Association between insulin resistant surrogate index and arterial stiffness in hypertensive population: a five year follow-up cohort study

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Original investigation

Keywords: TyG, TG/HDL-C, hypertension, arterial stiffness, cohort, Cox regression

Posted Date: December 10th, 2020

DOI: https://doi.org/10.21203/rs.3.rs-123782/v1

Abstract

Background

Causal association between triglyceride-glucose (TyG) index and triglyceride to high-density lipoprotein cholesterol (TG/HDL-C) ratio with arterial stiffness remains unclear. This study aims to assess the effect of TyG index and TG/HDL-C ratio on the incidence of arterial stiffness in hypertensive population, and identify the susceptible subgroups.

Methods

This study enrolled 1201 hypertensive participants without arterial stiffness aged 18 or above in 2013 and 2014 as baseline. Physical examination and biochemical test including fasting blood glucose (FBG), TG, HDL-C were measured. The TyG index was denoted as ln[TG*FBG/2]. Incident arterial stiffness cases were confirmed during the following annual examination by brachial-ankle pulse wave velocity (baPWV, > 1800 cm/s), until December 31 of 2019. The Cox model was used to explore the association of TyG index and TG/HDL-C ratio with the arterial stiffness.

Results

During a mean follow-up of 5.09 years, 430 cases of arterial stiffness were confirmed. In the multivariate Cox model, the higher TyG index and TG/HDL-C ratio were positively associated with a higher risk of arterial stiffness (adjusted HR for per-unit increase: 1.39 and 1.08, $P < 0.05$). The adjusted HR (95% CI) comparing participants in the highest quartile versus lowest quartile of TyG and TG/HDL-C ratio were 1.51 (1.10–2.07) and 1.08 (1.01–1.15), respectively. This positive linear association of evaluated TyG index and TG/HDL-C ratio with arterial stiffness was confirmed using restricted cubic spline function. The observed association was stronger in subgroups with overweight, co-diabetes and poor blood pressure control (systolic pressure ≥ 140 mmHg or without anti-hypertension medication).

Conclusion

The elevated TyG index and TG/HDL-C ratio independently increased the future risk of arterial stiffness in hypertensive population. Monitoring TyG index and TG/HDL-C ratio deserves more attention in clinical practice, especially in the population with overweight, co-diabetes and poor blood pressure control.

Introduction

Hypertension has caused a heavy economic burden worldwide, becoming a challenging public health issue. In 2010, 31.1% of the adults around the world were reported to have hypertension [1]. Among Chinese adults aged 35–75 years, nearly half are diagnosed with hypertension and the incidence is still

steadily increasing and the onset age is becoming younger [2]. Among hypertension patients, arterial stiffness is a common complication, which is also an independent risk factor and predictor of other cardiovascular and cerebrovascular diseases [3, 4]. Therefore, it is of great importance to focus on the occurrence of arterial stiffness in hypertension patients, and identify the early risk factor for arterial stiffness [5–7].

Disorder of glucose and lipid metabolism is a common pathophysiological feature accompanying hypertension patients, while insulin resistance (IR) participants in this biological process extensively [8]. The hyperinsulinemic euglycemic clamp is the golden standard for evaluating the status of IR [9]. However, this assessing method is expensive and complex, which in fact is not ideal for routine clinical monitoring. Recently, some novel and simple indicators have been reported to be reliable surrogate indexes of IR, such as triglyceride-glucose (TyG) index and the triglyceride to high-density lipoprotein cholesterol (TG/HDL-C) ratio, and lots of studies have found that these surrogate indexes are independent risk factors of some cerebro-cardiovascular diseases [10–13]. Moreover, the IR related indexes are indicated to be associated with arterial stiffness [14–18]. However, these studies are all based on general populations. Recently, Li et al. [19], found that TyG index is positively associated with arterial stiffness in hypertension patients. However, this study is a cross-sectional study, which makes the causality unclear. Moreover, the relation between TG/HDL-C ratio and arterial stiffness remains unclear yet.

Therefore, we aimed to comprehensively investigate the association between TyG index and TG/HDL-C ratio with the incidence of arterial stiffness in hypertensive population during a five years follow-up, based on a prospective cohort design. And we proposed that some subgroups were under stronger influence of TyG index and TG/HDL-C ratio.

Method

Study design and participants

Beijing health management cohort study (BHMC) is an ongoing community-based prospective cohort study established in 2008, specially designed to investigate the risk factors and blood biomarkers for metabolism-related diseases, such as hypertension and diabetes. The BHMC study was conducted in Beijing, China, and the recruited participants underwent a comprehensive annual health examination, face-to-face questionnaire survey and blood sample collection. Details of the study design have been described previously [20]. Of 62,311 participants who underwent health examination in 2013 or 2014 (at baseline), 8,063 were diagnosed with hypertension. To minimize the possible effect of reverse causality, we excluded 2,167 participants with an ankle-brachial index (ABI) <0.90 and 2,984 participants with brachia-ankle pulse wave velocity (baPWV) <1800 cm/s, Then, 688 participants using glucose-lowering medication, 231 participants using lipid-lowering medication, 784 participants unable to collect the required information at baseline and 11 participants lost to follow up were further excluded. Finally, this

study was restricted to a subset of 1201 participants with complete data and considered in the final analyses as shown in **Figure 1**.

This study was in accordance with the principles of the Declaration of Helsinki and was approved by the Ethics Committee of Capital Medical University. All participants provided their written informed consents before taking part in this study.

Data collection and definitions

Sociodemographic characteristics and lifestyles were collected via a standard questionnaire by trained staffs, including age, sex, smoking status, drinking status, physical activity levels and previous medical diagnoses. Smoking and drinking status was defined as 'current' and 'never or former'. Physical activity was classified as '>80 minutes per weak' and '<80 minutes per week or none'. The physical and biochemical examination data were acquired from the electronic medical record system. Body mass index (BMI) was calculated weight (in kilograms)/height*height (in meters squared). Waist hip ratio (WHR) was defined as waist (in centimeter)/hip (in centimeter). Systolic blood pressure (SBP) and diastolic blood pressure (DBP) were presented as the average of two measurements on the right arm using a sphygmomanometer after resting for at least 10 min. Hypertension status was defined as SBP ≥140 mmHg or DBP ≥90 mmHg or use of any anti-hypertension medication, or self-reported history of hypertension diagnosis.

Blood samples were stored and measured in the central laboratory of Beijing Xiaotangshan Hospital using the Olympus Automatic Biochemical Analyzer (Hitachi 747; Tokyo, Japan). Serum total cholesterol (TC), triglyceride (TG), high density lipoprotein cholesterol (HDL-C), and low density lipoprotein cholesterol (LDL-C) were measured with the enzymatic color-metric method. The estimated glomerular filtration rate (eGFR) was calculated using the Chronic Kidney Disease Epidemiology Collaboration (CKD-EPI 2009) serum creatinine equation [21]. Fatty liver was diagnosed by ultrasonic examination. The fasting blood glucose (FBG) was defined as the glucose concentrations before breakfast after overnight fasting (no food, except drinking water, for at least 8-10 hours), while two-hour postprandial blood glucose (PBG) was measured after 2 hours from the beginning of fixed meals through finger blood test. Diabetes was defined as FBG ≥7.0 mmol/l or PBG ≥11.1 mmol/l or the glycated hemoglobin (HbA1c) ≥6.5% or use of any glucose-lowering medication or self-reported history of diabetes.

The TyG index was denoted as ln[TG (mm/L)*fasting glucose (mm/L)/2]. The TG/HDL-C ratio was calculated as TG (mm/L) divided by HDL-C (mm/L).

Assessment of arterial stiffness

Arterial stiffness refers to the measurement of baPWV, which is a simple, noninvasive, automatic method and widely used in the clinical practice and large population-based studies. The baPWV was measured with Omron Colin BP-203RPE III device (Omron Health Care, Kyoto, Japan). After more than 5 minutes' rest in supine position, 4 cuffs were wrapped around bilateral brachia and ankles, then connected to a

plethysmographic sensor and oscillometric pressure sensor. ABI refers to the ratio of the ankle SBP divided by the brachial SBP. Semiconductor pressure sensors were used to assess the transmission time between the initial rises in both the brachial and tibial arteries waves in order to record pressure waveform. The distance between sampling points of baPWV was determined based on the height of the subjects. The baPWV was calculated according to the formula (La-Lb)/Tba. La is the path length from the heart to the ankle, Lb is the path legth from the heart to the brachium, and Tba is the time interval between the brachial and ankle waveform. The measurement was performed twice by two trained technicians, and the average value of the left and right sides was calculated as the final result. The incidence of arterial stiffness was confirmed with a BaPWV >1800 cm/s [22].

Statistical analysis

Baseline characteristics are presented as the mean (standard deviation, SD), median [interquartile range, IQR] or number (percentage). Differences between incident arterial stiffness and non- arterial stiffness groups were compared using Student's t-test or Mann-Whitney U test for continuous variables and Pearson's chi-sqaure test or Fisher's exact test for categorical variables.

The Cox proportional hazards regression models were used to estimate the association of TyG index and TG/HDL-C ratio with arterial stiffness in hypertensive population. TyG index and TG/HDL-C ratio categorized in quartile were also analyzed. The restricted cubic spline function was performed to illustrate to linear or non-linear correlation. To adjust for potential confounding factors, three models were established as follows: Model 1 adjusted for age and sex; Model 2 adjusted for age, sex, BMI, WHR, SBP and DBP; Model 3 further adjusted for eGFR, uric acid, homocysteine, smoking status, drinking status, physical activity, diabetes, fatty liver and use of anti-hypertension medication. The hazard ratio (HR) and 95% confidence interval (CI) were presented. The partial Spearman's correlation coefficients between TyG index and TG/HDL-C ratio, and other common cardiometabolic risk factors were presented, after adjusted for age and sex.

To identify the effect modifying factors, we conduct subgroup analyses. The factors, by which the observed association was significantly amplified or concealed, were referred as potential effect modifiers. All the analyses presented above were conducted using R software (version 3.6.3). The difference was considered statistically significant at two-side $P < 0.05$.

Data availability

The data of this cohort study are available to researchers on request by contacting with the corresponding author (Dr. Guo).

Results

The final sample included 1201 participants. The mean age of the population was 62.21 ± 13.70 years. Until December 31 of 2019, 430 arterial stiffness occurred with a mean follow-up of 5.09 years. The

incidence rate of arterial stiffness in this hypertensive population was 7.03 per 100 person-years. There was a significant difference between the incident arterial stiffness and non-arterial stiffness group in age, BMI, blood pressure, blood glucose level, TG, HDL-C, LDL-C, eGFR, homocysteine, co-diabetes or not, with fatty liver or not and taking anti-hypertension medication or not. The level of TyG index and TG/HDL-C ratio were significantly higher in participants with arterial stiffness. The detailed information of the baseline characteristics were presented in Table 1.

Table 1
Baseline characteristics of the study population.

	Total (n = 1201)	No incident artery stiffness (n = 771)	Incident artery stiffness (n = 430)	P value
Age(year)	62.21(13.70)	56.81(12.36)	71.90(10.20)	< 0.001
Sex(male,%)	1002(83.4)	641(83.1)	361(84.0)	0.777
BMI	26.60(3.18)	26.95(3.14)	25.97(3.15)	< 0.001
WHR	0.92(0.06)	0.92(0.06)	0.93(0.06)	0.117
Current smoking(Yes, %)	295(24.6)	204(26.5)	91(21.2)	0.048
Current drinking(Yes, %)	746(62.1)	485(62.9)	261(60.7)	0.488
Physical activity(n,%)*				0.115
none or mild	868(72.3)	545(70.7)	323(75.1)	
moderate or higher	333(27.7)	226(29.3)	107(24.9)	
SBP(mmHg)	145.23(12.45)	143.44(12.40)	148.44(11.90)	< 0.001
DBP(mmHg)	78.58(11.51)	81.06(11.24)	74.13(10.63)	< 0.001
FBG(mmol/L)	5.82(1.45)	5.68(1.27)	6.08(1.69)	< 0.001
PBG (mmol/L)	7.89(2.68)	7.45(2.30)	8.68(3.10)	< 0.001
HbA1c(%)	5.93(0.87)	5.83(0.76)	6.11(1.01)	< 0.001
Triglyceride(mmol/L)	1.74(1.37)	1.86(1.51)	1.52(1.02)	< 0.001
Total cholesterol(mmol/L)	4.72(0.97)	4.76(0.97)	4.66(0.96)	0.067

Data are the mean(SD), median[IQR] or number (%).

BMI, body mass index; WHR, waist hip ratio; SBP, systolic blood pressure; DBP, diastolic blood pressure; FBG, fasting blood glucose; PBG, postprandial blood glucose; HDL-C, high-density lipoprotein cholesterol; LDL-C, low-density lipoprotein cholesterol; eGFR, estimated glomerular fltration rate; TyG, triglyceride glucose.

* none or mild defined as ‘<80 minutes per week or none’; moderate or higher as ‘>80 minutes per weak’.

	Total (n = 1201)	No incident artery stiffness (n = 771)	Incident artery stiffness (n = 430)	P value
HDL-C(mmol/L)	1.27(0.34)	1.25(0.33)	1.30(0.36)	0.016
LDL-C(mmol/L)	3.05(0.85)	3.09(0.84)	2.97(0.87)	0.019
eGFR(mL/min per 1.73 m^2)	87.9[75.7,101.1]	90.3[78.2,103.4]	81.6[71.2,96.8]	< 0.001
Homocysteine(μmol/L)	12.1[8.6,14.7]	12.10[8.6,14.7]	11.9[8.50,13.9]	0.025
Uric acid(μmol/L)	368[315,422]	368[318,420]	371[312,423]	0.984
Diabetes(Yes,%)	231(19.2)	110(14.3)	121(28.1)	< 0.001
Fatty liver(Yes,%)	694(57.8)	488(63.3)	206(47.9)	< 0.001
anti-hypertension (Yes,%)	214(17.8)	162(21.0)	52(12.1)	< 0.001
TyG index	1.37[0.99,1.76]	1.28[0.94,1.68]	1.42[1.06,1.79]	0.003
TG/HDL-C ratio	1.15[0.74,1.78]	1.03[0.64,1.59]	1.25[0.79,1.92]	< 0.001
Data are the mean(SD), median[IQR] or number (%).				
BMI, body mass index; WHR, waist hip ratio; SBP, systolic blood pressure; DBP, diastolic blood pressure; FBG, fasting blood glucose; PBG, postprandial blood glucose; HDL-C, high-density lipoprotein cholesterol; LDL-C, low-density lipoprotein cholesterol; eGFR, estimated glomerular fltration rate; TyG, triglyceride glucose.				
* none or mild defined as '<80 minutes per week or none'; moderate or higher as '>80 minutes per weak'.				

We observed a positive association of TyG index and TG/HDL-C ratio with arterial stiffness in the fully adjusted model (Model 3) and the adjusted HR for per-unit increase was 1.387 (95% CI: 1.138–1.690) and 1.079 (95% CI: 1.012–1.151), respectively. Moreover, for the highest quartile in TyG index compared with the lowest quartile, the risk of arterial stiffness increased by 51% (HR: 1.51; 95% CI: 1.101 to 2.070). The risk of arterial stiffness increased by 45.8% (HR: 1.458; 95% CI: 1.075 to 1.977) when comparing the highest quartile to lowest quartile of TG/HDL-C ratio. The detailed results were shown in Table 2. There was consistent positive association of the TyG index and arterial stiffness incidence as shown in Fig. 2**(a)**. The similar result was observed for TG/HDL-C ratio in Fig. 2**(b)**.

Table 2
Association of TyG index and TG/HDL-C ratio with artery stiffness in hypertensive population.

	TyG index		TG/HDL-C ratio	
	HR (95% CI)	P value	HR (95% CI)	P value
Model 1				
quartile 1				
quartile 2	1.05(0.813–1.356)	0.710	1.008(0.782-1.3)	0.949
quartile 3	1.187(0.91–1.547)	0.206	1.072(0.824–1.394)	0.605
quartile 4	1.504(1.137–1.989)	0.004	1.414(1.062–1.884)	0.018
Per-unit increase	1.368(1.145–1.634)	0.001	1.081(1.014–1.152)	0.017
Model 2				
quartile 1				
quartile 2	1.075(0.828–1.395)	0.589	1.009(0.778–1.308)	0.948
quartile 3	1.224(0.931–1.607)	0.147	1.091(0.834–1.428)	0.525
quartile 4	1.527(1.141–2.043)	0.004	1.405(1.046–1.888)	0.024
Per-unit increase	1.38(1.15–1.656)	0.001	1.071(1.006–1.139)	0.032
Model 3				
quartile 1				
quartile 2	1.065(0.814–1.392)	0.648	1.087(0.834–1.419)	0.537
quartile 3	1.263(0.948–1.682)	0.110	1.22(0.92–1.618)	0.167
quartile 4	1.51(1.101–2.07)	0.010	1.458(1.075–1.977)	0.015
Per-unit increase	1.387(1.138–1.69)	0.001	1.079(1.012–1.151)	0.021
Model 1: adjusted age and sex;				
Model 2: model 1 and BMI, WHR, SBP, DBP;				
Model 3: model 2 and smoking status, drinking status, physical activity, serum uric acid, serum homocysteine, eGFR, diabetes, fatty liver, use of anti-hypertension medication.				

The results of correlation coefficients between the TyG index and TG/HDL-C ratio with other common cardiometabolic risk factors were described in Fig. 3. There were weak or no correlation between TyG index with BMI, WHR, SBP, DBP, FBG, PBG, TC, LDL-C, HDL-C, serum uric acid, eGFR and homocysteine (Spearman' coefficients less than 0.5), after adjusted for age and sex, apart from TG. Similar results were observed for TG/HDL-C ratio.

We performed stratified analyses to assess the risk effect of TyG index and TG/HDL-C ratio in different subgroups. The strength of association between the TyG index and arterial stiffness was stronger in BMI abnormal and diabetes coexistent group, than people with normal BMI and without diabetes. However, given blood pressure, we only observed significant association in subgroups of SBP ≥ 140 mmHg or without anti-hypertension medication. The results were similar for TG/HDL-C ratio as shown in Fig. 4**(a,b)**. The detailed results of three models in subgroup analyses were presented in **Supplementary Table S1.**

Discussion

In this prospective cohort study, we found that higher TyG index and TG/HDL-C ratio were associated with the elevated risk of arterial stiffness in hypertensive population during a mean follow-up of 5.09 years. The observed associations were still significant after the important confounding factors adjusted, including age, BMI, blood pressure related factor, lifestyle, serum uric acid, serum homocysteine, eGFR, diabetes or not and fatty liver or not, which were also the traditional cardiometabolic risk factors. In additional, we indicated that the hypertensive people with abnormal BMI, co-diabetes or poorly controlled blood pressure were more susceptible to the evaluated TyG index and TG/HDL-C ratio.

The TyG index and TG/HDL-C ratio, as reliable surrogate indexes of IR, has been of increasing interest at present. These two indicators own a high possibility to be easily applied into clinical practice for early detection of IR, arterial stiffness and even more other diseases. In recent years, there are also some studies that investigated the underlying biochemical mechanisms of TyG index and TG/HDL-C ratio. Klaus G. Parhofer et al. [23] reported that elevated triglyceride levels lead to an increase of free fatty acids, and the flow of free fatty acids from adipose tissue to non-fatty tissue may lead to the appearance of IR. Christian et al. [24] analyzed data from the Whitehall II study and found that the increase of hyper sensitive C-reactive protein (hsCRP) is related to the increase of fasting serum insulin and IR. These researches indicate that TyG index and TG/HDL-C ratio are promising markers for future screening of metabolic diseases.

Artery stiffness is of high incidence in hypertensive population. On the other hand, arterial stiffness can lead to microvascular complications and a series of organic damage, such as cerebrovascular diseases and renal damage [3, 25–27]. Moreover, research has found that arterial stiffness is positively correlated to the duration of diabetes mellitus in patients with hypertension [28]. Therefore, identifying early and reliable risk factors associated with artery stiffness in hypertensive population is of great importance. TyG index and TG/HDL-C ratio have been reported to be associated with artery stiffness in general population in previous studies. However, evidence in hypertensive population is scare, except for the study by Li et al. [17], which reported the TyG index as a risk factor for artery stiffness in hypertensive population based on a cross-sectional design. Our study supplemented the evidence of the causal association of TyG index and artery stiffness, based on a prospective cohort design. Moreover, we reported the TG/HDL-C ratio as a novel risk factor for artery stiffness for the first time.

Previous studies have also demonstrated the association of TyG index with cardiovascular, cerebrovascular and other metabolic diseases. In 2014, Fedchuk et al. [29] measured five steatosis biomarkers, including TyG index, fatty liver index (FLI), NAFLD liver fat score (NAFLD-LFS), hepatic steatosis index (HSI) and visceral adiposity index (VAI), and found that all five steatosis biomarkers could be contribute to the early diagnosis of steatosis and were correlated with IR. In the Northern Shanghai Study, Zhao et al. [16] got the conclusion that the elevated TyG index was significantly related with arterial stiffness and nephric microvascular damage, which supported the clinical application of TyG index for the assessment of vascular damage. In recent years, several studies have also reported that TyG index may predict several cardiovascular diseases, including acute coronary syndromes, symptomatic coronary heart disease (CHD) and ischemic stroke [30–34]. For TG/HDL-C ratio, in a 8-year period Japan Diabetes Complications Study, Hirohito Sone et al. [35] evaluated the conventional lipid variables, such as TG, nonHDLC, TC/HDL-C ratio, LDL-C/HDL-C ratio, TG/HDL-C ratio for the relationship with CHD. According to their analyses, all these variables could predict CHD events in men and women. Marcello et al. [36] carried out a cross-sectional study to investigate the association between IR, TG/HDL-C with CHD, and came to the conclusion that HOMA-IR, TG/HDL-C are positively associated with CHD and may be useful as high-specificity indicators of CHD for risk stratification. In our study, the TyG index and TG/HDL-C ratio were weakly correlated with other traditional cardiometabolic risk factors, such as blood pressure and glucose level, except for triglyceride. The TyG index and TG/HDL-C ratio may reflect the physiological status from a novel aspect, as these two IR surrogate indexes were correlated but not completely correlated with other risk factors, involving triglyceride. The underlying biological mechanism of TyG index and TG/HDL-C ratio warrants further study.

In this study, we found that the hypertensive population with abnormal BMI, co-diabetes or poorly controlled blood pressure (SBP ≥ 140 mmHg or no use of anti-hypertension medication) were more strongly affected by the evaluated TyG index and TG/HDL-C ratio. People with these specific characteristics should pay more attention to the TyG index and TG/HDL-C ratio in routine monitoring. Similarly, in another study, there shows an interaction between BMI, IR and blood pressure in the young hypertensive population [37], which is consistent with our research.

The strengths of the present study were the prospective cohort design to explore the causality between TyG index and TG/HDL-C ratio with the incidence of artery stiffness in hypertensive population, adjustment of the potential confounders, handling TyG index and TG/HDL-C ratio as both continuous variables and categorical variables to enhance the reliability of our findings, and the subgroup analyses to identify the susceptible populations. However, the results should be interpreted in the context of some limitations. First, the sample size was relatively small and the observed associations of this single-center study needed further validation in other cohorts. Second, our study was based on the Chinese population, more collaborations were needed to validate the generalizability of the results, and to evaluate the underlying biological mechanism of the effect of the TyG index and TG/HDL-C ratio on artery stiffness.

Conclusion

In summary, the elevated TyG index and TG/HDL-C ratio independently increased the future risk of arterial stiffness in hypertensive population, especially in the subgroups of overweight, co-diabetes and blood pressure poorly controlled population. Monitoring TyG index and TG/HDL-C ratio deserves more attention in clinical practice for the early prevention of arterial stiffness and other cardiovascular diseases in hypertensive population.

Declarations

Consent for publication: Not applicable.

Ethics approval and consent to participate

The study was approved by the Ethics Committees of Capital Medical University. All participants gave informed consent to participate before taking part. The number of the approval was 2020SY031.

Availability of data and materials

The datasets used and/or analysed during the current study are available from the corresponding author (Dr. Xiuhua Guo) on reasonable request.

Competing interest

The authors declare that they have no competing interests.

Funding

Our work was funded by the Program of Natural Science Fund of China (Number: 81530087, to XH. Guo) and the National Key R&D Program of China (Number: 2016YFC1302804, to XH. Guo).

Authors' contributions

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Acknowledgement

We thank all the staff and participants of the Beijing health management cohort and Beijing Xiaotangshan Hospital for their invaluable contributions.

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Figures

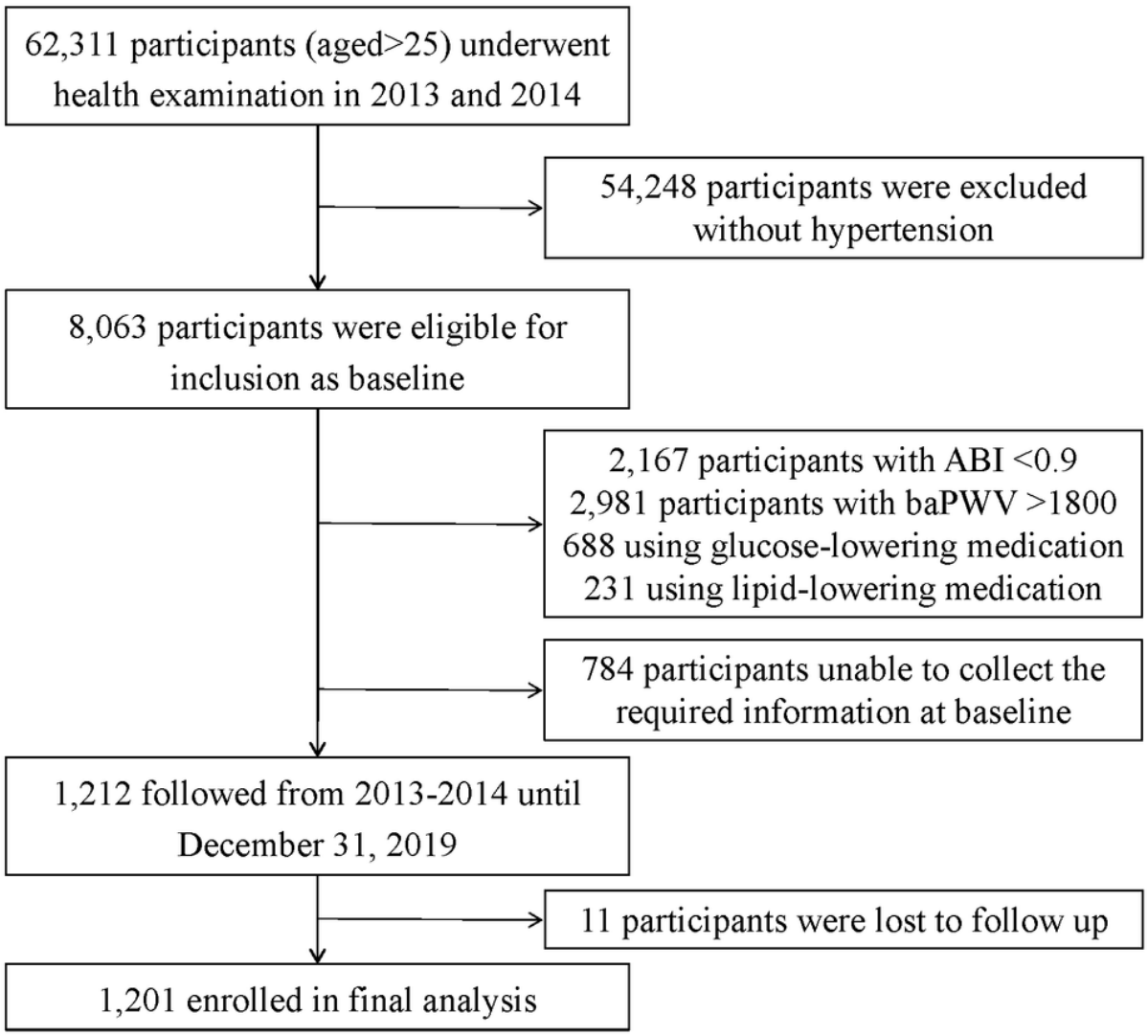
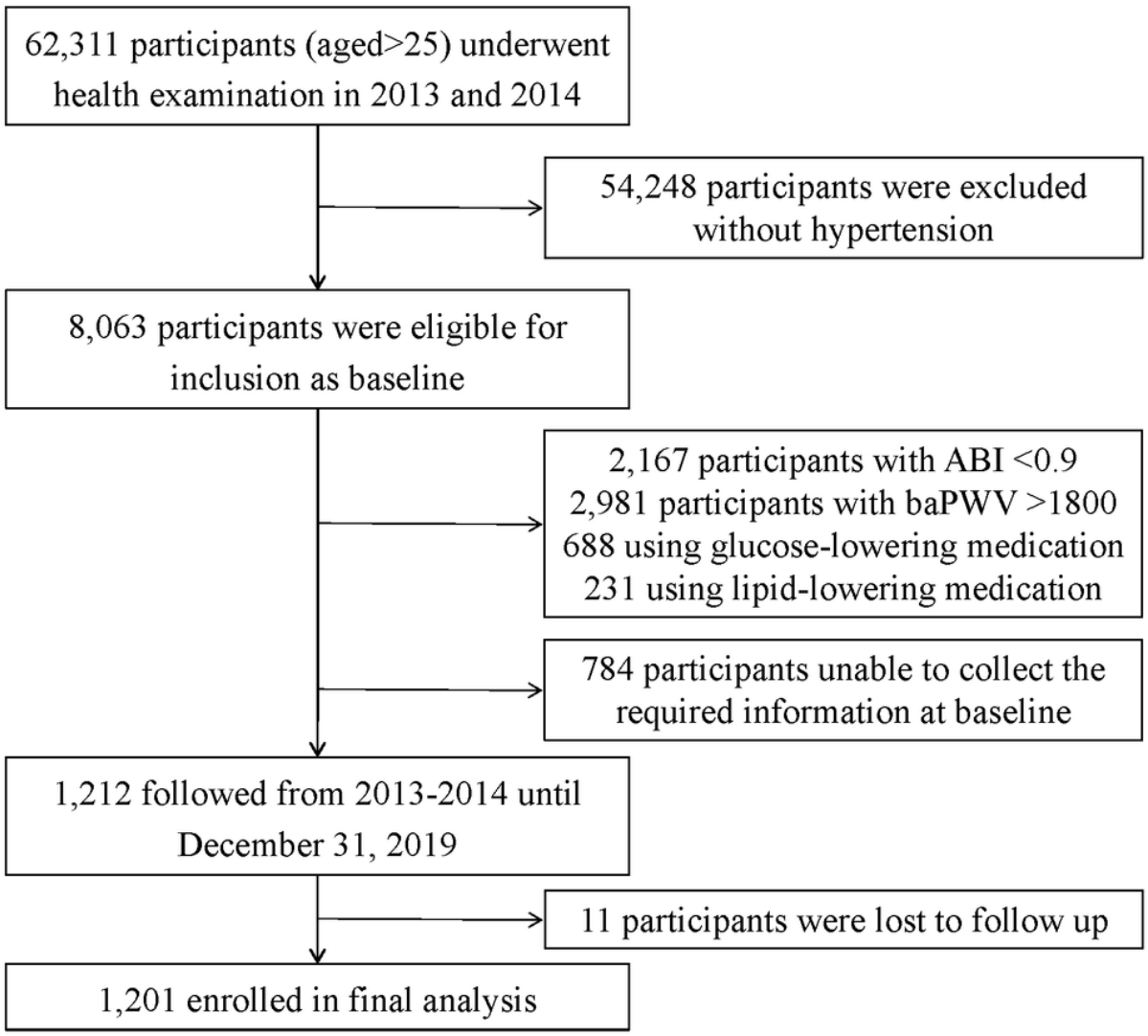


Figure 1

Flow chart of the study population.



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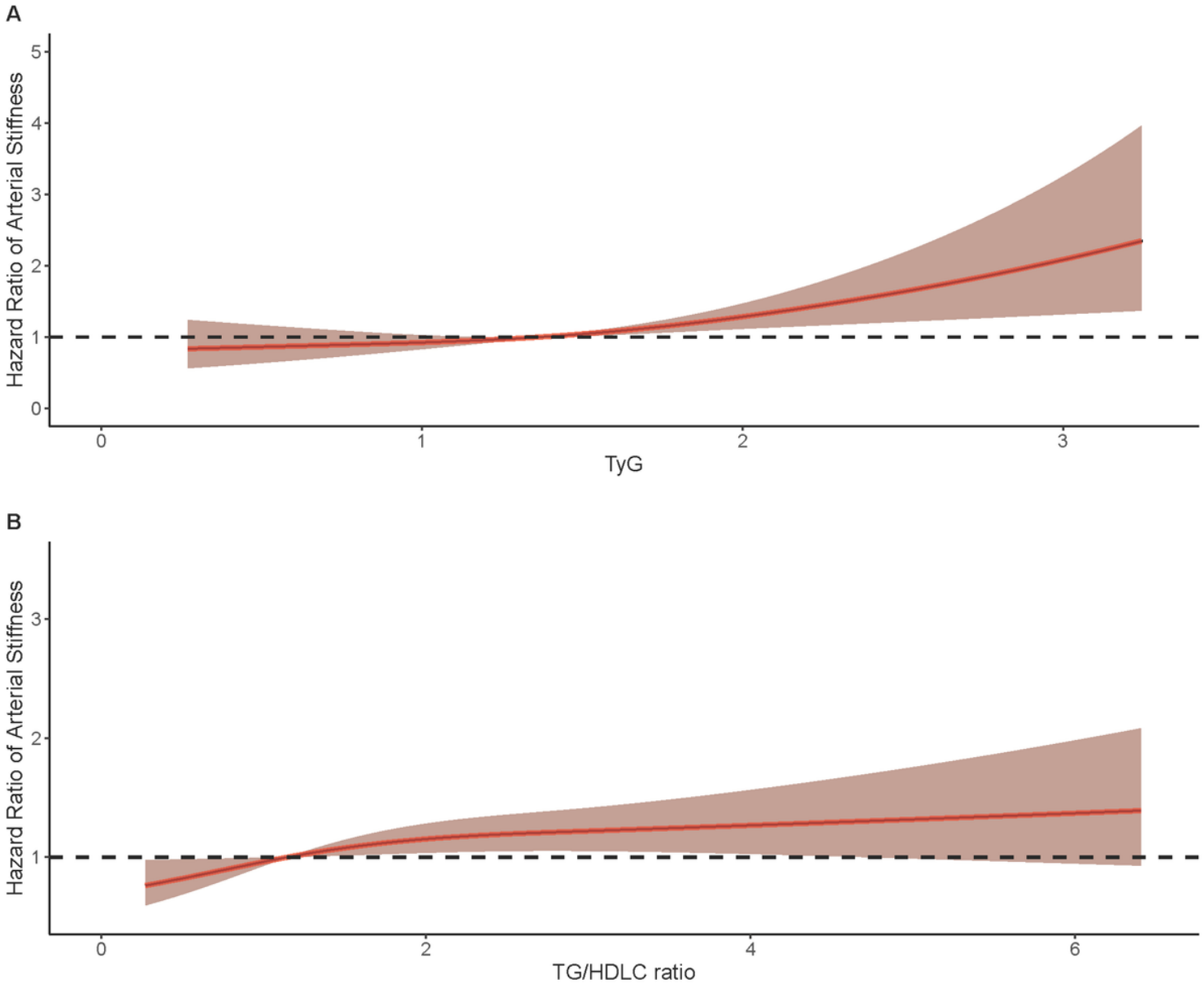
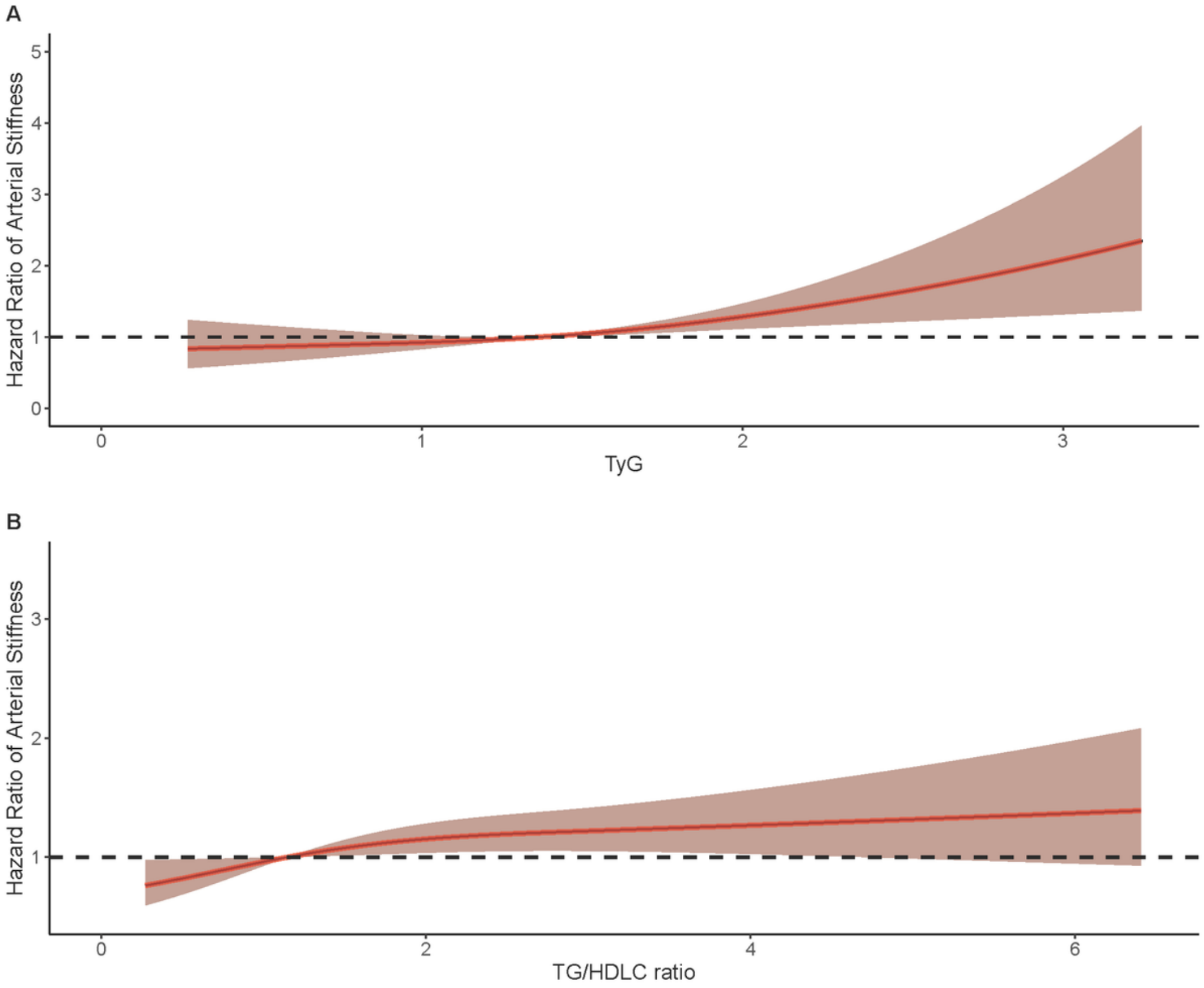


Figure 2

Dose-response correlation using restricted cubic spline function*. A: TyG index and artery stiffness; B: TG/HDL-C ratio and artery stiffness. * age, sex, BMI, WHR, SBP, DBP, smoking status, drinking status, physical activity, serum uric acid, serum homocysteine, eGFR, diabetes, fatty liver, use of anti-hypertension medication were adjusted in the model.



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	Spearman's coefficients		P value	
	TyG	TG/HDLC	TyG	TG/HDLC
BMI (kg/m^2)	0.238	0.113	<0.001	<0.001
WHR	0.266	0.201	<0.001	<0.001
SBP (mmHg)	0.085	0.049	0.003	0.091
DBP (mmHg)	0.076	0.031	0.008	0.290
FBG (mmol/L)	0.471	0.186	<0.001	<0.001
PBG (mmol/L)	0.402	0.204	<0.001	<0.001
TG (mmol/L)	0.818	0.844	<0.001	<0.001
TC (mmol/L)	0.339	0.235	<0.001	<0.001
LDLC (mmol/L)	0.171	-0.028	<0.001	0.329
HDLC (mmol/L)	-0.406	-0.448	<0.001	<0.001
Uric acid (umol/L)	0.218	0.201	<0.001	<0.001
eGFR (mL/min per 1.73 m^2)	-0.001	-0.053	0.983	0.069
Homocysteine (μmol/L)	-0.064	-0.032	0.026	0.275

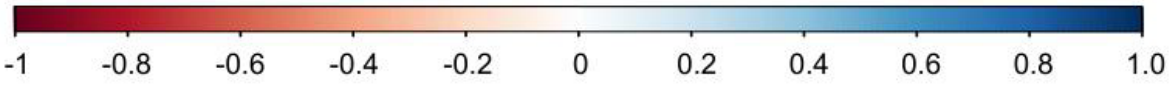

Figure 3

The partial correlation between TyG index and TG/HDL-C ratio with cardiometabolic risk factors*. * Spearman's coefficients were presented adjusted for age and sex.

	Spearman's coefficients		P value	
	TyG	TG/HDLC	TyG	TG/HDLC
BMI (kg/m^2)	0.238	0.113	<0.001	<0.001
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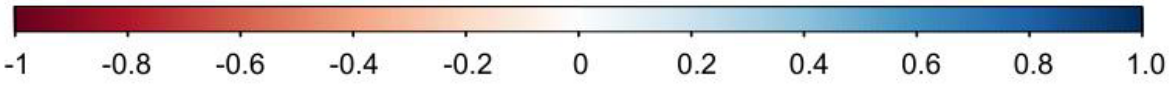

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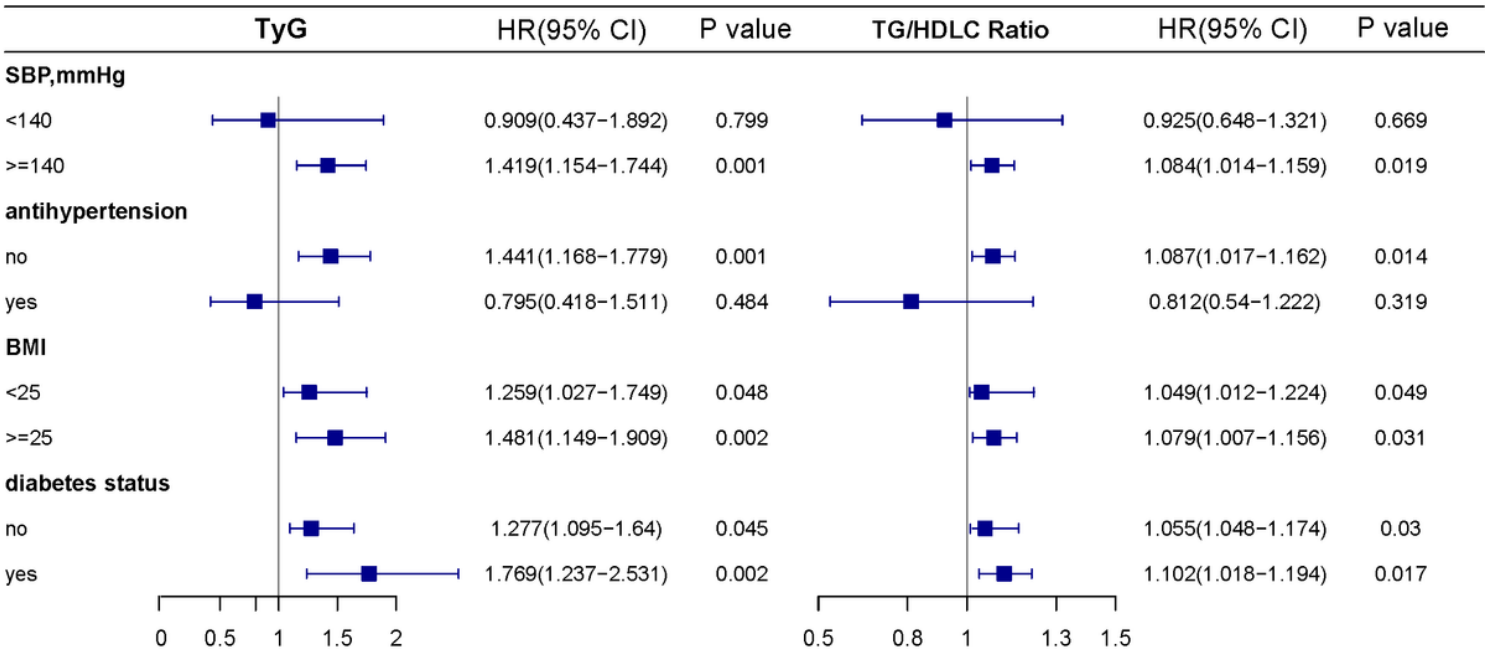
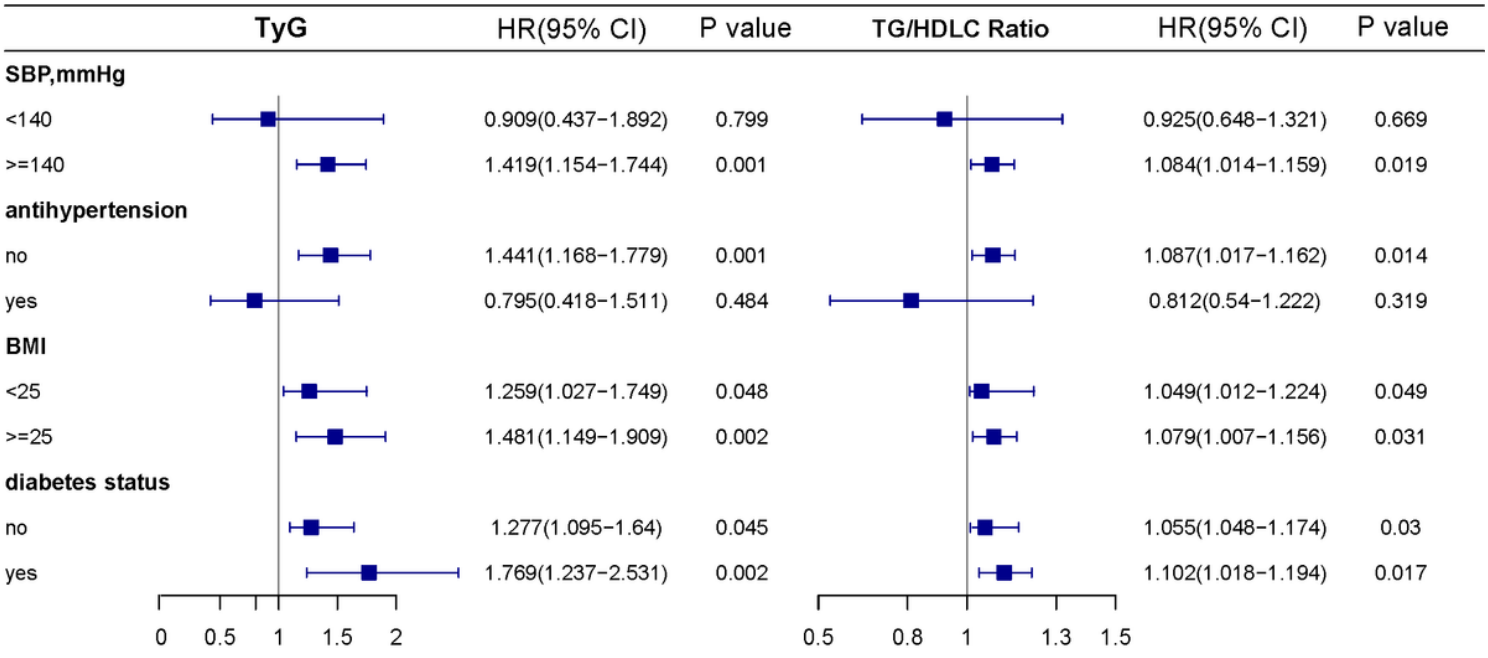


Figure 4

Forest plot for the association of TyG index and TG/HDL-C ratio with artery stiffness in subgroups*. * adjusted for age, sex, BMI, WHR, SBP, DBP, smoking status, drinking status, physical activity, serum uric acid, serum homocysteine, eGFR, diabetes, fatty liver, use of anti-hypertension medication, if not stratified.



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Supplementary Files

This is a list of supplementary files associated with this preprint. Click to download.

- SupplementaryTableS1.docx
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