

Comparison of triglyceride/HDL-C ratio and triglyceride glucose index in identifying NAFLD in Chinese population: a cross-sectional study

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Research

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Abstract

Background

Triglyceride (TG) to high-density lipoprotein cholesterol (HDL-C) ratio and triglyceride glucose index (TyG) have been recommended as surrogate markers for nonalcoholic fatty liver disease (NAFLD). In the present study, we aimed to compare the ability of TG/HDL-C, TyG and TyG-HDL-C, a new indicator deriving from TyG and HDL-C, in identifying NAFLD in Chinese population.

Methods

A total of 11,524 subjects who participated in a health checkup program were included. NAFLD was diagnosed by ultrasonography.

Results

The prevalence rates of NAFLD progressively increased across the quartiles of TG/HDL-C, TyG and TyG-HDL-C (P for trend < 0.0001). After adjustment for confounding factors, the three indicators were all independently associated with the risk of NAFLD. The odds ratios (ORs) for NAFLD of the second to fourth TyG-HDL-C quartiles compared to the first quartile were 2.24 (1.92–2.62), 4.24 (3.64–4.94) and 8.96 (7.64–10.50), respectively. There was no difference in areas under the ROC curve (AUCs) of the three indicators in men, regardless of body weight. AUCs of TyG were significantly higher than that of TG/HDL-C in overweight and obese women ($P < 0.0001$), with the optimal cut-off point of 8.56 (sensitivity = 74.4 %, specificity = 60.9 %). In normal or low body weight women, TyG-HDL-C, with a AUC of 0.827 (0.810–0.843), was better than the other two indicators, with AUCs of 0.813 (0.796–0.830), 0.815 (0.797–0.831), respectively ($P = 0.0015$). The optimal cut-off point of TyG-HDL-C in normal or low body weight women was 6.8 (sensitivity = 78.1%, specificity = 72.1 %).

Conclusions

TG/HDL-C is as effective as TyG in predicting NAFLD in Chinese men. TyG is superior to TG/HDL-C in identifying NAFLD in Chinese overweight and obese women. While in Chinese normal and low weight women, TyG-HDL-C is a better predictor for NAFLD.

Background

Nonalcoholic fatty liver disease (NAFLD) ranges from simple hepatic steatosis to non-alcoholic steatohepatitis (NASH) and cirrhosis. NAFLD is the most common chronic liver disease worldwide, with an estimated global prevalence of 15–40% that continues to increase rapidly [1]. And in mainland of China, the prevalence is about 20.09% (17.95–22.31%) [2]. In recent years, several studies [3–6] have

shown that NAFLD was also related to type 2 diabetes mellitus, abdominal obesity, dyslipidemia, hypertension and cardiovascular disease. Furthermore, the prediction for cardiovascular events was often independent of traditional cardiovascular risk factors [7]. Therefore, the early identification of NAFLD may be important for public health. There is a strong medical need of simple, noninvasive, cost-effective and reliable tools for predicting NAFLD.

Recently, the triglyceride and glucose index (TyG) [8–10] and triglyceride to high-density lipoprotein cholesterol (TG/HDL-C) ratio [11–14] have been recommended as an effective biomarker to identify NAFLD. To the best of our knowledge, there is no comparative study of TyG and TG/HDL-C in predicting NAFLD. Moreover, we speculated that whether TyG-HDL-C, concluding triglyceride (TG), fasting plasma glucose (FPG) and high-density lipoprotein cholesterol (HDL-C), can be better in predicting NAFLD.

Therefore, in the present study we sought to compare the ability of the TyG index, TG/HDL ratio and TyG-HDL-C in detecting NAFLD in Chinese adults with different sex and weight.

Methods

Subjects

The study population was recruited from adults who underwent health checkups at the Affiliated Hospital of Qingdao University between January 2018 and December 2018. Subjects with an alcohol intake > 140g/week for men and 70g/week for women, a history of viral hepatitis, auto-immune hepatitis or other forms of chronic liver disease were excluded from the study. Finally, a total of 11,524 subjects were included in the final analysis, consisting of 6,326 men and 5,198 women.

Our study was approved by institutional review board of the Affiliated Hospital of Qingdao University, and the informed consent requirement was exempted because of our retrospective estimation of unidentified database.

Clinical measurements

Physical examination was performed and anthropometry was obtained comprised of weight, height, systolic and diastolic blood pressure (SBP, DBP). Body mass index (BMI) was calculated as body weight (kg) divided by body height squared (m^2). According to the criteria for Chinese people, normal and low weight was defined as $BMI < 24 \text{ kg}/m^2$, overweight as $BMI \geq 24$ and $< 28 \text{ kg}/m^2$, and obesity as $BMI \geq 28 \text{ kg}/m^2$. Fasting blood samples were collected after at least 10 h overnight. Triglycerides (TG), total cholesterol (TC), low-density lipoprotein cholesterol (LDL-C), high-density lipoprotein cholesterol (HDL-C), FPG, serum uric acid (SUA) and homocysteine (HCY) were measured using an autoanalyzer (Beckman, Palo Alto, CA). The TyG index was calculated as established formulas, $TyG = \text{Ln} [TG \text{ (mg/dL)} \times FPG \text{ (mg/dL)}/2]$ [15]. TyG-HDL-C was calculated by subtracting HDL-C (mmol/L) from TyG.

Diagnosis of NAFLD

NAFLD was diagnosed according to the guidelines of NAFLD issued by the Chinese National Consensus Workshop on Nonalcoholic Fatty Liver Disease [16]. The diagnosis of NAFLD was based on ultrasonography findings of hepatic steatosis associated with characteristic echo patterns, including ultrasound beam attenuation, diffuse hyperechogenicity of liver, and poor visualization of intrahepatic structures, using a Toshiba Nemio 20 sonography machine with a 3.5-MHz probe (Toshiba, Tokyo, Japan).

Statistical analysis

Continuous variables were presented as median (interquartile range) because of their skew distribution, and categorical variables were displayed as percentages (%). The significance of differences between groups was evaluated by Mann–Whitney *U* test for continuous variables and chi-square test for categorical variables. Logistic regression was used to evaluate the association between TG/HDL-C, TyG, TyG-HDL-C and NAFLD. Four models were applied: model 1 was unadjusted. Model 2 was adjusted for age, sex and BMI. Model 3 was adjusted for all variables in model 2 plus SBP, SUA and Hcy. Model 4 was adjusted for all variables in model 3 plus HDL-C for TyG quartiles or plus FPG for TG/HDL-C quartiles. Receiver operator characteristic (ROC) curve analyses were performed to assess the abilities of the three indicators to detect NAFLD. *Z* test was used for comparing the differences between the areas under the curve (AUCs). $P < 0.05$ was considered statistically significant. SPSS for Windows version 23.0 (IBM Co., Armonk, NY, USA) and MedCalc (MedCalc software, Olstead, Belgium) were used for statistical analyses in the present study.

Results

Clinical characteristics of the study population

A total of 11,524 subjects were included in the present study. The mean age of the population was 55.7 (± 11.5) years and mean BMI 25.8 (± 3.5) kg/m². There were 4,843 participants diagnosed as NAFLD by liver ultrasonic examination, with a prevalence of 42%. In comparison with subjects without NAFLD, subjects with NAFLD were more likely to be male, and had higher levels of BMI, SBP, DBP, FPG, TG, TC, LDL-C, UA, HCY, TG/HDL-C ratio, TyG and TyG-HDL-C ($P < 0.0001$). In contrast, HDL-C was significantly reduced in the NAFLD group. Notably, the mean age of women with NAFLD was older than that of without NAFLD, while the mean age of men with NAFLD was younger than that of without NAFLD (Table 1).

Table 1
Clinical Characteristics of the Study Subjects Based on NAFLD Status

	group	Non-NAFLD	NAFLD	P value
Total, N (%)	total	6681(58%)	4843(42%)	
Men, N (%)	total	3079(46.1%)	3247(67%)	< 0.0001
Age, years	men	52(44–61)	49(42–56)	< 0.0001
	women	52(44–59)	56(51–63)	< 0.0001
	total	52(44–60)	54(45–59)	0.426
BMI, kg/m ²	men	24.73(22.94–26.58)	27.71(25.95–29.76)	< 0.0001
	women	23.73(21.78–25.91)	27.27(25.28–29.52)	< 0.0001
	total	24.24(22.31–26.26)	27.58(25.71–29.72)	< 0.0001
SBP, mmHg	men	127(117–139)	131(121–142)	< 0.0001
	women	122(111–136)	135(122–150)	< 0.0001
	total	125(114–138)	132(121–145)	< 0.0001
DBP, mmHg	men	79(72–87)	84(76–92)	< 0.0001
	women	73(65–81)	80(72–88)	< 0.0001
	total	76(68–85)	83(75–90)	< 0.0001
FPG, mmol/L	men	5.01(4.69–5.43)	5.30(4.88–5.90)	< 0.0001
	women	4.90(4.59–5.26)	5.35(4.92–5.99)	< 0.0001
	total	4.96(4.63–5.34)	5.31(5.90–5.93)	< 0.0001
TG, mmol/L	men	1.12(0.81–1.58)	1.81(1.26–2.62)	< 0.0001
	women	0.97(0.71–1.36)	1.64(1.19–2.29)	< 0.0001
	total	1.04(0.75–1.47)	1.75(1.23–2.50)	< 0.0001
TC, mmol/L	men	5.00(4.41–5.64)	5.22(4.62–5.88)	< 0.0001
	women	5.14(4.52–5.85)	5.46(4.81–6.19)	< 0.0001
	total	5.08(4.46–5.75)	5.29(4.69–5.98)	< 0.0001
HDL-C, mmol/L	men	1.41(1.22–1.63)	1.25(1.10–1.43)	< 0.0001
	women	1.62(1.41–1.86)	1.40(1.22–1.59)	< 0.0001

Data are presented as median (interquartile range) or percentage

	group	Non-NAFLD	NAFLD	<i>P</i> value
	total	1.52(1.31–1.77)	1.30(1.13–1.49)	< 0.0001
LDL-C, mmol/L	men	2.96(2.48–3.46)	3.19(2.67–3.69)	< 0.0001
	women	2.91(2.43–3.49)	3.30(2.78–3.85)	< 0.0001
	total	2.93(2.45–3.48)	3.22(2.71–3.74)	< 0.0001
SUA, mmol/L	men	359(313–407)	402(350–458)	< 0.0001
	women	268(233–306)	312(273–356)	< 0.0001
	total	305(255–365)	372(313–433)	< 0.0001
HCY, mmol/L	men	11.80(10.00–14.20)	11.80(10.18–14.05)	0.885
	women	9.30(7.91–11.04)	9.83(8.44–11.59)	< 0.0001
	total	10.40(8.70–12.60)	11.12(9.46–13.25)	< 0.0001
TG/HDL-C	men	0.79(0.53–1.20)	1.43(0.95–2.21)	< 0.0001
	women	0.60(0.40–0.91)	1.15(0.79–1.72)	< 0.0001
	total	0.68(0.45–1.05)	1.34(0.88–2.06)	< 0.0001
TyG	men	8.43(8.08–8.82)	8.97(8.59–9.40)	< 0.0001
	women	8.27(7.92–8.63)	8.88(8.54–9.29)	< 0.0001
	total	8.34(7.99–8.72)	8.94(8.57–9.37)	< 0.0001
TyG-HDL-C	men	7.00(6.54–7.49)	7.68(7.24–8.20)	< 0.0001
	women	6.62(6.11–7.12)	7.46(7.00–7.97)	< 0.0001
	total	6.80(6.29–7.31)	7.62(7.16–8.13)	< 0.0001
Data are presented as median (interquartile range) or percentage				

Comparison of the associations of TG/HDL-C, TyG and TyG-HDL-C with NAFLD risk

The prevalence of NAFLD was all significantly increased along with the TG/HDL-C, TyG and TyG-HDL-C quartiles (*P* for trend < 0.0001, Fig. 1). The phenomenon is more obvious in TyG-HDL-C quartiles. The prevalence of the highest TyG-HDL-C quartile was 73.7%, which showed a 6.8-fold increased with the ones in the lowest quartile. While the prevalence of the fourth quartile of TG/HDL-C and TyG rose 6.2 times and 6.3 times, respectively, compared with that of ones in lowest quartile.

We also observed a significant trend of increasing odds ratio for NAFLD with increasing levels of TG/HDL-C, TyG and TyG-HDL-C in Table 2 (*P* for trend < 0.0001). The crude ORs for NAFLD (model 1) of

the second to fourth TyG-HDL-C quartiles compared to the first quartile (3.8 (3.3–4.3), 9.1 (7.9–10.5), and 23.2 (20.1–26.8), respectively) were greater than corresponding figures of TyG quartiles and TG/HDL-C quartiles. After adjustment for age, sex and BMI (model 2), and further for SBP, SUA and HCY (model 3), the odds ratios (ORs) for NAFLD remained progressively increased across quartiles of TG/HDL-C, TyG and TyG-HDL-C. The ORs for NAFLD of the second to fourth TyG-HDL-C quartiles compared to the first quartile were 2.24 (1.92–2.62), 4.24 (3.64–4.94) and 8.96 (7.64–10.50), respectively. Finally, the associations persisted after additional adjustment for HDL-C in TyG quartiles and FPG in TG/HDL-C quartiles (model 4).

Table 2
Odds ratios for NAFLD in different quartiles of TyG index or ALT

		Model1	Model2	Model3	Model4
TG/HDL-C	Q1(Reference)	1	1	1	1
	Q2(OR, 95% CI)	3.71(3.23–4.26)	2.51(2.16–2.91)	2.37(2.03–2.75)	2.27(1.95–2.64)
	Q3(OR, 95% CI)	7.89(6.89–9.03)	4.28(3.69–4.96)	3.91(3.36–4.54)	3.69(3.17–4.29)
	Q4(OR, 95% CI)	20.06(17.43–23.07)	9.45(8.11–11.02)	8.04(6.88–9.39)	7.18(6.14–8.41)
TyG	Q1(Reference)	1	1	1	1
	Q2(OR, 95% CI)	3.55(3.10–4.08)	2.45(2.10–2.85)	2.30(1.98–2.68)	2.19(1.88–2.56)
	Q3(OR, 95% CI)	7.83(6.84–8.96)	4.51(3.89–5.23)	4.08(3.51–4.74)	3.74(3.22–4.36)
	Q4(OR, 95% CI)	20.65(17.95–23.77)	10.75(9.22–12.54)	9.26(7.92–10.82)	7.99(6.79–9.39)
TyG-HDL-C	Q1(Reference)	1	1		
	Q2(OR, 95% CI)	3.75(3.26–4.32)	2.37(2.03–2.77)	2.24(1.92–2.62)	
	Q3(OR, 95% CI)	9.10(7.92–10.45)	4.67(4.01–5.42)	4.24(3.64–4.94)	
	Q4(OR, 95% CI)	23.16(20.06–26.75)	10.41(8.89–12.17)	8.96(7.64–10.50)	
Model 1 was unadjusted.					
Model 2 was adjusted for age, sex and BMI.					
Model 3 was adjusted for all variables in model 2 plus SBP, SUA and HCY.					
Model 4 was adjusted for all variables in model 3 plus HDL-C in TyG quartiles and plus FPG in TG/HDL-C quartiles.					

Diagnostic accuracy of TG/HDL, TyG and TyG-HDL-C for NAFLD

To compare the ability of TG/HDL-C, TyG and TyG-HDL-C for detecting NAFLD, subjects were further grouped by sex and weight, and the ROC curves were analyzed. As shown in Table 3, with the decrease of BMI, the areas under the ROC curve (AUCs) of the three indicators became larger, except for TyG in men.

There was no difference in AUCs of the three indicators in men, regardless of body weight. Furthermore, the optimal cut-off point of TG/HDL-C was 1.02 in men, with a sensitivity of 70.9% and specificity of 66.4%.

Table 3
Comparison of AUCs (95% CI) of evaluated parameters for NAFLD in subjects categorized by sex and weight

Groups	TG/HDL-C		TyG		TyG-HDL-C	
	AUROC (95% CI)	P	AUROC (95% CI)	P	AUROC (95% CI)	P
Men						
Obesity	0.641 (0.619–0.664)	< 0.0001	0.654 (0.631–0.676)	< 0.0001	0.644 (0.621–0.666)	< 0.0001
Overweight	0.703 (0.687–0.719)	< 0.0001	0.704 (0.687–0.720)	< 0.0001	0.706 (0.689–0.722)	< 0.0001
Normal and low weight	0.756 (0.733–0.778)	< 0.0001	0.769 (0.746–0.791)	< 0.0001	0.753 (0.729–0.775)	< 0.0001
Women						
Obesity	0.718 (0.688–0.745)	< 0.0001	0.751 (0.723–0.778) ^a	< 0.0001	0.739 (0.710–0.766) ^a	< 0.0001
Overweight	0.725 (0.705–0.744)	< 0.0001	0.741 (0.722–0.759) ^a	< 0.0001	0.743 (0.724–0.762) ^a	< 0.0001
Normal and low weight	0.813 (0.796–0.830)	< 0.0001	0.815 (0.797–0.831)	< 0.0001	0.827 (0.810–0.843) ^b	< 0.0001
Comparison of AUCs using Z test. ^a means a significant difference compared with that of TG/HDL-C in the same weight group. ^b means a significant difference compared with that of TyG in the same weight group.						

In contrast, the AUCs of TyG were significantly higher than those of TG/HDL-C in overweight and obese women, while similar to those of TyG-HDL-C. The optimal cut-off point of TyG for NAFLD of overweight and obese women was 8.56, with a sensitivity of 74.4% and specificity of 60.9%. In normal or low body weight women, the AUCs of TG/HDL-C and TyG had no difference, while TyG-HDL-C was better than the former two. The optimal cut-off point of TyG-HDL-C in normal or low body weight women was 6.8, with a sensitivity of 78.1% and specificity of 72.1% (Fig. 2).

Discussion

In the present study, we observed TG/HDL-C, TyG and TyG-HDL-C were all closely and positively related to risk of NAFLD, after adjustment for potential confounders. We also demonstrated that, in men, there was no difference in the effectiveness of TG/HDL-C, TyG and TyG-HDL-C for identifying NAFLD, regardless of body weight. In contrast, TyG was superior to TG/HDL-C for predicting NAFLD in overweight and obese women, while not different from TyG-HDL-C. In women with normal or low body weight, TyG and TG/HDL-C had no difference in identification for NAFLD, while TyG-HDL-C was better than the former two. The optimal cut-off point of TyG-HDL-C for NAFLD in normal and low body weight women was 6.8. The optimal cut-off point of TyG for NAFLD in overweight and obese women was 8.56. Compared with the other two indicators, TG/HDL-C is more suitable for predicting NAFLD in Chinese men for its simple calculation, with the cut-off point of 1.02, although there was no difference in effectiveness.

In recent years, a growing body of evidence has shown an association between TG/HDL-C and NAFLD, as well as TyG and NAFLD. Two cohort studies [12, 14] showed that higher TG/HDL-C was strongly associated with increased risk of NAFLD. Similarly, in a cross-sectional study [11] involving 18,061 participants, TG/HDL-C was independently related with NAFLD in apparently healthy individuals and was recommended as a surrogate for NAFLD. Several cross-sectional studies [8–10] also revealed a strong and positive association between TyG and NAFLD, and TyG was effective to screen NAFLD. Similarly, in a nine-year cohort study [17], the researchers found that TyG could predict the risk of NAFLD in the next few years. Consistently, our present study also revealed a close relationship between TG/HDL-C and NAFLD, as well as TyG and NAFLD. Furthermore, both TG/HDL-C and TyG were effective in detecting NAFLD.

The mechanisms associated with the onset of NAFLD remain poorly understood. The current evidence [18] suggests a “multiple-hit” hypothesis including insulin resistance (IR), hormones secreted from the adipose tissue, nutritional factors, gut microbiota and genetic and epigenetic factors, among which IR plays an important role. Moreover, IR has been found to be associated with the development of NAFLD [19, 20]. Besides, the severity of IR was also positively related to the progress and prognosis of NAFLD [21]. On the other hand, TG/HDL-C [22–25] and TyG [10, 26–29] were both found to be closely associated with insulin resistance in different populations and have been proposed as markers of insulin resistance. Thus, IR may be the mechanism underlying the link between TG/HDL-C, TyG and NAFLD.

Previous study by Er et al. [30] showed that TyG was more efficient than TG/HDL-C for identifying insulin resistance. Another study by Babic et al. [31] showed TG/HDL-C might be a useful predictor of glycemic control in normal weight, and TyG index in overweight and obese patients with diabetes mellitus type 2. The comparison of TG/HDL-C and TyG in predicting NAFLD was not investigated in previous studies. We created a new indicator, TyG-HDL-C, deriving from three variables highly correlated with IR. Besides, BMI is an important factor affected TyG efficacy for identifying NAFLD [8]. Thus, our present study compared the ability of TG/HDL-C, TyG and TyG-HDL-C in predicting NAFLD in different sex and weight groups. Our study found with the decrease of BMI, all of the three indicators were more closely related with NAFLD. There was no difference in the ability of TG/HDL-C, TyG and TyG-HDL-C for identifying NAFLD, regardless

of body weight. Compared with the other two indicators, TG/HDL-C, with a AUC of 0.746 (0.735–0.757), is more suitable for predicting NAFLD in Chinese men for its simple calculation, although there was no difference in effectiveness. And the optimal cut-off point was 1.02, with a sensitivity of 70.9% and specificity of 66.4 %. In contrast, TyG was superior to TG/HDL-C for predicting NAFLD in overweight and obese women, while not different from TyG-HDL-C. The optimal cut-off point of TyG for diagnosing NAFLD in overweight and obese women was 8.56, with a AUC of 0.748 (0.732–0.763), a sensitivity of 74.4% and specificity of 60.9 %. In women with normal or low body weight, TyG and TG/HDL-C had no difference in identification for NAFLD, while TyG-HDL-C was better than the former two. The optimal cut-off point of TyG-HDL-C for NAFLD in normal or low body weight women was 6.8, with a AUC of 0.827 (0.810–0.843), a sensitivity of 78.1% and specificity of 72.1 %.

The differences of TyG and TG/HDL-C in diagnostic efficacy between men and women may be caused by the different distribution of HDL-C in gender, which had dose-response relationship with IR and the risk of NAFLD [32–34]. In our study, the level of HDL-C in men was lower than that in women (men, 1.36 ± 0.32 mmol/L vs women, 1.58 ± 0.35 mmol/L, $P < 0.0001$), and the prevalence of low HDL-C in men was significantly higher than that in women (men, 11.8% vs women, 3.9%, $P < 0.0001$). A nationally representative survey [35] of 163,641 Chinese adults also found low HDL-C and high TG were the primary forms of dyslipidemia, and the prevalence of low HDL-C in men was much higher than that in women. In the Chinese population, low HDL-C mainly affects men. This may be the reason why TG/HDL-C is weaker than TyG in identifying NAFLD, while in men, TG/HDL-C is as effective as TyG. We also found a phenomenon that the mean age of women with NAFLD was older than that of without NAFLD, while the mean age of men with NAFLD was younger than that of without NAFLD. This may be related to different exercise and eating habits of men in different ages.

This research has some advantages, for instance, the relative large sample size and the subgroups analysis. However, there are several limitations in the present study. First of all, we diagnosed NAFLD using ultrasonography, which has limited in detecting mild liver steatosis. However, this noninvasive method is still widely used in clinical practice. Secondly, the study was cross-sectional in design, therefore, a causal relationship cannot be obtained. Thirdly, information about IR was unavailable in our study, which may be potential link.

Conclusions

TG/HDL-C is as effective as TyG in predicting NAFLD in Chinese men. TyG is superior to TG/HDL-C in identifying NAFLD in Chinese overweight and obese women. While in Chinese normal and low weight women, TyG-HDL-C is a better predictor for NAFLD.

Abbreviations

AUC: area under the ROC curve; BMI: body mass index; DBP: diastolic blood pressure; FPG: fasting plasma glucose; HCY: homocysteine; HDL-C: high-density lipoprotein cholesterol; LDL-C: low-density

lipoprotein cholesterol; NAFLD: nonalcoholic fatty liver disease; OR: odds ratio; ROC: receiver operator characteristic; SBP: systolic blood pressure; SUA: serum uric acid; TC: total cholesterol; TG: triglycerides; TG/HDL-C: TG to HDL ratio

Declarations

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Availability of data and materials

The datasets analyzed during the current study are available from the corresponding author on reasonable request.

Authors' contributions

Jinyan Ren and Fei Gao took part in study design and writing the manuscript. Xinfeng Wang and Yingmei Zheng collected the data. Hui Li and Xuan Yang performed the statistical analyses. All authors also read and approved the final version of this manuscript.

Competing interests

The authors declare that they have no competing interests.

Consent for publication

Not applicable.

Ethics approval and consent to participate

This study was approved by institutional review board of the Affiliated Hospital of Qingdao University, and the informed consent requirement was exempted because of our retrospective estimation of de-identified database.

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Figures

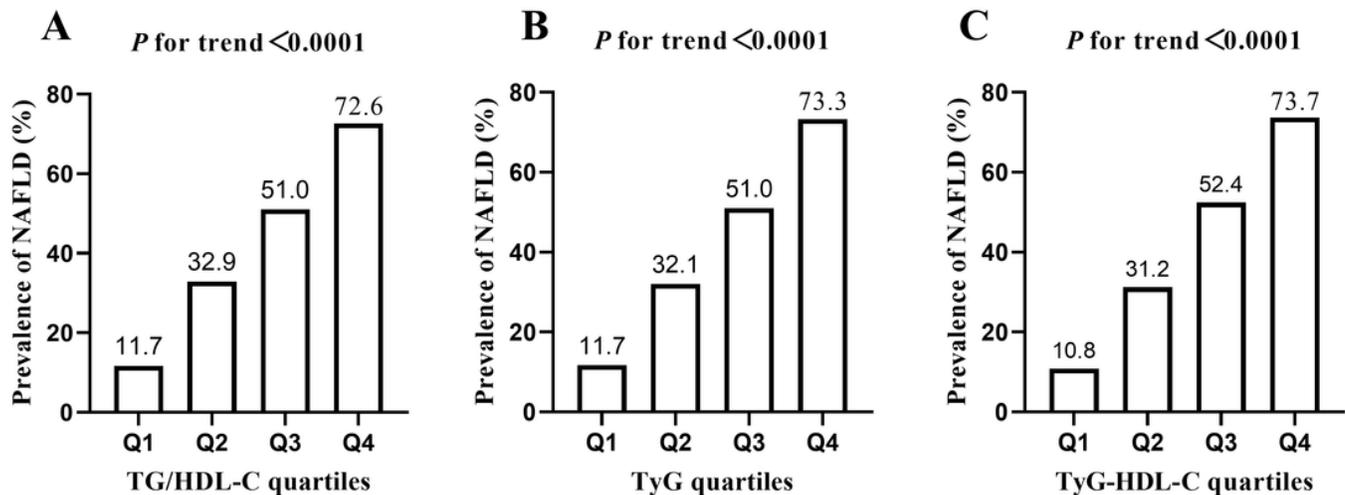


Figure 1

Prevalence of NAFLD according to the quartiles of TG/HDL-C (A), TyG(B) or TyG-HDL-C (C). Classification of TG/HDL-C quartiles: Q1 (~0.57), Q2 (0.58~0.90), Q3 (0.91~1.48), Q4 (1.49~); TyG quartiles: Q1 (~8.17), Q2 (8.18~8.59), Q3 (8.60~9.04), Q4 (9.05~); TyG-HDL-C quartiles: Q1 (~6.59), Q2 (6.60~7.16),

Q3 (7.17~7.73), Q4 (7.74~). NAFLD, nonalcoholic fatty liver disease; Q1, first quartile; Q2, second quartile; Q3,third quartile; Q4, fourth quartile

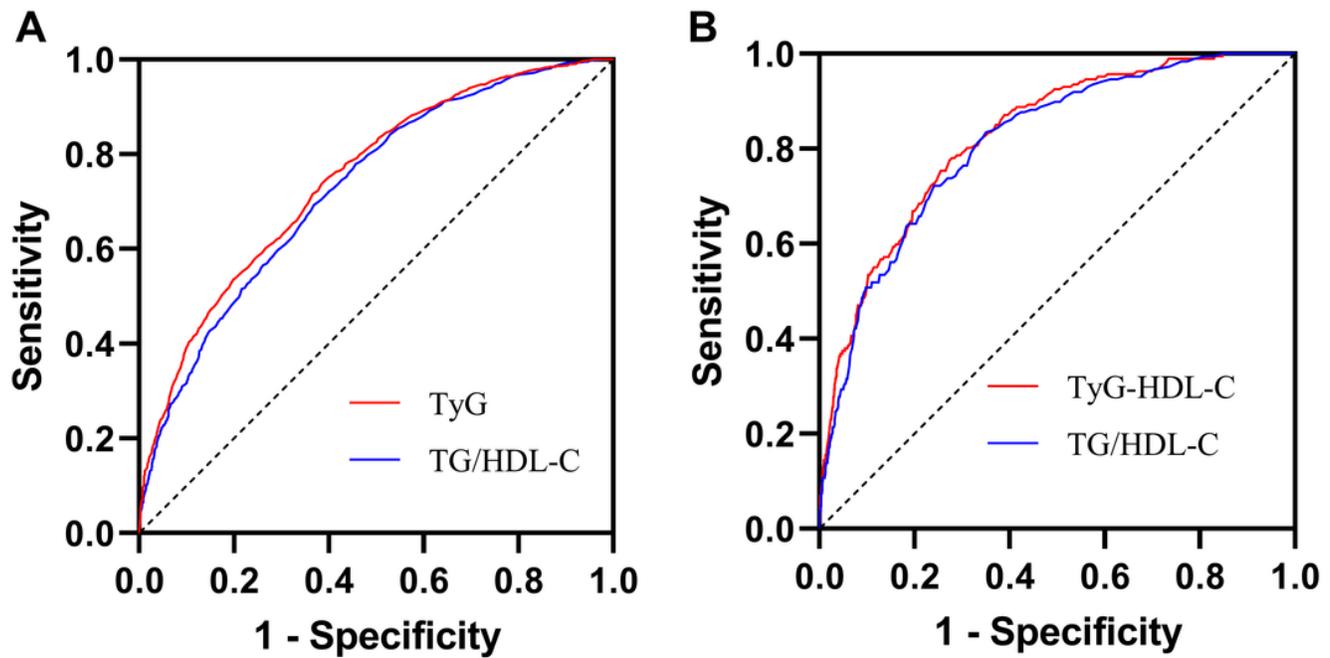


Figure 2

ROC curves for NAFLD in women. A ROC curves in overweight and obese women. The AUC of TyG and TG/HDL-C were 0.748 (95% CI 0.732–0.763), 0.724 (95% CI 0.712–0.744), respectively. P value for the difference was <0.0001. B ROC curves in normal and low weight women. The AUC of TyG-HDL-C, and TG/HDL-C were 0.827 (95% CI 0.810–0.843), 0.813 (95% CI 0.796–0.830), respectively. P value for the difference was =0.0015.