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Association between the Triglyceride to High-Density Lipoprotein Cholesterol Ratio and Metabolic Syndrome

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Abstract **Original Research Article**

Metabolic syndrome is a constellation of metabolic abnormalities that results in increased risk of Cardiovascular disease and Diabetes mellitus. Triglyceride/High-density lipoprotein cholesterol (TG/HDL-C) ratio is suggested as a compliment to Low density lipoprotein cholesterol (LDL-C) for predicting the risk of development of Cardiovascular diseases and Diabetes. The aims and objectives are to estimate and compare TG/HDL-C ratio between controls and Metabolic syndrome patients and to assess the correlation between TG/HDL-C ratio and number of components of Metabolic syndrome. A case control study was conducted at Tirunelveli Medical College Hospital during July to October 2018. The subjects attending OPD were allocated into groups with and without Metabolic syndrome, matched by age and gender. Adults aged 20-70 years were enrolled. Subjects with a history of Angina pectoris, Myocardial infarction, Stroke and Cancer were excluded. Fasting venous blood samples were used for estimation of Fasting Plasma Glucose (FPG), Total Cholesterol, Triglycerides, HDL-C, LDL-C. Of 120 subjects enrolled, 67 were cases and 53 were controls. Statistically significant positive correlation was found with TG/HDL-C ratio and weight, FPG in cases. In study subjects, TG/HDL-C ratio increased significantly with the increase in the number of components of Metabolic syndrome. In the Odds Ratios (ORs) of Metabolic syndrome according to TG/HDL-C ratio quartiles, the risk of developing Metabolic syndrome in males is 25 times greater in quartile 3 than in quartile 1 and 34 times greater in quartile 4 when compared with quartile 1. For females the risk of developing Metabolic syndrome is 14 times greater in quartile 4 than in quartile 1. On conclusion the TG/HDL-C ratio is significantly associated with Metabolic syndrome. Assessment of TG/HDL-C ratio will be more valid and useful for early detection and treatment of Cardiovascular disease and Diabetes mellitus.

Keywords: Metabolic syndrome; Diabetes Mellitus; Cardiovascular disease; Triglycerides; High-Density Lipoprotein Cholesterol (HDL-C); Low-Density Lipoprotein Cholesterol (LDL-C).

INTRODUCTION

Metabolic syndrome (MetS) is a constellation of metabolic abnormalities that results in increased risk of Cardiovascular disease and Diabetes mellitus [1]. The major components of the Metabolic syndrome include Central Obesity, Hypertriglyceridemia, low levels of High-density lipoprotein cholesterol (HDL-C), Hyperglycemia, and Hypertension. In India, the prevalence of Metabolic syndrome ranges from 10% to 50%[2]. The probability of developing Diabetes Mellitus, Myocardial Infarction and Stroke within 20 years is 19% to 40% in persons with MetS, depending on the number of components present [3]. Therefore to identify individuals with Metabolic syndrome before the development of the disease, is of paramount importance. Among the risk factors, Dyslipidemia an important integral component of MetS, is a major cause for the development of Cardiovascular disease. With previous studies, it is very clear that the Triglyceride /High density lipoprotein cholesterol (TG/HDL-C) ratio is positively associated with insulin resistance than that of the individual lipid levels [4, 5]. This ratio provides integrated information and it is considered as a good index for the prediction of Cardiovascular diseases [6, 7]. To assess the association between TG/HDL-C ratio and Cardiovascular diseases, various studies have already been conducted [8-11]; however, there are limited information about the association between TG/HDL-C ratio and MetS. With the above view, this study was aimed to estimate TG/HDL-C ratio and to compare the ratio between controls and Metabolic syndrome patients and to assess the correlation between TG/HDL-C ratio and number of components of Metabolic syndrome.

MATERIALS AND METHODS

A case control study was conducted by the Department of Biochemistry, at Tirunelveli Medical College Hospital during July to October 2018. The subjects attending OPD were allocated into groups with and without Metabolic syndrome, matched by age and gender. Adults aged 20 to 70 years with MetS were enrolled as cases. Diagnosis of Metabolic syndrome was based on National Cholesterol Education Program and Adult Treatment Panel III (NCEP: ATP III) and harmonized definition emphasizing variations of waist circumference according to racial groups. Presence of 3 of the following 5 criteria is required to make a diagnosis of Metabolic syndrome. 1) Waist circumference ≥ 80cms in women and ≥ 90cms in men. 2) BP ≥ 130 mm Hg systolic or ≥ 85 mm Hg diastolic or on anti-hypertensive medication. 3) FPG ≥ 100 mg/dl or on drug treatment for Diabetes mellitus. 4) Serum TG ≥ 150mg/dl. 5) Serum HDL-C < 40mg/dl in men and < 50mg/dl in women. Subjects with a history of Angina pectoris, Myocardial infarction, Stroke and Cancer were excluded. An informed consent was taken from every participant. Fasting venous blood samples were used for estimation of Total Cholesterol, Triglycerides, HDL-C and Fasting Plasma Glucose (FPG). LDL-C was calculated using Friedewald's equation [LDL-C = TC- (HDL-C) - TG/5]. The statistical analysis was performed using SPSS 16.0 software and p value of < 0.05 was taken as statistically significant.

RESULTS

A total of 120 subjects were enrolled for study, out of which 67 (38 females and 29 males) were cases and 53 (22 females and 31 males) were controls.

Table-1: Clinical and Biochemical characteristics of the study subjects

	Cases(With MetS) n = 67	Controls(Without MetS) n = 53
	Mean ± SD	Mean ± SD
Age	43.84±11.58	44.11±11.97
Waist circumference	93.64±7.75	91.36±7.25
FPG	111.96 ± 21.17	81.21±15.38
SBP	128.57±16.41	119.62±14.40
DBP	82.15±6.78	78.83±6.04
TG	203.34± 58.63	143.64±37.51
HDL-C	40.16±5.82	43.68±6.30
LDL-C	91.22±32.08	74.53±28.02
VLDL	40.22±11.77	29.75±9.39
TG/HDL-C ratio	5.21±1.87	3.38±1.38
Total cholesterol	171.63±30.56	148.08±26.43

Mean value of Fasting Plasma Glucose, Systolic Blood Pressure, Diastolic Blood Pressure, Total Cholesterol, Triglycerides, High Density Lipoprotein Cholesterol, Low Density Lipoprotein Cholesterol, Very Low Density Lipoprotein and TG/HDL-C ratio are significantly high (p <0.01) in cases compared to controls. There is no statistically significant difference in the mean value of age (p = 0.9) and waist circumference (p = 0.1) in cases and control. There is a significant positive correlation observed between TG/HDL-C ratio and number of components of Metabolic syndrome in all subjects.TG/HDL-C ratio increased significantly (p value <0.01) with the increase in the number of components of Metabolic syndrome in study subjects. When analysing the TG/HDL-C ratio and the MetS components among cases it was found that TG/HDL-C ratio had significant positive correlation with body weight and FPG in Cases.

Table-2: TG/HDL-C ratio according to the number of components of MetS present in study subjects

No. of components of MetS	Male	Female
	Mean ± SD	Mean ± SD
0	-	2.62± 0.12
1	2.74± 0.48	3.44± 1.70
2	3.30± 0.56	3.97± 1.09
3	4.14± 0.95	4.93± 1.23
4	4.81± 1.57	5.50± 1.75
5	5.75± 2.14	7.11± 3.59

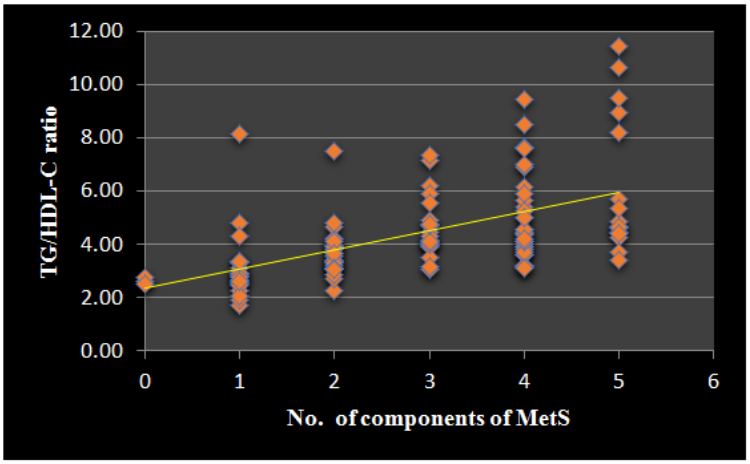

Fig-1: TG/HDL-C ratio and No. of components of MetS

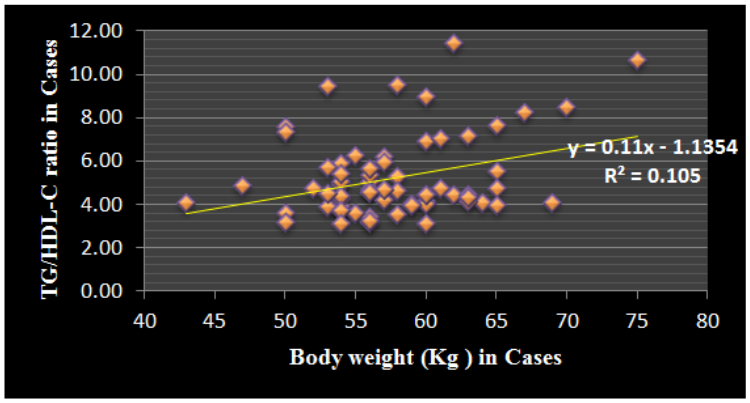

Fig-2: Correlation between TG/HDL-C ratio and Body weight in Cases

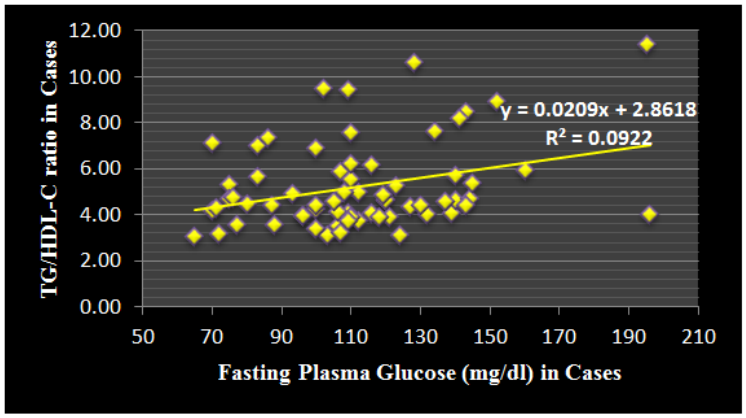

Fig-3: Correlation between TG/HDL-C ratio and Fasting Plasma Glucose in Cases

TG/HDL-C ratio values of cases were divided into four quartiles as follows Q1 (<3.20), Q2(3.21-3.98), Q3(3.99-4.78) and Q4(>4.78). Odds ratio for MetS was calculated among cases which were further adjusted for age, FPG, Waist circumference, Total cholesterol, SBP, DBP. Attributable risk of developing MetS according to TG/HDL-C ratio quartiles, are as follows. Males who fall in Q3 and Q4 of TG/HDL-C ratio have 25 times and 34 times respectively greater risk of having MetS when compared to Q1 of TG/HDL-C. Females with Q4 of TG/HDL-C ratio have 14 times greater risk of having MetS when compared to Q1 of TG/HDL-C ratio.

Table-3: Odds ratio for Metabolic syndrome across the TG/HDL-C ratio quartiles

Quartile of TG/ HDL-C ratio (quartile value)	Odds ratio for male		Odds ratio for female	
	Adjusted† (95% CL)	p-value	Adjusted† (95% CL)	p-value
Q1 (<3.20)	1		1	
Q2 (3.21-3.98)	4.93 (0.42-57.04)	0.2	3.34 (0.53-20.97)	0.19
Q3 (3.99-4.78)	25.39 (2.19-293.62)	0.01	10.33 (0.72-146.0)	0.08
Q4 (>4.78)	34.24 (2.58-453.25)	< 0.01	14.22 (1.07-189.02)	< 0.05

Adjusted for Age, FPG, Waist circumference, Total Cholesterol, Systolic blood pressure, Diastolic blood pressure

DISCUSSION

With the results in both sexes, individuals with MetS had higher TG/HDL-C ratio when compared to the subjects who were not having MetS. Mean values of Fasting Plasma Glucose, Systolic Blood Pressure, Diastolic Blood Pressure, Total Cholesterol, Triglycerides, High Density Lipoprotein Cholesterol, Low Density Lipoprotein Cholesterol, Very Low Density Lipoprotein and TG/HDL-C ratio were significantly high in cases compared to controls. These findings were in accordance with study of M. Abbasian *et al*. [12].

In our study, TG/HDL-C ratio showed significant positive correlation with body weight and FPG in Cases. In addition, there is a significant positive correlation between TG/HDL-C ratio and number of components of MetS among the study subjects which was similar to that observed in the study of M. Abbasian *et al*. [12]. This explains clearly that the increased value of TG/HDL-C ratio results in the increased no. of components of MetS. Though TG/HDL-C ratio is obtained from dyslipidemic component of MetS, it correlates well with the other components of MetS such as Hyperglycemia, Hypertension and Obesity.

In our study, the Odds ratio for MetS according to Q4 TG/HDL-C ratio was 34.44 in males and 14.22 in females, but in Hyun-Gyu Shin, *et al*. study the Odds risk for MetS according to Q4 of TG/HDL-C ratio was 29.65 in males and 20.60 in females. The Q4 of TG/HDL-C ratio was >4.78 in our study and it was 3.48 in Hyun-Gyu Shin, *et al*. study. Though some subtle discrepancies have been noted between these studies, it was very clear that the risk of developing MetS was higher in the subjects who have high TG/HDL-C ratio [13]. Apparently, the discrepancies in the results (Odds Ratio and Q4 levels) can be attributed to the differences between the study populations in terms of race and ethnicity.

According to Cordero *et al*. in MESYAS study, the presence of the TG/HDL-C ratio is a part of the MetS and the cut-off points of this ratio which is >2.75 in males and >1.65 in females, is able to establish their relationship with MetS [14]. According to the study done by Jianfeng Liang et al. on Chinese obese children, the cut of value for MetS were: TG/HDL-C ratio > 1.25 (sensitivity: 80 %; specificity: 75 %) [15]. In our study, the lowest value of TG/HDL-C ratio among cases with Metabolic syndrome was 3.08 which was well above the value given by the Cordero et al. and Jianfeng Liang *et al*.

TG/HDL-C could be used to identify a greater number of individuals exposed to the risk of developing MetS. TG/HDL-C ratio as an independent factor for predicting Cardiovascular diseases had been suggested in various studies [6, 16-18].

CONCLUSION

The TG/HDL-C ratio, besides routinely done simple clinical laboratory test, is significantly associated with Metabolic syndrome than that of the individual dyslipidemic components. Assessment of TG/HDL-C ratio would be more reliable and useful for early detection and treatment of Cardiovascular disease and Diabetes mellitus.

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