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Observational Study

Atherogenic index of plasma combined waist circumference and body mass index to predict metabolic-associated fatty liver disease

Duan SJ *et al*. AIP and A-W-B to predict MAFLD

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Abstract

BACKGROUND

Early identification of metabolic-associated fatty liver disease (MAFLD) is urgent. Atherogenic index of plasma (AIP) is a reference predictor of obesity-related diseases, but its predictive value for MAFLD remains unclear, and no studies have reported whether its combination with waist circumference (WC) and body mass index (BMI) can improve the predictive performance for MAFLD.

AIM

This study has two main objectives: (1) to systematically explore the relationship between AIP and MAFLD and evaluate its predictive value for MAFLD; and (2) to pioneer a novel noninvasive predictive model combining AIP, WC, and BMI, and validate its predictive performance for MAFLD.

METHODS

This cross-sectional study consecutively enrolled 864 participants. Multivariate logistic regression analysis and receiver operating characteristic (ROC) curve were used to evaluate the relationship between AIP and MAFLD and its predictive power for MAFLD. The novel prediction model "A-W-B" combining AIP, WC, and BMI to predict MAFLD was established, and internal verification was completed by magnetic resonance imaging diagnosis.

RESULTS

Subjects with higher AIP exhibited a significantly increased risk of MAFLD, with an odds ratio of 12.420 (6.008-25.675) for AIP after adjusting for various confounding factors. The area under ROC curve (AUC) of the A-W-B model was 0.833 (0.807-0.858), which was significantly higher than that of AIP, WC, and BMI (all P <0.05). Subgroup analysis illustrated that the A-W-B model had significantly higher AUCs in female, young and nonobese subgroups (all P <0.05). The best cutoff values for A-W-B model to predict MAFLD in males and females were 0.5932 and 0.4105, respectively. Additionally, in the validation set, the AUC of A-W-B model to predict MAFLD was 0.862 (0.791-0.916). The A-W-B level was strongly and positively associated with the liver proton density fat fraction (r = 0.630, P < 0.001), and significantly increased with the severity of MAFLD (P < 0.05).

CONCLUSION

AIP was strongly and positively associated with the risk of MAFLD and can be a reference predictor for MAFLD. The novel prediction model "A-W-B" combining AIP, WC and BMI can significantly improve the predictive ability of MAFLD and provide better services for clinical prediction and screening of MAFLD.

Key Words: Atherogenic index of plasma; Metabolic-associated fatty liver disease; Receiver operating characteristic curve; Predictor

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Core Tip: Metabolic-associated fatty liver disease (MAFLD) is the most common chronic liver disease and early identification of MAFLD is urgent. This study demonstrated that the atherogenic index of plasma (AIP) was strongly and positively associated with the risk of MAFLD and it can be a reference predictor for MAFLD. Then, we pioneered a novel noninvasive prediction model "A-W-B" combining AIP, waist circumference, and body mass index, and validated its excellent predictive performance for MAFLD. Furthermore, we also pointed out the optimal cutoff values of A-W-B model to predict MAFLD in males and females, which will facilitate early clinical identification of MAFLD in different gender populations. This study is highly innovative, and the noninvasive prediction model "A-W-B" is convenient, affordable, and easy to obtain, which can provide better services for clinical prediction and screening of MAFLD and metabolic-related diseases.

INTRODUCTION

Metabolic-associated fatty liver disease (MAFLD), formerly known as nonalcoholic fatty liver disease (NAFLD), is a common disease closely related to genetic, obesity, and metabolic abnormalities and has become a global public health problem[1,2]. In recent decades, obesity has become increasingly widespread owing to huge changes in dietary structure and living habits[3,4]. The prevalence of MAFLD has risen rapidly, and patients tend to be younger[5]. Notably, MAFLD can not only progress to hepatitis, liver cirrhosis, and liver cancer[6] but also increase the occurrence and development of diabetes[7] and cardiovascular diseases[8,9], which seriously endangers individual health and increases the social and medical economic burden[10]. Therefore, it is necessary to predict and screen MAFLD at an early stage to intervene in a timely manner.

The occurrence and development of MAFLD are closely related to lipid metabolism disorders and dyslipidemia caused by the accumulation of visceral fat[11]. Patients with fatty liver usually have elevated triglycerides (TG) and generally lower high-density lipoprotein cholesterol (HDL-C) than healthy people[12]. Waist circumference (WC) and body mass index (BMI) are commonly used as indicators to assess obesity, and it has been shown that elevated WC and BMI can significantly increase the risk of fatty liver disease. However, they have certain limitations in accurately reflecting the accumulation of visceral fat[13].

Recently, the atherogenic index of plasma (AIP), calculated from the logarithm of the ratio of TG to HDL-C[14], has been proven to be closely related to abdominal obesity, and it can sensitively reflect the accumulation of visceral fat and effectively predict the risk of atherosclerosis and cardiovascular disease[15,16]. Previous studies indicate that AIP is significantly higher in patients with fatty liver and may be a potential indicator for identifying fatty liver disease[17]. However, few studies have systematically reported the predictive value of AIP for MAFLD, and whether AIP combined WC and BMI can improve the predictive ability for MAFLD is unclear.

Therefore, the two main objectives of this study were: (1) to systematically assess the relationship between AIP and MAFLD and evaluate its predictive value for MAFLD; and (2) to establish a novel noninvasive prediction model combining AIP, WC and BMI, and validate its predictive performance for MAFLD.

MATERIALS AND METHODS

Study design and participants

This study was conducted in Beijing, China. Among the adults who underwent a physical examination for health at China-Japan Friendship Hospital in Beijing from September 2018 to October 2021, we consecutively recruited 943 participants who completed the standardized questionnaire, finished anthropometric tests, and laboratory tests and underwent liver ultrasonography. All subjects agreed to participate in this study voluntarily and submitted informed consent forms.

According to quality control, after excluding pregnant and lactating women, subjects who had a history of any severe brain, heart, lung, kidney, or blood diseases, mental illness, infectious diseases, malignant tumors, *etc.* as well as the subjects with incomplete data, a total of 864 subjects were finally included (Figure 1), with 624 males and 240 females, aged from 20 to 78 years old.

This study was approved by the Clinical Research Ethics Committee of China-Japan Friendship Hospital (2018-110-K79-1).

Data collection and definition

The physical examination was performed in the morning in fasting state. Anthropometric indicators were measured by professionally trained doctors. Height, weight, and waist circumference were measured while subjects were naturally standing barefoot with lightweight clothes. After 10 min of rest, the blood pressure was measured with an upper arm electronic sphygmomanometer. Peripheral blood was drawn into an *EDTA*-containing tube and subjected to biochemical experiments within 2 h. The relevant laboratory indicators were obtained through the electronic database of this physical examination center, including alanine aminotransferase (ALT), aspartate aminotransferase (AST), total cholesterol (TC), TG, HDL-C, low-density lipoprotein cholesterol (LDL-C), fasting blood glucose (FBG), serum uric acid (SUA) and so on.

BMI was calculated as the body weight (in kilograms) divided by the square of the height (in meters). WC referred to the waist circumference at the level of the flat navel. AIP was calculated as the logarithmic transformation of the ratio of TG to HDL-C [log (TG/HDL-C)].

Diagnostic criteria and detection methods of MAFLD

The diagnostic criteria of MAFLD refer to the consensus of international experts in 2020 that in addition to the evidence of hepatic steatosis[18], one of the following three criteria, namely, overweight/obesity, type 2 diabetes or metabolic dysregulation, needs to be met[19,20]. Among them, metabolic dysregulation refer to the existence of at least two of the following metabolic risk criteria: (1) Waist circumference ≥ 102/88 cm in Caucasian men and women or ≥ 90/80 cm in Asian men and women; (2) Blood pressure ≥ 130/85 mmHg or specific drug treatment; (3) Plasma triglycerides ≥ 1.70 mmol/L or specific drug treatment; (4) Plasma HDL-cholesterol < 1.0 mmol/L for men and < 1.3 mmol/L for women or specific drug treatment; (5) Prediabetes (*i.e.*, fasting glucose levels 5.6 to 6.9 mmol/L, or 2-h post load glucose levels 7.8 to 11.0 mmol or HbA1c 5.7% to 6.4%; (6) Homeostasis model assessment-insulin resistance score ≥ 2.5; and (7) Plasma high-sensitivity C-reactive protein level >2 mg/L.

In the training set, fatty liver (hepatic steatosis) was defined by liver ultrasound examination based on at least two of the following three abnormal findings: (1) Diffusely increased echogenicity of the liver relative to the kidney or spleen; (2) Ultrasound beam attenuation; and (3) Poor visualization of intrahepatic structures.

In the validation set, the proton density fat fraction (PDFF) based on magnetic resonance spectroscopy and magnetic resonance imaging (MRI) was used to diagnose fatty liver and to evaluate the severity of MAFLD[21]. PDFF < 5% was defined as no fatty liver, PDFF 5.0%-14.0% was defined as mild MAFLD, PDFF > 14.0% was defined as moderate to severe MAFLD.

Statistical analysis

First, the baseline characteristics of the MAFLD and non-MAFLD groups were compared. The independent samples *t* test was used for comparing normally or approximately normally distributed quantitative data between groups, expressed as the mean and standard deviation. The Mann-Whitney *U* test was used for comparing nonnormally distributed quantitative data between groups, represented as medians and quartiles. The chi-squared test was used for comparing categorical data between groups, represented as numbers and percentages.

Then, multivariate logistic regression analysis was conducted to calculate the odds ratios (ORs) and 95% confidence intervals (CIs) of AIP for MAFLD under different adjustment conditions. The logistic regression prediction model "A-W-B" combining

AIP, WC and BMI was established, the Hosmer-Lemeshow test and the receiver operating characteristic (ROC) curve were used to evaluate the calibration and discrimination of this model, the DeLong test was used to compare the predictive ability of the AIP, WC, BMI, and A-W-B model for MAFLD. Spearman correlation analysis was used to explore the correlation between parameters. Finally, the internal verification was completed with MRI as the diagnostic standard.

All statistical tests were two-tailed and were considered significant for P less than 0.05 (P <0.05). Statistical analyses were performed using Statistical Package for the Sciences (SPSS, version 25.0) and MedCalc statistical software (version 19.6.4).

RESULTS

Characteristics of participants

The demographics, anthropometrics, and laboratory test characteristics of 864 subjects are presented in Table 1. The prevalence of male and young patients (age < 40 years old) and the percentage of smoking history, drinking history, overweight, obesity, elevated ALT, and elevated ALT in MAFLD subjects were significantly higher than those in the non-MAFLD subjects (all P < 0.05). Participants with MAFLD had dramatically higher WC, BMI, SBP, DBP, ALT, AST, TC, TG, LDL-C, FBG, and SUA and significantly lower AST/ALT and HDL-C (all P < 0.05). In addition, a significant association between AIP and MAFLD was initially demonstrated.

Multivariate logistic regression analysis of AIP on the risk of MAFLD

Multivariate logistic regression analyses were conducted to further explore the relationship between AIP and MAFLD, and the results are shown in Table 2. AIP had a strong association with the risk of MAFLD, and the OR for a 1-standard-deviation (SD) increase in AIP was 50.286 (26.953-93.819) without adjustment (Model 1). After adjusting for gender and age, the OR for a 1-SD increase in AIP was 48.874 (26.087-91.569) (Model 2). After further adjusting for smoking history, drinking history, WC, and BMI, the degree of this association changed but was still strong, the OR for a 1-SD increase in AIP was 16.184 (7.961-32.902) (Model 3). Further adjusting for SBP, DBP, ALT, AST, TC, TG, HDL-C, LDL-C, FBG, and SUA attenuated the association but not too much, there was still a 12.420-fold (6.008-25.675) higher risk for MAFLD with a 1-SD increase in AIP (Model 4).

After dividing AIP into quartiles, the risk of MAFLD increased robustly with higher AIP quartiles. When comparing the top quartiles with the bottom categories, the risk of MAFLD increased 16.882-fold to 7.160-fold from Model 1 to Model 4. The *P* values for the linear trend were less than 0.01, signifying that linear trends from the lowest to the highest quartiles were eminent.

Predictive ability of AIP for MAFLD in different subgroups

The ROC curve of AIP for predicting MAFLD in different gender, age, and weight subgroups was plotted, and the DeLong test was used to compare the area under the ROC curve (AUC) between the subgroups. As shown in Figure 2, the AUC of AIP for MAFLD in young was significantly higher than that in middle-age and elderly subjects [0.816 (0.779-0.849) *vs* 0.726 (0.678-0.771), $P < 0.05$]. The AUC of AIP for MAFLD in nonobese subjects was significantly higher than that in obese subjects [0.783 (0.747-0.816) *vs* 0.579 (0.519-0.638), $P < 0.0001$]. However, there was no significant difference between males and females ($P = 0.0639$).

In addition, the best cutoff values for AIP to predict MAFLD in males and females were 0.0821 and -0.1390, respectively. The AUCs of AIP, WC, and BMI for predicting total MAFLD were 0.780 (0.751-0.807), 0.790 (0.761-0.817), and 0.788 (0.759-0.814), respectively, with no significant difference among the three (Table 4).

Establishment of the A-W-B model for better predicting MAFLD

To further improve the predictive ability of MAFLD, we combined AIP, WC, and BMI and put them into the binary logistic regression model to construct a new logistic regression prediction model "A-W-B". The regression equation was logit (A-W-B) = -8.782 + 2.560 × AIP + 0.049 × WC + 0.170 × BMI (Table 3).

The Hosmer-Lemeshow test and ROC curve analysis were used to evaluate the calibration and discrimination of the A-W-B model. Figure 3A illustrated the calibration line graph of the A-W-B model, and the result of the Hosmer-Lemeshow test showed that χ^2 = 8.5901, P = 0.3780 > 0.05, indicating that the A-W-B model had a good calibration ability for MAFLD. Figure 3B illustrated the ROC curve of the A-W-B model, with the AUC of 0.833 (0.807-0.858), indicating that the A-W-B model had a good discrimination ability for MAFLD.

Predictive ability of the A-W-B model for MAFLD in different subgroups

To further evaluate the predictive power of the A-W-B model for MAFLD in different populations, we performed a subgroup analysis. As shown in Figure 4, the AUCs of A-W-B for MAFLD in female, young and nonobese subjects were 0.874 (0.826-0.914), 0.863 (0.830-0.892) and 0.822 (0.789-0.852), respectively, which were significantly higher than those in male [0.814 (0.781-0.843)], middle-aged and elderly [0.787 (0.742-0.828)] and obese subjects [0.644 (0.585-0.700)], respectively (all P < 0.05). These results indicate that the A-W-B model has stronger predictive power for MAFLD in female, young, and nonobese subjects. Furthermore, the results in Table 4 showed that the best cutoff values for A-W-B to predict MAFLD in males and females were 0.5932 and 0.4105, respectively.

Comparison of the A-W-B model and AIP, WC, and BMI for predicting MAFLD

The DeLong test was used to compare the predictive ability of the A-W-B model and AIP, WC, and BMI. The AUC of the A-W-B model for MAFLD was 0.833 (0.807-0.858), which was significantly higher than that of AIP, WC, and BMI (P < 0.05). The sensitivity, specificity, Youden index, and cutoff value of the A-W-B model were 86.13%, 68.47%, 0.5460, and 0.5019, respectively (Table 4).

As shown in Figure 5A-E, subgroup analysis showed that the AUCs of the A-W-B model were significantly higher than those of AIP, WC, and BMI in male, female, young, middle-aged and elderly, and nonobese subjects (all P < 0.01), demonstrating that the A-W-B model has a higher ability to predict MAFLD than AIP, WC, and BMI in a different age, gender, and nonobese subjects. However, as shown in Figure 5F, among obese subjects, the predictive ability of the A-W-B model for MAFLD was only better than that of AIP. In addition, the Z values between the AIP, WC, BMI, and the A-W-B model in different subgroups were illustrated in Supplementary Table 1.

The concrete ROC curve results of the AIP, WC, BMI, and A-W-B model for predicting MAFLD in different subgroups were illustrated in Table 4. Compared to AIP, WC, and BMI, the A-W-B model had the best sensitivity in male, young and nonobese subjects, which may be more conducive to identifying patients with positive MAFLD to reduce the missed diagnosis rate. Meanwhile, the A-W-B model had the best specificity in female and middle-aged and elderly subjects, which may be more beneficial to identifying people without MAFLD and reducing the misdiagnosis rate.

Moreover, Spearman correlations between A-W-B, AIP, WC, BMI, and various physical and chemical indicators are illustrated in Table 5. Compared with AIP, WC, and BMI, the A-W-B model had a higher positive association with SBP, DBP, ALT, AST, FBG, and SUA.

Validation of the A-W-B model

To further validate the diagnostic performance of the A-W-B model for MAFLD, we randomly selected approximately 15% of the subjects (131 cases) from the overall subjects as the validation set and used MRI to diagnose MAFLD. Among them, 35 cases were in the control group, 67 cases were mild MAFLD, and 29 cases were moderate to severe MAFLD. The data comparison between the training set and validation set was shown in Table 6, there was no statistically significant difference in age, gender, and various indicators between the two groups (all $P > 0.05$).

Figure 3C illustrated the ROC curve of the A-W-B model in the validation set, with the AUC of 0.862 (0.791-0.916), indicating that the A-W-B model also exhibited outstanding discrimination for MAFLD in the validation set. In addition, Figure 6 shows that the A-W-B level was strongly and positively associated with the proton density fat fraction (r = 0.630, $P < 0.001$). With the degree of severity of MAFLD increased, the A-W-B level also increased significantly ($P < 0.05$).

DISCUSSION

In this study, the relationship between AIP and MAFLD was systematically assessed, and it was confirmed that AIP had a strong and positive association with the risk of MAFLD and can be used as a reference predictor for MAFLD. Then, to further improve the predictive power for MAFLD, we combined AIP, WC, and BMI to pioneer a novel noninvasive prediction model "A-W-B", and confirmed that it had a better predictive value for MAFLD than AIP, WC, and BMI. At the same time, we also pointed out the optimal cutoff values of A-W-B model to predict MAFLD in males and females, which will facilitate early clinical identification of MAFLD in different gender populations. Finally, we internally validated the model with MRI as the diagnostic standard, further affirming its outstanding predictive performance for MAFLD, which provided a new idea for the early prevention and screening of MAFLD.

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As a new type of body fat index calculated as the logarithmic transformation of the ratio of TG to HDL-C, AIP is more sensitive to visceral fat accumulation than WC and BMI and has shown predictive potential for fatty liver in previous studies[15]. Xie *et al*[17] found that a higher AIP level was positively associated with fatty liver, which might be a novel and strong predictor associated with fatty liver in the Chinese Han population. In this study, the multivariate logistic regression results showed that the subjects with higher AIP still exhibited a significantly increased risk of MAFLD after adjusting for age, sex, smoking history, drinking history, WC, BMI, and various physical and chemical indicators, indicating that AIP was strongly and positively associated with the risk of MAFLD. Visceral fat accumulation has been proven to increase the prevalence of a variety of cardiovascular risk factors, including insulin resistance and dyslipidemia, which also play a tremendously crucial role in the pathogenesis of fatty liver disease[16]. It is widely accepted that the increased TG caused by liver lipid accumulation is a prerequisite for MAFLD and that insulin resistance is a key factor during its development. Previous studies demonstrated that increasing levels of TG and decreasing concentrations of HDL-C could reduce sensitivity to insulin, and higher TG/HDL-C usually indicates insulin resistance[22], which may explain the close relationship between AIP and MAFLD. In addition, this study also pointed out the optimal cutoff values of AIP for predicting MAFLD in men and women, which provided a new idea for the early prevention of MAFLD. People with AIP levels above this cutoff point may be at higher risk for MAFLD and require more attention to liver conditions.

Xie *et al*[17] indicated that the ORs of AIP on the risk of fatty liver disease in women and young adults increased faster. This study showed that the AIP had a better predictive ability for MAFLD in young subjects, which may be related to the higher excessive fat accumulation of young people caused by dietary irregularities and insufficient exercise. However, there was no significant difference between males and females. Wang *et al*[23] and Dong *et al*[24] studied the predictive value of AIP for NAFLD in obese and nonobese populations separately, with AUCs of 0.718 and 0.803, respectively. It seems that the predictive ability of AIP in the nonobese population might be better, but no studies have directly compared the ability of AIP in identifying MAFLD between different weights. Fortunately, our study filled this gap, and confirmed that the AIP had a remarkably higher predictive ability for MAFLD in nonobese subjects. A cohort study demonstrated that visceral obesity was dose-dependently associated with NAFLD[25]. It is worth noting that lean people with unhealthy metabolism may have a greater accumulation of visceral fat[26], and nonobese MAFLD patients with unhealthy metabolism usually exhibit higher liver damage and cardiovascular risks[27]. AIP, as a sensitive indicator that reflects the accumulation of visceral fat, might have a stronger association with nonobese MAFLD patients and thus might have a better predictive ability for MAFLD in nonobese populations.

WC and BMI are common indicators for obesity evaluation and have been proven to be good predictors of fatty liver[17]. This study confirmed that they also had good predictive ability for MAFLD, with no significant difference compared to AIP.

However, no previous study has assessed the predictive power of AIP combined with WC and BMI for MAFLD. Therefore, another focus of this study was to explore whether AIP combined with WC and BMI can improve the ability to identify MAFLD. The results showed that the logistic regression prediction Model A-W-B established by AIP combined with WC and BMI had excellent calibration and discrimination for MAFLD, and behaved a significantly better ability to identify MAFLD. At the same time, it also had an outstanding ability to identify MAFLD in the validation, further affirming its outstanding predictive performance for MAFLD. Interestingly, we also found that the level of A-W-B was positively correlated with the liver fat content and the degree of severity of MAFLD in the validation, which may be objective evidence explaining the positive association and excellent predictive ability of the A-W-B model for MAFLD. The Spearman correlation analysis showed that AIP, WC, and BMI were all positively associated with SBP, DBP, ALT, AST, FBG, and SUA. Notably, these physical and chemical indicators were also risk factors for MAFLD, and compared with AIP, WC, and BMI, the A-W-B model had a higher correlation with SBP, DBP, ALT, AST, FBG, and SUA, which may indirectly explain the better correlation and predictive ability of the A-W-B model for MAFLD. Furthermore, this study also pointed out that the optimal cutoff values of the A-W-B model to predict MAFLD in males and females were 0.5932 and 0.4105, respectively, which will facilitate early clinical identification of MAFLD in different gender populations. When the A-W-B level of the subject is above the cutoff point, it can be preliminarily identified as MAFLD.

In summary, compared with other studies, this study has the following advantages. First, this study confirmed that AIP was strongly and positively associated with the risk of MAFLD and it can be a reference predictor for MAFLD, and pointed out the optimal cutoff values of AIP for predicting MAFLD in men and women, providing a new idea for early prevention of MAFLD. Then, we pioneered a novel noninvasive prediction model "A-W-B" combining AIP, WC, and BMI that can significantly improve the predictive ability for MAFLD, and pointed out its optimal cutoff values of A-W-B model to predict MAFLD in men and women. Furthermore, we also validated the model with MRI as the diagnostic standard, further affirming its outstanding predictive performance for MAFLD. This study is highly innovative, and this noninvasive prediction model "A-W-B" is convenient, affordable, and easy to obtain, which can provide better services for clinical prediction and screening of MAFLD and metabolic-related diseases.

However, there are still some limitations. First, to avoid subject recall bias, this study did not collect confounding factors such as specific dietary structure and physical activity, and mainly focused on objective laboratory indicators and basic demographic indicators, which may slightly affect the results of multiple logistic regression analysis. Second, the subjects in this study were limited to a single physical examination center, which may cause selection bias. Third, fatty liver in the training set of this study was diagnosed by abdominal ultrasonography, and we did not use ultrasonography to accurately classify the severity of MAFLD. Therefore, the relationship between AIP, A-W-B model and the severity of fatty liver by ultrasonography was unclear. Notably, we found that A-W-B levels were positively correlated with MRI-diagnosed MAFLD severity in the validation set. However, due to limited funds, the number of validation sets using MRI as the diagnostic standard was relatively small. Therefore, further multicenter, large-sample prospective cohort studies are needed in the future to verify and explore the predictive value of AIP and A-W-B for MAFLD and its different severity.

CONCLUSION

AIP was strongly and positively associated with MAFLD and it can be a reference predictor for MAFLD. The novel noninvasive prediction model "A-W-B" combining AIP, WC, and BMI can significantly improve the predictive ability for MAFLD and provide better services for clinical prediction and screening of MAFLD.

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ARTICLE HIGHLIGHTS

Research background

Metabolic-associated fatty liver disease (MAFLD) is the most common chronic liver disease and poses great harm to people's health. Early identification of MAFLD is imminent.

Research motivation

Atherogenic index of plasma (AIP) is a reference predictor of obesity-related diseases, but its predictive value for MAFLD remains unclear, and no studies have reported whether its combination with waist circumference (WC) and body mass index (BMI) can improve the predictive performance for MAFLD.

Research objectives

This study has two main objectives: (1) to systematically explore the relationship between AIP and MAFLD and evaluate its predictive value for MAFLD; and (2) to pioneer a novel prediction model combining AIP, WC and BMI, and validate its predictive performance for MAFLD.

Research methods

This cross-sectional study consecutively enrolled 864 participants. 5 Multivariate logistic regression analysis and receiver operating characteristic (ROC) curve were used to evaluate the relationship between AIP and MAFLD and its predictive power for MAFLD. The novel prediction model "A-W-B" combining AIP, WC, and BMI to predict MAFLD was established, and internal verification was completed by magnetic resonance imaging diagnosis.

Research results

Subjects with higher AIP exhibited a significantly increased risk of MAFLD, with an odds ratio of 12.420 (6.008-25.675) for AIP after adjusting for various confounding factors. The area under ROC curve (AUC) of the A-W-B model was 0.833 (0.807-0.858), which was significantly higher than that of AIP, WC, and BMI (all P <0.05). The best cutoff values for A-W-B model to predict MAFLD in males and females were 0.5932 and 0.4105, respectively. Additionally, in the validation set, the AUC of A-W-B model to predict MAFLD was 0.862 (0.791-0.916). The A-W-B level was strongly and positively associated with the liver proton density fat fraction (r = 0.630, P < 0.001), and significantly increased with the severity of MAFLD (P < 0.05).

Research conclusions

AIP was strongly and positively associated with MAFLD and can be a reference predictor for MAFLD. The novel noninvasive prediction model "A-W-B" combining AIP, WC, and BMI can significantly improve the predictive ability for MAFLD and provide better services for clinical prediction and screening of MAFLD.

Research perspectives

Studies that may be conducted in the future should further explore the predictive value of AIP and A-W-B model for different severities of MAFLD and other related metabolic diseases.

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