Inverse association between Health-diet status and non-alcoholic fatty liver disease among patients with diabetes mellitus.

Xiao Gu, Xiang Hu, Xingxing Zhang, Lijuan Yang, Yinfeng Zheng, Jingzong Zhou, Linjia Du, Zhiying He, Bo Yang, Xuejiang Gu

Department of Endocrine and Metabolic Diseases, the First Affiliated Hospital of Wenzhou Medical University

BACKGROUND

- The prevalence of non-alcoholic fatty liver disease (NAFLD) is increasing worldwide, of 49%-62% type 2 diabetes mellitus (T2DM) is potentially affected by the disease [1].
- Previous studies indicate that NAFLD is believed to participate in the pathogenesis of type 2 diabetes and cardiovascular disease [2], while dietary patterns may be one of the most important factors in the genesis, prevention and control of NAFLD [3].
- Few studies focused on the associations between dietary patterns and NAFLD among type 2 diabetes mellitus.
- To address this issue, this cross-sectional study examined the association of health-diet status with non-alcoholic fatty liver disease (NAFLD) among Chinese patients with diabetes mellitus.

METHODS

➢Study population

This cross-sectional study included 2,404 individuals with 1,504 men and 900 women, who were consecutively enrolled in the Metabolic Management center (MMC) of 1st affiliated hospital of Wenzhou Medical University between 2017 and 2021.

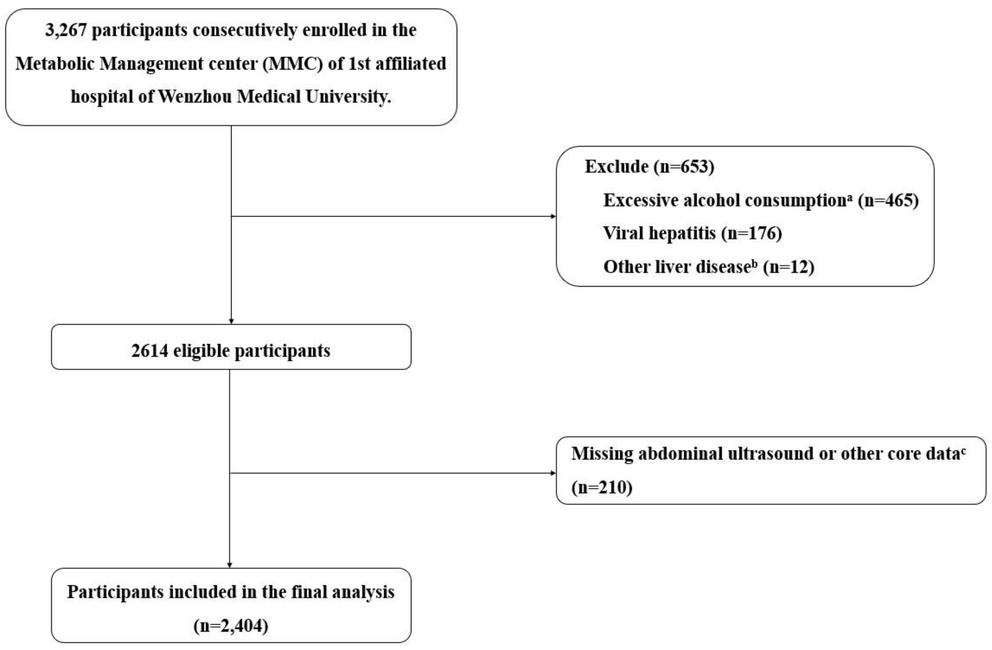

Fig 1 Flowchart of participants in the present study. (a) Excessive alcohol consumption: ≥210 g/week in men and ≥140 g/week in women. (b) Other liver disease: such as liver cirrhosis. (c) Core data: data to calculate the Healthy diet score or to determine the status of non-alcoholic fatty liver disease.

➢Definition and assessment of the Health-diet status

- ✓ Food frequency questionnaire (FFQ) was used to assess the dietary habits.
- ✓ Healthy diet score in this study consists of four components: fruits and vegetables, fish, sweets/sugar sweetened beverages and soy protein[4].
- ✓ Health-diet status was defined based on the number of healthy diet scores and thus classified into three dietary-pattern categories: most healthy diet (3–4 scores), moderate healthy diet (2 scores), and least healthy diet (0–1 score).

➢Assessment of non-alcoholic fatty liver disease

NAFLD was evaluated by using abdominal ultrasonography, in which radiologists were blinded to the participants' information.

➢Anthropometric and biochemical assessments

Anthropometric variables: waist circumference (WC), resting blood pressure and body mass index (BMI). Standard laboratory measurements were performed.

➢Statistical analysis

All statistical analyses were carried out using the SPSS 26.0.

RESULTS

➢Clinical characteristics of the study participants

A total of 2,404 subjects (1,504 men and 900 women) were eligible to be included in the analysis with a mean age of 50.18±12.06 years.

Table 1 Baseline characteristics of individuals according with NAFLD and Non-NAFLD.

Variables	Total	NAFLD	Non-NAFLD	P value*
N (%)	2,404 (100%)	1,259 (52.37%)	1,145 (47.63%)	—
Socio-demographics				
Age (years)	50.18±12.06	48.34±12.40	52.21±11.33	<0.001
Male (%)	1,504 (62.60%)	828 (65.80%)	676 (59.00%)	—
Education attainment (high school or above)	614 (26.00%)	380 (30.60%)	234 (20.90%)	<0.001
Family history of diabetes	1,378 (57.30%)	763 (60.70%)	615 (53.70%)	0.001
Diabetes duration (months)	67.00 (7.00-139.00)	52.00 (1.00-128.00)	89.00 (24.50-153.50)	<0.001
Hypertension (n, %)	1,061 (44.10%)	623 (49.50%)	438 (38.30%)	<0.001
MetS (n, %)	1,482 (64.60%)	986 (81.90%)	496 (45.50%)	<0.001
Anthropometric indicators				
WC (cm)	88.00 (82.00-95.00)	86.00 (82.00-92.00)	78.00 (72.00-84.00)	<0.001
SBP (mmHg)	126.72±18.76	129.57±17.29	123.59±19.79	<0.001
DBP (mmHg)	74.78±11.04	77.22±10.63	72.10±10.86	<0.001
BMI (Kg/m²)	24.30 (22.10-26.70)	25.80 (23.80-28.10)	22.70 (20.80-24.62)	<0.001
Biochemical Indicators				
FPG (mmol/L)	7.60 (6.00-9.70)	7.70 (6.30-9.70)	7.50 (5.70-9.70)	<0.001
HbA1c (%)	10.08±2.54	9.89±2.33	10.28±2.75	<0.001
HOMA-IR	0.37±0.36	0.49±0.30	0.24±0.37	<0.001
TC (mmol/L)	4.81 (3.99-5.66)	4.97 (4.11-5.84)	4.63 (3.83-5.46)	<0.001
TG (mmol/L)	1.51 (1.03-2.28)	1.86 (1.33-2.78)	1.19 (0.84-1.73)	<0.001
HDL-c (mmol/L)	0.99 (0.84-1.17)	0.93 (0.81-1.09)	1.05 (0.89-1.25)	<0.001
LDL-c (mmol/L)	2.69±0.90	2.76±0.91	2.62±0.89	<0.001
ALT (U/L)	22.00 (15.00-35.00)	28.00 (19.00-44.00)	17.00 (12.00-25.00)	<0.001
AST (U/L)	21.00 (17.00-28.00)	24.00 (19.00-33.00)	19.00 (16.00-23.00)	<0.001
Lifestyle risk factors				
Current smoking (n, %)	581 (24.20%)	326 (25.90%)	255 (22.30%)	0.038
Current drinking (n, %)	770 (32.00%)	450 (35.70%)	320 (27.90%)	<0.001
Physical activity				0.712
Physical inactivity	1,055 (43.90%)	557 (44.20%)	498 (43.50%)	
Ideal physical activity	1,349 (56.10%)	702 (55.80%)	647 (56.50%)	
Sleep duration (h/d)				
≤6.0	323 (13.90%)	155 (12.70%)	168 (15.20%)	0.001
6.1-8.0	1,206 (52.00%)	679 (55.70%)	527 (47.80%)	
>8.0	791 (34.10%)	384 (31.50%)	407 (36.90%)	
Healthy diet score				
0-1	646 (26.90%)	389 (30.90%)	257 (22.40%)	<0.001
2	1,006 (41.8%)	503 (40.00%)	503 (43.90%)	
3-4	752 (31.30%)	367 (29.20%)	385 (33.60%)	

➢Individual Associations of Health-diet Status With NAFLD

Health-diet status is negatively associated with NAFLD prevalence, participants with the most healthy diet had a lower odds of NAFLD than those with the least healthy diet (OR: 0.66, 95% CI: 0.50, 0.88, P=0.004).

Table 2 Odds Ratios with 95% Confidence Intervals for non-alcoholic fatty liver disease according to Health-diet status.

Health-diet status	Case/participants	Model 1		Model 2		Model 3	
	(%)	OR (95%CI)	p	OR (95%CI)	p	OR (95%CI)	p
Least (0-1)	389/646 (60.22%)	1.00 [reference]		1.00 [reference]		1.00 [reference]	
Moderately (2)	503/1006 (50.00%)	0.63 (0.51,0.78)	<0.001	0.73 (0.55,0.98)	0.039	0.73 (0.54,0.99)	0.044
Most (3-4)	367/752 (48.80%)	0.66 (0.54,0.81)	<0.001	0.67 (0.51,0.88)	0.005	0.66 (0.50,0.88)	0.004

Model 1 is unadjusted.

Model 2 adjusted for age, gender, education attainment, family history of diabetes, diabetes duration, hypertension, dyslipidemia, central obesity, BMI, hemoglobin A1c and HOMA-IR.

Model 3 further adjusted for lifestyle risk factors.

➢Subgroup analyses of the associations between Health-diet status and NAFLD

There is no significant interaction between health-diet status and strata (gender, age, diabetes duration, metabolic status) analyzed.

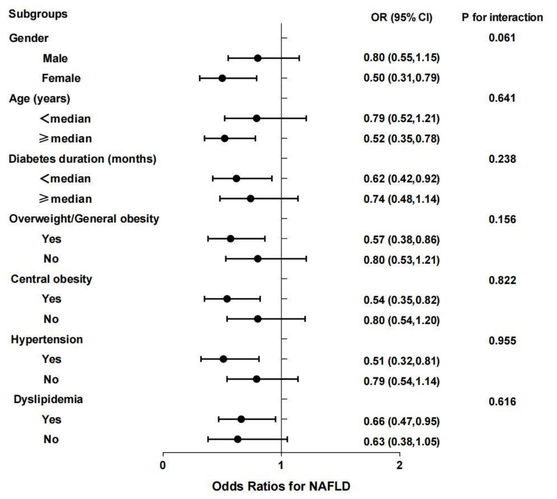

Fig 1 Subgroups analysis of non-alcoholic fatty liver disease with the top vs. bottom tertile of Health-diet status.

➢Individual Associations of Health-diet Status With FLI

Linear regression analyses showed comparing with least healthy diet, most healthy diet was negatively associated with FLI (β: -4.70, 95% CI: -7.61, -1.79, P=0.002).

Table 3 Relationships between FLI and Health-diet status by multivariable linear regression.

Health-diet status	Case/participants	FLI	
	(%)	β	P
Least (0-1)	389/646 (60.22%)	reference	
Moderately (2)	503/1006 (50.00%)	-3.44 (-6.16, -0.71)	0.013
Most (3-4)	367/752 (48.80%)	-4.70 (-7.61, -1.79)	0.002

Adjusting for age, gender, education attainment, family history of diabetes, diabetes duration, hypertension, hemoglobin A1c, HOMA-IR, lifestyle risk factors.

CONCLUSION

These findings indicate that Health-diet status was inversely associated with prevalent NAFLD in this Chinese diabetic population, which was not interfered by age, gender, diabetic duration and metabolic status.

REFERENCES

- [1] Smith BW, Adams LA. Nonalcoholic fatty liver disease and diabetes mellitus: pathogenesis and treatment. Nat Rev Endocrinol. 2011 May 10;7(8):456-65. doi: 10.1038/nrendo.2011.72. PMID: 21556019.
- [2] Adams LA, Lymp JF, St Sauver J, Sanderson SO, Lindor KD, Feldstein A, Angulo P. The natural history of nonalcoholic fatty liver disease: a population-based cohort study. Gastroenterology. 2005 Jul;129(1):113-21. doi: 10.1053/j.gastro.2005.04.014. PMID: 16012941.
- [3] de Wit NJ, Afman LA, Mensink M, Müller M. Phenotyping the effect of diet on non-alcoholic fatty liver disease. J Hepatol. 2012 Dec;57(6):1370-3. doi: 10.1016/j.jhep.2012.07.003. Epub 2012 Jul 11. PMID: 22796155.
- [4] Bi Y, Jiang Y, He J, Xu Y, Wang L, Xu M, Zhang M, Li Y, Wang T, Dai M, Lu J, Li M, Chen CS, Lai S, Wang W, Wang L, Ning G; 2010 China Noncommunicable Disease Surveillance Group. Status of cardiovascular health in Chinese adults. J Am Coll Cardiol. 2015 Mar 17;65(10):1013-25. doi: 10.1016/j.jacc.2014.12.044. PMID: 25766949.

If you need additional information, please contact Xuejiang Gu.

Address: Ouhai District, Wenzhou 325000, Zhejiang Province, China.; Tel: +86-577-55579382; Fax: +86-577-55579382; E-mail: guxuejiang@wmu.edu.cn

PP029