approximately once in 1–2 days	0.63	0.39	1.62	0.105	1.87 (0.87,3.98)					
Approximately once in 3–7 days	0.43	0.34	1.28	0.201	1.54 (0.79,2.98)					
Approximately once in 8–15 days	0.43	0.36	1.2	0.231	1.54 (0.75,3.12)					
Approximately once in 16–30 days	0.81	0.42	1.94	0.052	2.24 (0.99,5.05)					
Once a month or less										
Age, years										
≤ 40	−0.83	0.22	−3.79	**< 0.001**	0.43 (0.28,0.66)	−0.49	0.28	−1.75	0.08	0.61 (0.35,1.06)
> 40										
Marriage										
Other	−0.60	0.27	−2.21	**0.027**	0.54 (0.31,0.93)	−0.45	0.30	−1.49	0.136	0.63 (0.35,1.15)
Married										
Education										
Middle school and below	0.01	0.43	0.03	0.974	1.01 (0.44,2.33)	0.37	0.51	0.72	0.473	1.44 (0.53,3.91)
High school/technical school	0.80	0.34	2.37	**0.018**	2.22 (1.14,4.31)	0.79	0.47	1.67	0.094	2.19 (0.87,5.51)
Associate/bachelor	1.00	0.47	2.14	**0.032**	2.72 (1.08,6.79)	0.66	0.62	1.06	0.289	1.92 (0.57,6.48)
Master and above										
Job										
Full-time	−0.36	0.30	−1.21	0.227	0.69 (0.38,1.25)	0.27	0.38	0.7	0.484	1.30 (0.61,2.74)
Part-time/self-employed/freelance	−1.05	0.33	−3.2	**0.001**	0.35 (0.18,0.66)	−0.45	0.41	−1.08	0.278	0.63 (0.28,1.43)
Retired	0.48	0.50	0.95	0.34	1.61 (0.60,4.31)	1.40	0.61	2.28	**0.023**	4.04 (1.21,13.4)
Other										
Monthly income, Yuan										
< 5000	0.35	0.28	1.27	0.202	1.42 (0.82,2.44)	0.05	0.32	0.17	0.865	1.05 (0.56,1.97)
5000–9999	0.76	0.30	2.55	**0.011**	2.13 (1.19,3.82)	0.23	0.36	0.66	0.509	1.26 (0.63,2.53)
10,000–19,999	0.71	0.36	1.97	**0.049**	2.03 (1.00,4.11)	−0.03	0.43	−0.06	0.95	0.97 (0.41,2.28)
≥ 20,000										
BMI										
Normal or underweight	0.08	0.24	0.34	0.737	1.08 (0.68,1.71)					
Overweight	−0.07	0.30	−0.23	0.821	0.93 (0.52,1.67)					
Obesity										
Smoking										
No	0.09	0.25	0.35	0.727	1.09 (0.66,1.80)					
Yes										

Table 6 (continued)

Practice	Univariable					Multivariable				
	β	S.E	Z	*P*	OR (95%CI)	β	S.E	Z	*P*	OR (95%CI)
Chronic condition										
No	0.15	0.23	0.65	0.516	1.16 (0.73,1.83)					
Yes										
Social Insurance										
No	0.07	0.77	0.09	0.928	1.07 (0.23,4.86)					
Yes										
Commercial Insurance										
No	0.06	0.22	0.25	0.803	1.05 (0.68,1.64)					
Yes										
Drink amount										
1	0.26	0.27	0.96	0.335	1.29 (0.76,2.20)					
2	0.09	0.29	0.3	0.766	1.09 (0.61,1.93)					
3										
Time since diagnosis of non-alcoholic liver disease										
<6 months	0.15	0.46	0.32	0.752	1.15 (0.46,2.87)					
6–11.9.9 months	0.13	0.37	0.36	0.723	1.13 (0.55,2.34)					
1–1.9.9 years	0.51	0.40	1.28	0.202	1.66 (0.76,3.65)					
2–2.9.9 years	−0.15	0.25	−0.58	0.562	0.86 (0.52,1.41)					
≥3 years										

Abbreviations

KAP	Knowledge, attitude, and practice
SD	Standard deviation
NAFLD	Non-alcoholic fatty liver disease
NASH	Non-alcoholic steatohepatitis

Supplementary Information

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Supplementary material 1.

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Authors' contributions
SH, HS, LX, and XZ carried out the studies, participated in collecting data, and drafted the manuscript. YY and XX performed the statistical analysis and participated in its design. PZ participated in the acquisition, analysis, or interpretation of data and drafted the manuscript. All authors read and approved the final manuscript.

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Data availability
No datasets were generated or analysed during the current study.

Declarations

Ethics approval and consent to participate
Ethical approval has been obtained from the medical ethics committee of the Sichuan Academy of Medical Sciences, Sichuan People's Hospital. All participants provided written informed consent before starting the survey.

Consent for publication
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Competing interests
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