Nonalcoholic Fatty Liver Disease as a Risk Factor of Arterial Stiffness Measured by the Cardioankle Vascular Index

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Abstract: Nonalcoholic fatty liver disease (NAFLD) is associated with risk factors for cardiovascular disease. The cardioankle vascular index (CAVI), a new measure of arterial stiffness, was recently developed and is independent of blood pressure. We investigated whether NAFLD is associated with arterial stiffness as measured using the CAVI in an apparently healthy population.

A total of 2954 subjects without any known liver diseases were enrolled. NAFLD was diagnosed via typical ultrasonography. The clinical characteristics examined included age, sex, body mass index (BMI), waist circumference (WC), and the levels of aspartate aminotransferase, alanine aminotransferase, total cholesterol, high-density lipoprotein-cholesterol, low-density lipoprotein-cholesterol, triglycerides, and glucose. Arterial stiffness was defined using an age- and sex-specific threshold of the upper quartile of the CAVI.

NAFLD was found in 1249 (42.3%) of the analyzed subjects. Using an age-, sex-, and BMI-adjusted model, NAFLD was associated with a 42% increase in the risk for arterial stiffness (highest quartile of the CAVI). The risk for arterial stiffness increased according to the severity of NAFLD (adjusted odds ratio [95% confidence interval], 1.27 [1.02 – 1.57] vs 1.78 [1.37 – 2.31], mild vs moderate-to-severe, respectively). When adjusted for other risk factors, including BMI, WC, smoking status, diabetes, and hypertension, these relationships remained statistically significant.

Patients with NAFLD are at a high risk for arterial stiffness regardless of classical risk factors. The presence of cardiometabolic risk factors may attenuate the prediction of arterial stiffness by means of NAFLD presence. Thus, physicians should carefully assess subjects with NAFLD for atherosclerosis and associated comorbidities.

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INTRODUCTION

Nonalcoholic fatty liver disease (NAFLD) is the most common liver disease with an estimated prevalence of 20% to 30% in the West and 16% to 33% in Korea. Because the development of NAFLD has been linked to insulin resistance and metabolic syndrome, NAFLD is closely associated with obesity, dyslipidemia, type II diabetes, and cardiovascular disease. Evidences suggest that the severity of NAFLD is associated with the extent of increased cardiovascular risk, independent of conventional risk factors.

Arterial stiffness has been established as a surrogate marker for the prognosis of cardiovascular disease. Arterial stiffness is a strong predictor of future cardiovascular events and all-cause mortality, and is among the earliest detectable manifestations of adverse structural and functional changes to blood vessel walls.

Increased arterial stiffness is found in patients with cardiometabolic risk factors including hypertension and metabolic syndrome. The association between arterial stiffness and NAFLD has been reported. Many methods such as pulse wave velocity (PWV), the augmentation index, and the β-stiffness index have been designed to assess arterial stiffness. However, most of these approaches have the drawback of affecting blood pressure during measurement. Additionally, β-stiffness is limited in that it is applicable to only a local segment of the artery.

The cardioankle vascular index (CAVI) is a new index representing the stiffness of entire arterial segments from the aorta to the ankle; it is independent of the blood pressure at the time of the measurement. The CAVI is highly reproducible and easy to measure. The CAVI has been demonstrated as a superior index of arterial stiffness compared with previously established parameters, such as brachial-ankle PWV, and displays good correlations with left ventricular diastolic indices and lipid profiles in patients with angina pectoris. Associations between CAVI and coronary atherosclerosis, cardiac function, hypertension, and stroke have been shown. However, no data regarding the association between CAVI and NAFLD have been reported. In this study, we aimed to evaluate
the association between NAFLD and arterial stiffness using the CAVI in the apparently healthy general population.

**PATIENTS AND METHODS**

**Study Population**

A cross-sectional study was conducted to evaluate the association between NAFLD and the CAVI. The participants who underwent abdominal ultrasonography and the CAVI on the same day at the Seoul National University Hospital’s Gangnam Healthcare Center in Seoul, Korea, for routine health checkups from 2010 to 2013 were recruited. Most of the study population voluntarily paid for their health checkups, whereas others were supported by their company. Patients with previous peripheral artery disease, an ankle–brachial index <0.9, or a history of clinically significant valvular heart disease were excluded from CAVI analysis.

Of a total of 119 subjects who were positive for hepatitis B virus, 36 subjects who were positive for hepatitis C virus and 448 subjects with a history of alcohol consumption (>30 g/d for males and >20 g/d for females) or had a history of other types of hepatitis were excluded. Finally, 2954 subjects were enrolled in this study. Ethical approval for this study was obtained from the institutional review board of the Seoul National University Hospital with an informed consent waiver prior to the study.

**Clinical and Laboratory Assessments**

Each subject completed a questionnaire on past medical history and lifestyle. Current smokers were defined as having smoked at least 1 cigarette per day during the previous year. Former smokers were defined as prior regular cigarette smokers. All subjects received an anthropometric assessment and the laboratory and radiologic tests on the same day. Body weight and height were measured using a digital scale, and body mass index (BMI) was calculated as the weight (kilogram) divided by the height (meter) squared. Waist circumference (WC) was measured at the midpoint between the lower costal margin and the anterior superior iliac crest by a well-trained individual using a tape measure. Systolic and diastolic blood pressures were measured twice, and the average values were recorded. Hypertension was defined as treatment with an antihypertensive drug, a systolic blood pressure >140 mm Hg, or a diastolic blood pressure >90 mm Hg.

Blood samples were collected before 10:00 AM after a 12-hour overnight fast. All laboratory tests were performed using standard laboratory methods. Laboratory tests included alanine aminotransferase (ALT), aspartate aminotransferase (AST), total cholesterol, triglycerides, high-density lipoprotein (HDL)-cholesterol, low-density lipoprotein (LDL)-cholesterol, fasting glucose, hepatitis B surface antigen, and hepatitis C virus antibody levels. Diabetes mellitus was defined as a fasting serum glucose level >126 mg/dL, or the use of blood glucose-lowering agents.

**Assessment of NAFLD**

NAFLD was defined as the presence of fatty liver disease as determined via ultrasonography in the absence of the following: a positive serologic marker for hepatitis B surface antigen or hepatitis C virus serological marker, excessive alcohol intake (>30 g/d for males and >20 g/d for females), medications known to produce fatty liver disease, and other specific hepatic disease. Ultrasonographic examination of the liver was performed by experienced radiologists blinded to the patients’ clinical characteristics. The diagnosis of fatty liver was performed via ultrasonography (Acuson, Sequoia 512; Siemens, Mountain View, CA) using previously described standardized categories as follows: normal, normal echogenicity; mild, slight diffuse increase in bright homogenous echoes in the liver parenchyma, with normal visualization of the diaphragm and the portal and hepatic vein borders; moderate, diffuse increase in bright echoes in the liver parenchyma, with slightly impaired visualization of the peripheral portal and hepatic vein borders; severe, marked increase in bright echoes at a shallow depth, with deep attenuation and impaired visualization of the diaphragm and marked vascular blurring.

**The CAVI Measurement**

The CAVI was measured using a VaSera VS-1000 (Fukuda Denshi Co Ltd, Tokyo, Japan) according to previous descriptions. Briefly, the brachial pulse pressure was measured with an automated cuff oscillometer on seated individuals following a 5-minute rest. The average value of 2 measurements was obtained to determine the systolic and diastolic pressures and pulse pressure. Next, the cuffs were applied to ankles and both upper arms with the individuals in a resting lying position. After 10 minutes of rest, the measurement was performed. A phonocardiogram used for the detection of heart sounds was placed over the right sternum between the second intercostal spaces, and electrocardiogram electrodes were applied on both wrists. The PWV was calculated as the vascular length (L) by the time (T) required for the pulse wave to propagate from the aortic valve to the ankle. Because the initiation of blood release from the aortic valve is difficult to identify based on the opening sound of the valve, T is difficult to determine; thus, T value was defined as summing the interval between the initiation of the brachial pulse waveform and the initiation of the ankle pulse waveform, and the interval between the closing sound of the aortic valve and the notch of the brachial pulse waveform. Measurements were performed by a well-trained staff member. The CAVI was determined using the following equation:

\[
\text{CAVI} = a[2(\rho/\Delta P) \times \ln (P_s/P_d) \times \text{PWV}^2] + b
\]

where Ps and Pd are the systolic and diastolic blood pressures, respectively, \(\Delta P = P_s - P_d\), \(\rho\) is the blood density, and \(a\) and \(b\) are constants. The mean values of the left and right CAVI were used. Given the lack of data regarding an appropriate reference of “arterial stiffness,” we selected the age- (10-year interval) and sex-specific highest quartile of the CAVI as the arterial stiffness group.

**Statistical Analysis**

Comparisons of continuous variables between the 2 groups were performed using Student t test, and categorical variables were compared using a \(\chi^2\) test or Fisher exact test. Analysis of variance and analysis of covariance (ANCOVA) were used to compare dependent variables. Logistic regression analysis was used to analyze the association between NAFLD and arterial stiffness while controlling for potential confounders. All statistical analyses were performed using SPSS 19.0 software (SPSS Inc, Chicago, IL). P values <0.05 were considered to be statistically significant.

**RESULTS**

A total of 2954 subjects (mean age 55.5 ± 9.6, male 64.7%) were analyzed. The characteristics of the study subjects...
Table 1. Comparison of Baseline Characteristics Between Subjects With and Without Arterial Stiffness

|                  | No Arterial Stiffness (n = 2258) | Arterial Stiffness (n = 696) | P Value |
|------------------|----------------------------------|-----------------------------|---------|
| Age, y           | 55.4 ± 9.9                       | 57.3 ± 9.3                  | <0.001  |
| Male, n (%)      | 1466 (64.9)                      | 446 (64.1)                  | 0.684   |
| Smoking, n (%)   |                                  |                             | 0.029   |
| Never            | 1783 (79.0)                      | 519 (74.6)                  |         |
| Former           | 137 (6.1)                        | 44 (6.3)                    |         |
| Current          | 338 (15.0)                       | 133 (19.1)                  |         |
| DM, n (%)        | 175 (7.8)                        | 116 (16.7)                  | <0.001  |
| Hypertension, n (%) | 600 (26.6)       | 226 (32.5)                  | 0.002   |
| Systolic BP, mm Hg | 120.4 ± 13.1      | 123.7 ± 15.3                | <0.001  |
| Diastolic BP, mm Hg | 77.9 ± 10.1     | 79.5 ± 11.2                 | 0.001   |
| BMI, kg/m²       | 24.27 ± 2.9                    | 23.61 ± 2.89                | <0.001  |
| WC, cm           | 86.38 ± 8.75                   | 85.81 ± 8.97                | 0.141   |
| AST, IU/L        | 24.7 ± 12.3                    | 25.9 ± 13.4                 | 0.043   |
| ALT, IU/L        | 26.7 ± 18.5                    | 28.0 ± 21.0                 | 0.142   |
| Total cholesterol, mg/dL | 195.7 ± 35.9  | 194.1 ± 38.2               | 0.345   |
| Triglycerides, mg/dL | 118.3 ± 73.9   | 125.9 ± 86.9               | 0.039   |
| HDL-cholesterol, mg/dL | 52.8 ± 13.5    | 54.7 ± 34.1               | 0.168   |
| LDL-cholesterol, mg/dL | 123.0 ± 33.9  | 120.7 ± 36.5              | 0.144   |
| FBS, mg/dL       | 108.4 ± 29.4                  | 108.4 ± 29.4                | <0.001  |
| NAFLD, n (%)     | 941 (41.7)                      | 308 (44.3)                  | 0.229   |

Data are shown as the mean ± SD. BMI = body mass index, ALT = alanine aminotransferase, AST = aspartate aminotransferase, BP = blood pressure, DM = diabetes mellitus, FBS = fasting blood sugar, HDL = high-density lipoprotein, LDL = low-density lipoprotein, NAFLD = nonalcoholic fatty liver disease, WC = waist circumference.

are shown in Table 1. Older age, currently smoking, increased prevalence of diabetes mellitus, hypertension, higher blood pressure, and levels of triglycerides and fasting glucose were found in the arterial stiffness group (highest age- and sex-specific quartile of the CAVI) compared with the nonarterial stiffness group. However, BMI was lower in the arterial stiffness group than in the nonarterial stiffness group. There were no differences in the rates of NAFLD depending on the presence of arterial stiffness.

Of the 2954 subjects, 1249 (42.3%) had ultrasonographically diagnosed NAFLD. Table 2 compares the subjects with and without NAFLD. The individuals with NAFLD had a higher prevalence of diabetes mellitus and hypertension, higher blood pressure, BMI, WC, and serum levels of AST, ALT, total cholesterol, triglycerides, LDL-cholesterol, fasting glucose, hemoglobin A1c (HbA1c) and lower levels of HDL-cholesterol than those without NAFLD. Individuals with moderate-to-severe NAFLD had a higher prevalence of diabetes mellitus and hypertension, higher blood pressure, BMI, WC, and serum levels of ALT, AST, total cholesterol, triglycerides, LDL-cholesterol, fasting glucose, and HbA1c, and lower levels of HDL-cholesterol than those with mild NAFLD.

The mean values of the CAVI for the subjects with and without NAFLD are shown in Table 3 and Supplementary Figure 1, [http://links.lww.com/MD/A231](http://links.lww.com/MD/A231). This effect of NAFLD was attenuated, but remained significant based on multivariable analyses in which other well-identified risk factors for arterial stiffness were considered. When adjusted for age, sex, BMI, WC, smoking status, diabetes, and hypertension, NAFLD was associated with a 32% increase in the risk for arterial stiffness compared with the control. The risk for arterial stiffness increased according to the severity of NAFLD (adjusted odds ratio [OR] [95% confidence interval, CI], 1.27 [1.02–1.57] vs 1.78 [1.37–2.31], mild vs moderate to severe NAFLD, respectively).

We also analyzed the association between NAFLD and arterial stiffness according to age and obesity (Table 5). Multivariate analyses showed an independent (OR 1.54, 95% CI 1.11–2.12) and dose-dependent relationship (moderate–severe NAFLD: OR 1.97, 95% CI 1.28–3.01, P for trend = 0.002) between NAFLD and arterial stiffness in the younger group (age < 55). In contrast, subjects over 55 years showed an insignificant association with the presence of NAFLD and the degree of NAFLD. Likewise, the presence and degree of NAFLD was associated with arterial stiffness in a dose-dependent manner, especially in the nonobese group (OR 1.35, 95% CI 1.05–1.73; moderate–severe NAFLD: OR 1.80, 95% CI 1.19–2.71, P for trend = 0.004).

**DISCUSSION**

In this study, we identified a strong relationship between NAFLD and arterial stiffness, a surrogate marker of cardiovascular disease. This association was independent of various influences of age, sex, and BMI. Based on an age-, sex-, and BMI-adjusted model, NAFLD was associated with a 42% increase in the risk for arterial stiffness. The risk for arterial stiffness increased according to the severity of NAFLD (adjusted odds ratio [OR] [95% confidence interval, CI], 1.27 [1.02–1.57] vs 1.78 [1.37–2.31], mild vs moderate to severe NAFLD, respectively).

Next, we analyzed the association between NAFLD and arterial stiffness (highest quartile of the CAVI). The associations between NAFLD and arterial stiffness, as measured using the CAVI, appeared to be robust to the
well-identified risk factors for arterial stiffness, and canonical risk factors may attenuate the prediction of arterial stiffness by means of the NAFLD presence. Moreover, the risk for arterial stiffness increased with the severity of NAFLD, suggesting an important role for NAFLD in the pathogenesis of arterial stiffness.

Several studies have suggested NAFLD as an independent risk factor of arterial stiffness. A population-based cohort study of Italian adults showed that arterial stiffness measured using the carotid-femoral PWV was significantly lower in controls than in subjects with NAFLD. NAFLD was an independent risk factor of increased PWV in patients with biopsy-proven NAFLD. A population-based cohort study of adolescents in Australia showed that NAFLD is only associated with increased arterial stiffness in subjects with adverse metabolic profiles. Because subjects with severe fatty liver may have additional risk factors for metabolic syndrome, the findings of our study are in accordance with this previous result. However, it is a novel method of evaluating arterial stiffness, as it is not affected by blood pressure. In addition, our results expand upon the current knowledge by indicating that arterial stiffness increases in accordance with the severity of NAFLD.

### Table 2. Comparison of Baseline Characteristics Between Subjects With and Without NAFLD

|                      | No NAFLD (n = 1705) | NAFLD (n = 1249) | P Value | Mild (n = 749) | Moderate–Severe (n = 500) | P Value |
|----------------------|---------------------|------------------|---------|---------------|--------------------------|---------|
| Age, y               | 55.8 ± 10.2         | 55.9 ± 9.2       | 0.819   | 56.5 ± 9.0    | 55.0 ± 9.4               | 0.020   |
| Male, %              | 961 (56.4)          | 951 (76.1)       | <0.001  | 543 (72.5)    | 408 (81.6)               | <0.001  |
| Smoking, %           |                     |                  | <0.001  |               |                          |         |
| Never                | 1382 (81.1)         | 920 (73.7)       |         |               |                          |         |
| Former               | 88 (5.2)            | 93 (7.4)         | <0.001  | 44 (5.9)      | 49 (9.8)                 |         |
| Current              | 235 (13.8)          | 236 (18.9)       |         | 131 (17.5)    | 105 (21.0)               |         |
| DM, %                | 119 (7.0)           | 172 (13.8)       | <0.001  | 83 (11.1)     | 89 (17.8)                | <0.001  |
| HT, %                | 396 (23.2)          | 430 (34.4)       | <0.001  | 264 (35.2)    | 166 (33.2)               | 0.002   |
| Systolic BP, mm Hg   | 119.7 ± 13.8        | 123.3 ± 13.3     | <0.001  | 122.5 ± 12.9  | 124.4 ± 13.7             | <0.001  |
| Diastolic BP, mm Hg  | 77.0 ± 10.5         | 80.9 ± 10.0      | <0.001  | 79.4 ± 10.0   | 80.9 ± 9.9               | <0.001  |
| BMI, kg/m²           | 23.07 ± 2.59        | 25.54 ± 2.84     | <0.001  | 24.86 ± 2.63  | 26.57 ± 2.83             | <0.001  |
| WC, cm               | 83.08 ± 8.17        | 90.54 ± 7.75     | <0.001  | 88.76 ± 7.46  | 93.19 ± 7.41             | <0.001  |
| AST, IU/L            | 22.8 ± 10.9         | 28.10 ± 14.0     | <0.001  | 26.1 ± 13.0   | 30.8 ± 15.0              | <0.001  |
| ALT, IU/L            | 21.8 ± 12.7         | 34.1 ± 23.5      | <0.001  | 30.0 ± 20.8   | 40.3 ± 26.0              | <0.001  |
| Total cholesterol, mg/dL | 192.9 ± 34.8       | 198.8 ± 38.4     | <0.001  | 198.8 ± 37.4  | 198.3 ± 39.9             | <0.001  |
| Triglycerides, mg/dL | 98.7 ± 32.9         | 149.1 ± 93.7     | <0.001  | 138.4 ± 76.5  | 165.0 ± 113.8            | <0.001  |
| HDL-C, mg/dL         | 56.1 ± 24.2         | 49.4 ± 12.5      | <0.001  | 50.9 ± 13.3   | 47.2 ± 10.9              | <0.001  |
| LDL-C, mg/dL         | 119.4 ± 33.3        | 126.3 ± 35.7     | <0.001  | 127.0 ± 33.7  | 126.0 ± 38.6             | <0.001  |
| FBS, mg/dL           | 98.0 ± 17.9         | 109.4 ± 27.6     | <0.001  | 106.8 ± 25.1  | 113.2 ± 30.7             | <0.001  |
| HbA1c                | 98.0 ± 17.9         | 109.4 ± 27.6     | <0.001  | 106.8 ± 25.1  | 113.2 ± 30.7             | <0.001  |
| Arterial stiffness, % | 388 (22.8)          | 308 (24.7)       | 0.229   | 178 (23.8)    | 130 (26.0)               | 0.320   |

Data are shown as the mean ± SD. ALT = alanine aminotransferase, ANOVA = analysis of variance, AST = aspartate aminotransferase, BMI = body mass index, BP = blood pressure, DM = diabetes mellitus, FBS = fasting blood sugar, HbA1c = hemoglobin A1c, HDL-C = high-density lipoprotein cholesterol, HT = hypertension, LDL-C = low-density lipoprotein-cholesterol, NAFLD = nonalcoholic fatty liver disease, WC = waist circumference.

| TABLE 3. CAVI Between Control and NAFLD |
|----------------------------------------|
| Control | NAFLD    | P Value |
|--------|---------|---------|
| CAVI   | 7.67 ± 1.02 | 7.80 ± 1.05 | <0.001 |
| CAVI, adjusted age, sex, and BMI      | 7.64 ± 0.02   | 7.84 ± 0.02   | <0.001 |
| CAVI, adjusted for the model          | 7.66 ± 0.02   | 7.81 ± 0.02   | <0.001 |

Data are presented as mean ± standard error. The multivariable model was adjusted for age, sex, BMI, WC, smoking status, diabetes, and hypertension. BMI = body mass index, CAVI = cardiovascular ankle index, NAFLD = nonalcoholic fatty liver disease, WC = waist circumference.
factor-α and interleukin-6, leading to lipid peroxidation in hepatocytes and resulting in hepatic inflammation in NAFLD.\(^{41,42}\) Furthermore, NAFLD was associated with increased circulating levels and hepatic expression of molecular mediators of atherosclerosis, such as intracellular adhesion molecule and plasminogen activator inhibitor-1, which may exert a direct effect on arterial stiffness.\(^{43}\)

A strength of this study is the first use of the CAVI, a reliable marker of arterial stiffness on a large number of subjects.

The multivariable model was adjusted for age, sex, BMI, WC, smoking status, diabetes, and hypertension. BMI = body mass index, CI = confidence interval, NAFLD = nonalcoholic fatty liver disease, OR = odds ratio, WC = waist circumference.

\(^{1}\) P value for the test of trend of odds.

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### TABLE 4. Univariable and Multivariable Binary and Ordinal Analyses of the Risk for Arterial Stiffness in Subjects With Versus Without NAFLD

| Age, Sex, and BMI Model | Multivariable Model |
|-------------------------|---------------------|
| **OR (95% CI)** | **P Value** | **OR (95% CI)** | **P Value** |
| No NAFLD | 1 (reference) | 1 (reference) | 0.007 |
| NAFLD | 1.42 (1.17–1.72) | <0.001 | 1.32 (1.08–1.61) | 0.007 |
| NAFLD grade | | | |
| No NAFLD | 1 (reference) | 0.001* | 1 (reference) | 0.001* |
| Mild NAFLD | 1.27 (1.02–1.57) | 0.032 | 1.20 (0.96–1.50) | 0.104 |
| Moderate–severe NAFLD | 1.78 (1.37–2.31) | <0.001 | 1.59 (1.21–2.08) | 0.001 |

The multivariable model was adjusted for age, sex, BMI, WC, smoking status, diabetes, and hypertension. BMI = body mass index, CI = confidence interval, NAFLD = nonalcoholic fatty liver disease, OR = odds ratio, WC = waist circumference.

\(^{1}\) P value for the test of trend of odds.

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### TABLE 5. Multivariate Analysis of the Association Between NAFLD and Risk Factors According to Age and Obesity

| Age <55 (n = 1343) | OR (95% CI) | P Value |
|--------------------|------------|---------|
| No NAFLD | 1 (reference) | 0.009 |
| NAFLD | 1.54 (1.11–2.12) | 0.122 |
| NAFLD grade | | |
| No NAFLD | 1 (reference) | 0.002* |
| Mild NAFLD | 1.34 (0.92–1.93) | 0.081 |
| Moderate–severe NAFLD | 1.97 (1.28–3.01) | 0.002 |
| Age ≥55 (n = 1611) | | |
| No NAFLD | 1 (reference) | 0.257 |
| NAFLD | 1.16 (0.90–1.49) | 0.104* |
| NAFLD grade | | |
| No NAFLD | 1 (reference) | 0.623 |
| Mild NAFLD | 1.07 (0.81–1.42) | 0.081 |
| Moderate–severe NAFLD | 1.37 (0.96–1.96) | 0.005 |
| BMI<25 (n = 1875) | | |
| No NAFLD | 1 (reference) | 0.018 |
| NAFLD | 1.35 (1.05–1.73) | 0.134 |
| NAFLD grade | | |
| No NAFLD | 1 (reference) | 0.004* |
| Mild NAFLD | 1.23 (0.94–1.62) | 0.005 |
| Moderate–severe NAFLD | 1.80 (1.19–2.71) | 0.005 |
| BMI ≥25 (n = 1079) | | |
| No NAFLD | 1 (reference) | 0.205 |
| NAFLD | 1.24 (0.89–1.74) | 0.128* |
| NAFLD grade | | |
| No NAFLD | 1 (reference) | 0.490 |
| Mild NAFLD | 1.15 (0.78–1.69) | 0.128 |
| Moderate–severe NAFLD | 1.35 (0.92–1.98) | 0.128 |

The multivariable model was adjusted for age, sex, BMI, WC, diabetes, hypertension, smoking, and NAFLD. BMI = body mass index, CI = confidence interval, NAFLD = nonalcoholic fatty liver disease, OR = odds ratio, WC = waist circumference.

\(^{1}\) P value for the test of trend of odds.
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