The relationship between ratio of serum triglyceride to high-density lipoprotein cholesterol and frequency of sarcopenia in Chinese community adults

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Research

Keywords: sarcopenia, triglyceride, high-density lipoprotein cholesterol, Chinese community adults

Posted Date: August 19th, 2020

DOI: https://doi.org/10.21203/rs.3.rs-36062/v2

Version of Record: A version of this preprint was published on December 4th, 2020. See the published version at https://doi.org/10.1186/s12944-020-01422-4.

Abstract

Background In a previous study, the high ratio of serum triglyceride to high-density lipoprotein cholesterol (TG/HDL-C) was relevant to a high risk of sarcopenia in Korean old males. In this study, the purpose was to discover the correlation in Chinese community adults.

Methods Chinese adults who had physical examinations from May 2016 to August 2017 at the First Affiliated Hospital of Wenzhou Medical University were involved in this study. The univariable and multivariable analyses were applied to evaluate possible effect and an association was found in a subgroup analysis.

Results In total, 2613 adults were involved in the study, with 13.85% presenting sarcopenia. Individuals with TG/HDL-C ratios <2.78 or ≥2.78 were categorized as TG/HDL-C^{low} or TG/HDL-C^{high}, respectively. 1266 individuals were in high group and the remaining were in the low group. By univariate and multivariable analyses, the ratio of TG/HDL-C remained independent association with sarcopenia status(OR: 0.63; 95%CI: 0.49-0.81). Besides, the effect of the TG/HDL-C ratio kept significantly favorable (OR<1.00) in most subgroups, except in groups aged≥65 years and in the overweight population.

Conclusions The negative correlation between sarcopenia and TG/HDL-C ratio was discovered in Chinese community population, particularly in subjects aged <65 years and in non-overweight population.

Introduction

The reduction of muscle mass and function relevant to age, referred to “sarcopenia,” has drawn public attention all over the world (1-5). The Asian Working Group for Sarcopenia (AWGS) put forward a concept of sarcopenia in 2014. It referred to reduction of muscle mass and function, or low physical capability relevant to age (5). In 2019, AWGS regarded either reduced muscle strength or reduced physical capability as “possible sarcopenia”. Sarcopenia is incrementally general in the society, with a prevalence rate of 5.5%-25.7% (6-8). Sarcopenia has become a public health issue gradually.

Up to now, the potential mechanism of sarcopenia have not yet been fully expounded. Many variables, such as aging, inflammation, hormonal changes, and cachexia,

have been deemed to be causes of sarcopenia (9-15).

Serum lipid profile is commonly tested in a clinical setting, including fasting serum triglyceride (TG) and cholesterol. A meta-analysis by Jaekyung No *et al.* on sarcopenia and blood lipid profiles was recently published, which confirmed that TG had a positive relation with sarcopenia, whereas high-density lipoprotein cholesterol (HDL-C) had a negative effect (16). Tae-Ha *et al.* demonstrated that the higher ratio of TG/HDL-C was relevant to an increased rate of sarcopenia in elderly Korean men (17). Given this finding, the purpose of this research was to discover a potential correlation between serum lipid profile and sarcopenia in Chinese community adults.

Methods

Study population

This cross-sectional study involved in individuals having routine health examinations from May 2016 to August 2017 at the First Affiliated Hospital of Wenzhou Medical University. Subjects with age≥18, having serum lipid profile and bioelectrical impedance analysis (BIA) measures were involved in our study. Exclusion criteria included individuals with aged<18 years; taking lipid-lowering medicine; with a history of stroke, malignant tumor, chronic kidney or liver disease, or thyroid disease.

The research was agreed by the Institutional Review Board (IRB) of the hospital. Given its cross-sectional nature, the consent was waived by the IRB and the medical privacy was protected. All data were reviewed complying with the Declaration of Helsinki.

Data collection

Data regarding the health examinations were collected, including questionnaires concerning to lifestyles and pre-existing conditions, and results of BIA, blood, biochemical and anthropometric measurements.

Living habits contained smoking and drinking. Alcohol drinking higher than 70 g per week for women and higher than 140 g per week for men were regarded as heavy drinking. The 3 kinds of smoking status were defined as follows: current smoker (currently smokes and has smoked for at least the past 6 months or who abandoned smoking <2 years ago), past smoker (smoked in the past and had quitted smoking for at least 2 years) and never (never smoked).

Pre-existing conditions included diabetes mellitus (DM), hypertension (HTN), and hyperuricemia. DM was referred to random plasma glucose(PG), fasting plasma glucose (FPG) or 2-h PG equal or greater than 200 mg/dL, 126 mg/dL, or 200 mg/dL, respectively (18). Every individual took a blood pressure measure at the morning of medical examination, containing systolic blood pressure (SBP) and diastolic blood pressure (DBP). HTN was referred to SBP ≥140 mmHg or DBP ≥90 mmHg (19). Hyperuricemia was referred to serum uric acid (UA) levels higher than 6 mg/dL in females and higher than 7.0 mg/dL in males (20). Additionally, past morbidities included medical histories of DM, HTN or hyperuricemia or taking corresponding medications from self-reports.

To monitor appendicular skeletal muscle mass (ASM; kg), every subject carried out BIA detection (InBody770; InBody Japan Inc., Tokyo, Japan). Then, skeletal muscle mass index (SMI; kg/m^2) was computed through following formula: ASM(kg)/height^2 (m^2). Additionally, according to the AWGS 2019 Consensus(1), males with SMI lower than 7.0kg/m^2 and females with SMI lower than 5.7kg/m^2 were diagnosed as sarcopenia. Subjects with Body mass index (BMI) higher than 25 kg/m^2 were regarded as with status of overweight.

The following parameters were measured at the morning of medical examination: TG, HDL-C, low density lipoprotein cholesterol (LDL-C), total cholesterol (TC), glycated hemoglobin (HbA1c), FPG, albumin, UA, hemoglobin (Hb), leukocyte count (WBC) and platelet (PLT).

Statistical analysis

Continuous and categorical factors were displayed as medians (ranges) and frequencies (percentages), respectively. Through receiver operating characteristic (ROC) curves, the diagnostic accuracies of lipid profile for sarcopenia were assessed. The optimal indicator was selected, based on area under curve (AUC) and Youden index. The subjects were grouped according to the selected indicator(high and low group). The differences of the continuous factors were compared with the Mann-Whitney test, while the differences of the categorical factors was compared with the χ2 test. Through univariate and multivariate logistic regression models, the effects of the factors on the risk of sarcopenia were evaluated. Factors with a *P* value lower than 0.1 in the univariate analysis and factors and with clinical importance were brought into pursuant multivariable analysis. Subgroup analyses were also conducted to get rid of confound factors. In addition, individuals were stratified by quartiles, χ^2 test was utilized to compare the different rate of sarcopenia.

R version 3.6.1 was utilized to perform statistical analyses (https://www.r-project.org/). All analyses were 2-sided, and a *P* value <0.05 was regarded as significance level.

Results

Population features

In total, 2613 subjects were involved in the research. The medians of ASM and SMI were 20.14 (8.9-32.98) and 7.27 (4.35-11.50). The medians of TG and HDL-C were 127.44 (35.40-1896.56) and 45.23 (17.40-108.25). Other clinical features are shown in Table 1. Among 2613 subjects, 362 (13.85%) individuals were diagnosed with sarcopenia.

Cutoff of TG/HDL-C ratio and clinical features according to grouping

By ROC curves, TG, diagnostic performances of lipid profile were evaluated (Supplementary Figure). The cutoff for TG was 138.50 mg/dL with AUC of 0.63 and Youden Index of 0.2(sensitivity: 0.72; specificity: 0.48; *P*<0.01). The cutoff for HDL-C was 42.72 mg/dL with AUC of 0.64 and Youden Index of 0.22(sensitivity: 0.78; specificity: 0.44; *P*<0.01). The cutoff for TG/HDL-C ratios was 2.78 with AUC of 0.64 and Youden Index of 0.22(sensitivity: 0.67; specificity: 0.55; *P*<0.01). Regarding to Youden index and AUC, TG/HDL-C ratio was selected as the optimal indicator. Subjects were classified into TG/HDL^{low} group (TG/HDL-C ratio<2.78) and TG/HDL^{high} group (TG/HDL-C ratio≥2.78).

There were 1266 individuals in low group and 1347 in high group. In all, 243 (19.19%) in the low group and 119 (8.83%) in the high group were diagnosed with sarcopenia. The clinical features were displayed in Table 1. The high group showed higher ASM ($p<0.01$), SMI ($p<0.01$) and BMI ($p<0.01$), and a greater proportion of elderly ($p<0.01$) and male ($p<0.01$) subjects, compared to the low group.

Univariate and multivariate analyses

Univariable and multivariable analyses were utilized to assess the possible effect of clinical variables on sarcopenia. As depicted in Table 2, factors including the ratio of TG/HDL-C (high *vs.* low, OR: 0.63, 95% CI: 0.49-0.81), overweight status (yes *vs.* no, OR: 0.04, 95% CI: 0.04-0.07) and age (>65 *vs.* ≤65, OR: 2.10, 95% CI: 1.43-3.10) kept independent effects, with C-index of 0.73.

When the TG/HDL-C ratio was a continuous predictor in multivariable logistic regression analysis(Table 3), it continued to exert an independent effect on sarcopenia (OR: 0.75, 95%CI: 0.63-0.89), with C-index of 0.75.

Subgroup analyses

As shown in Table 2, confounding factors existed in the study, including overweight status and age. Besides, gender may be a confounder, as Chung *et al.* proposed that the risk of sarcopenia was related to the ratio of TG/HDL-C in males(17). Thus, these 3 factors were selected and included in subgroup analyses in this study, as shown in Fig 1.

In the age equal or lower than 65 subgroup, more individuals were diagnosed as sarcopenia in the low group(218 of 1174 individuals [18.57%] *vs.* 101 of 1246 [8.60%]). In both the male[94 of 564 individuals (16.67%) *vs.* 86 of 1050 (8.19%)] and female subgroups (149 of 702 individuals [21.22%] *vs.* 33 of 297 [11.11%]), the ratio continued to exert an independent effect. More individuals in the low group tended to be diagnosed as sarcopenia, among individuals with non-overweight status (240 of 1026 individuals [23.39%] *vs.* 115 of 701 [16.41%]). The effect kept favorable (OR<1.00) in most subgroups, except in subgroups aged≥65 years (OR: 0.58, 95%CI: 0.29-1.15)and in the overweight population (OR: 0.49, 95%CI: 0.11-2.22).

Correlation between rate of sarcopenia and the ratio of TG/HDL-C

Subjects were stratified by quartiles as Fig 2 showed. The rate of sarcopenia reduced as the TG/HDL-C ratio augmented ($p<0.01$). In addition, it was further validated by multivariate logistic regression model in TG/HDL-C quartiles that the exposure continued to be an independent factor (OR: 0.82, 95%CI: 0.73-0.92).

Discussion

The negative association between sarcopenia and the TG/HDL ratio was discover in this study. In a research by Tae-Ha *et al.*, the ratio of TG/HDL-C was positively relevant to the rate of sarcopenia in Korean old males, along with insulin resistance. However, this study was limited to older age and sex-based differences in general (17). A larger number of subjects were involved in our study, including men and women, with a median age of 48 years. It is possible that nationality and sex differences may have contributed to completely different results. Genetic and environmental factors among different populations contribute to interindividual variations in serum cholesterol and triglyceride levels. Previous studies have verified some special loci in different populations. For instance, there were novel loci near MYL2 and HECTD2 associated with HDL-C in Korean individuals (21). The missense variants at PNPLA3 and PKD1L3 were discovered to be correlated to TG and LDL-C in the Chinese population (22).

In subgroup analyses, TG/HDL-C didn't display a significant relationship with sarcopenia in subjects aged >65 years, which was discrepant with the study by Tae-Ha *et al.* (17). In this study, the proportion of individuals over 65 years old was 7.39%. We speculate that there may be a variable association related to age. Further studies regarding the relationship between the sarcopenia and ratio of TG/HDL-C related to age are required in the future.

The lipid profile, a widely used test, is a group of easy and economic parameters. Among lipid profile, it was found that medium-chain TG could be a feasible nutrient for sarcopenia, as medium-chain TG could enhance muscle strength through motivating ghrelin (23). Besides, it was proposed by Stella *et al.* that muscle loss could be attenuated by plasma TG, which was generated from omega 3 fatty acids. (24). HDL-C was discovered to be negatively relevant to muscle function improvement (25-27). According to these findings, a negative association between the ratio of TG/HDL-C and risk of sarcopenia should be took into account. Thus, appropriate supplementation of fatty foods could be good for building muscle function; however, further researches are needed to determine the degree of supplementation that is required.

Study strengths and limitations

This was a large cross-sectional study investigating in 2613 Chinese individuals, and provided new and opposite results compared to the Korean study (17). Our results indicate that the relationship may be relevant to different nationalities and territories.

However, there were some limitations. First, since its cross-sectional nature, causality could not be determined, and there is a possibility of reverse causality bias. Additionally, the study was not registered in a database of clinical studies. Second, due to the lack of data, the new definition was not taken into consideration, which proposed that the diagnosis of sarcopenia included 2 elements: low muscle mass and function (1). Third, many of the individuals involved in this study with age younger than 65 years and without any severe diseases. Thus, our results may not apply to older and critically ill patients. Finally, the cutoff was determined by the ROC curve, with restrictive sensitivity and specificity.

Conclusion

In general, a low ratio of TG/HDL-C was a potential risk marker for sarcopenia regardless of whether it is a continuous variable or a categorical variable. In clinical practice, to lessen the impact and frequency of sarcopenia, the supplementation of TG and control of HDL could be put into effect, especially in Chinese patients.

Prospective studies with more comprehensive data and a larger sample size are requisite to validate the relationship in the future.

Declarations

Ethics approval and consent to participate

The study was approved by the IRB of the First Affiliated Hospital of Wenzhou Medical University. Given its cross-sectional nature, the consent was waived by the IRB and the medical privacy was protected.

Consent for publication

Not applicable.

Availability of data and materials

The datasets used and analyzed during the current study will be provided by the corresponding author upon reasonable request.

Competing interests

The authors declare that they have no competing interests.

Funding

This study was supported by grants from the Wenzhou Municipal Sci-Tech Bureau's program(No.Y20170063).

Authors' contributions

Na Wang, Mengjun Chen, and Danhong Fang contributed to the conception and design of the work. Na Wang and Mengjun Chen contributed to the acquisition, analysis, or interpretation of data. Na Wang drafted the manuscript. Danhong Fang critically revised the manuscript. All authors gave final approval and are accountable for all aspects of the work and its integrity and accuracy.

Acknowledgements

Not applicable.

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Tables

Due to technical limitations, the tables are only available as a download in the supplemental files section.

Figures

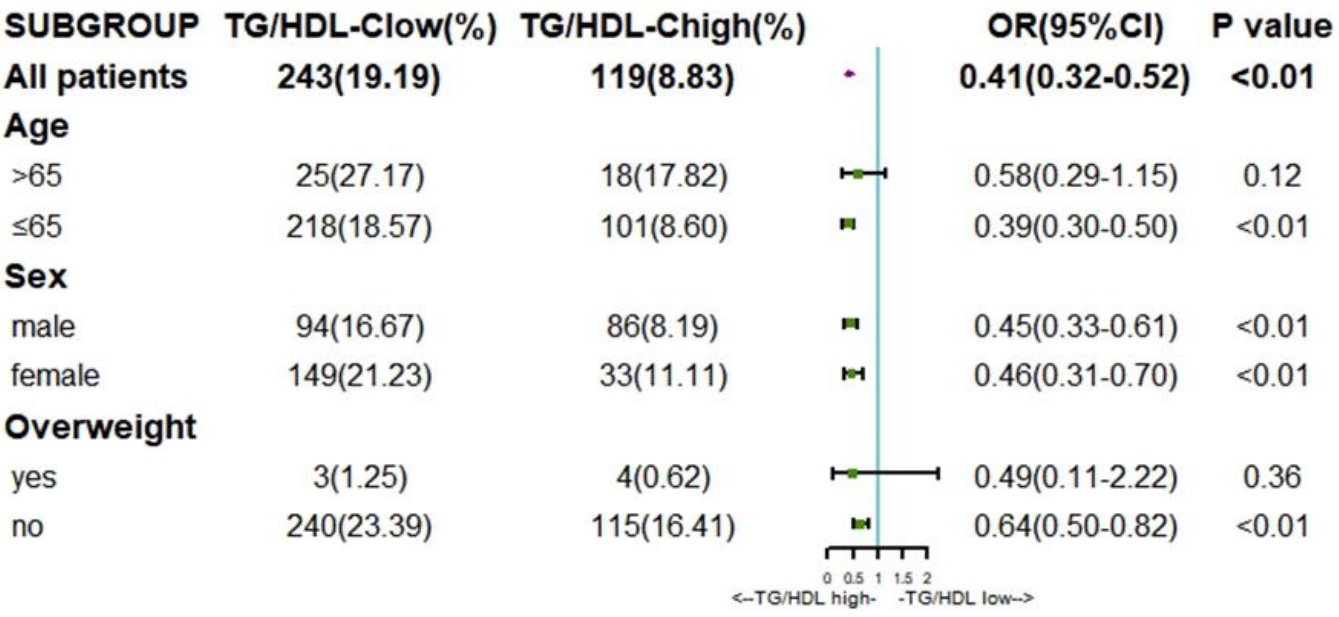

Figure 1

Subgroup analysis of TG/HDL ratio in sarcopenia status. Note: The second column lists numbers(%) of individuals with sarcopenia in TG/HDLlow group. The third column lists numbers(%) of individuals with sarcopenia in TG/HDLhigh group.

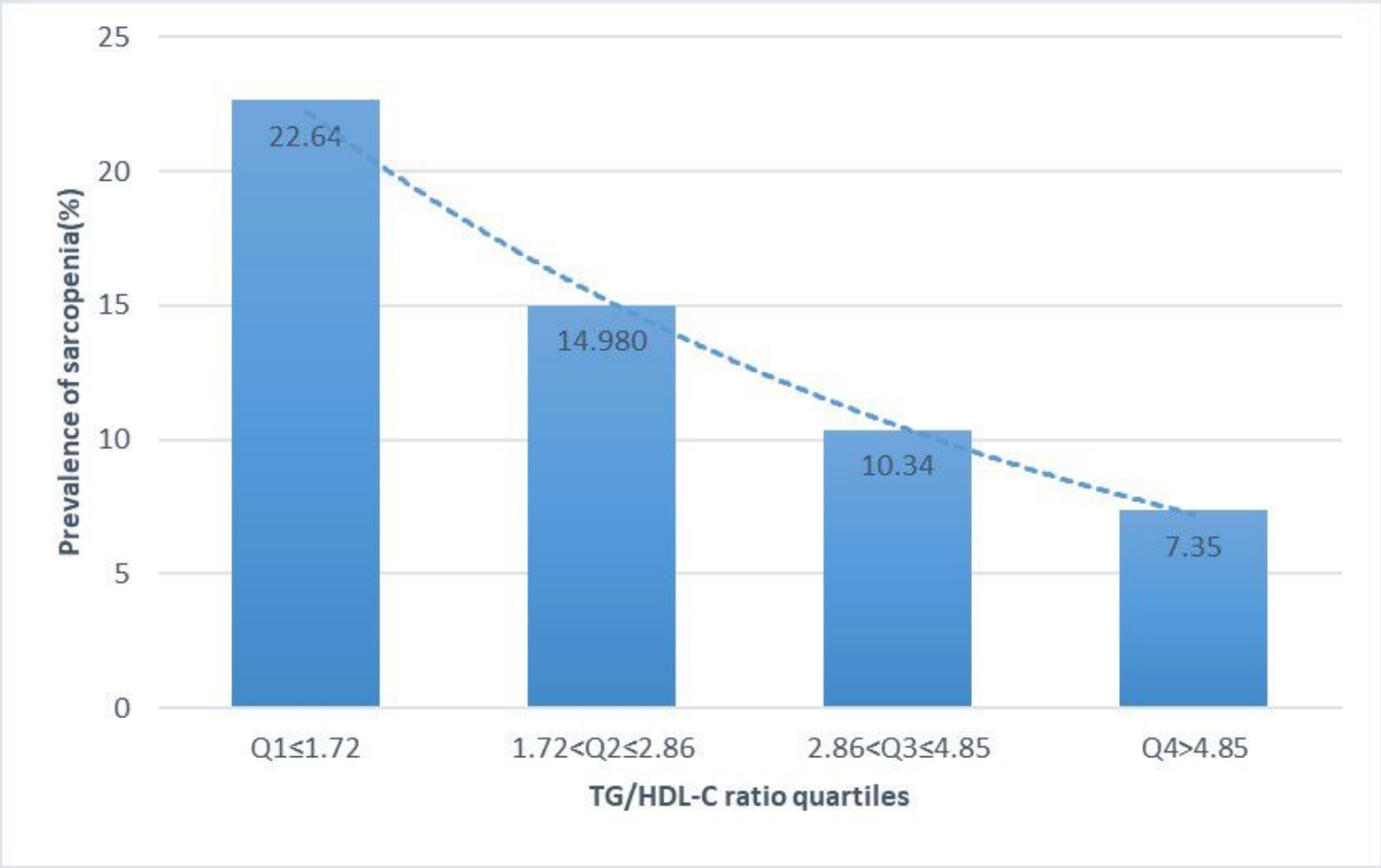

Figure 2

The prevalence of sarcopenia according to the TG/HDL ratio quartiles. Supplementary Figure. Receiver operating characteristic(ROC) curve analyses of the TG, HDL and TG/HDL ratio in sarcopenia status.

Supplementary Files

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- supplementaryFigure.jpg