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The Significance of the TG/HDL Ratio in Predicting Coronary Artery Disease among Younger Adults in Pakistan

Dr Azhar Ijaz^{1*}, Dr Rahat Jan Wazir², Dr Ahmad Yar³, Dr Misbah Aslam⁴,
Dr Sana Javed⁵, Dr Marifat Shah⁶

^{1*}Associate Professor, Department of Physiology, Loralai Medical College, Loralai, Pakistan

²Assistant Professor, Department of Physiology, Gomal Medical College, Dera Ismail Khan, Pakistan

³Assistant Professor, Department of Physiology, Loralai Medical College, Loralai, Pakistan

⁴Demonstrator, Department of Physiology, Quetta Institute of Medical Science, Quetta, Pakistan

⁵Demonstrator, Department of Physiology, Mohuddin Islamic Medical College, Mirpur, AJK

⁶Associate Professor, Department of Medicine, Jinnah Medical College and Teaching Hospital, Peshawar, Pakistan

*Corresponding author's email: drazharijaz@gmail.com

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ABSTRACT

Background: Coronary arteria disease CAD is currently the leading cause of mortality across the globe and is also notably prevalent in South Asian countries. In CAD which is prevalent among South Asian population, a major risk factor is dyslipidemia which is characterized by a high level of triglycerides and low concentration of HDL. The goal of this study was to determine the viability of using the triglyceridomic biomarker TG/HDL ratio as an indicator that may be associated with CAD among younger Pakistani men and women.

Materials and Methods: This is a cross-sectional study conducted over nine months with 70 participants at the Punjab Institute of Cardiology (PIC) Lahore. The participants were aged between 21 and 45 years. Group 1 was made up of 35 patients with a diagnosis of acute coronary syndromes while Group 2 had 35 age-matched healthy controls. Serum total cholesterol, triglycerides, HDL-C and LDL-C were measured. 'The TG/HDL cholesterol ratio was calculated' and the data was processed using SPSS version 16.0, employing statistical techniques like Student's t-test and odds ratio estimation.

Results: The triglyceride levels of the patient group was noted to be higher at 171.34 ± 78.8 mg/dl while the control was significantly lower at 106.66 ± 31.3 mg/dl (pvalue 0.001). The patient group also had mean HDL-C levels of 37.37 ± 8.1 mg/dl which was significantly lower than the mean HDL-C levels of the control group at 42.54 ± 8.5 mg/dl (pvalue 0.01). The patient group had TG/HDL ratios which was higher at 5.02 ± 3.3 when compared to the control group which had a TG/HDL ratio of 2.57 ± 0.83 (pvalue 0.001). The TG/HDL ratio noted also had an odds ratio of 8.4 (95% CI: 2.6-26.7, $p=0.0003$) suggesting its relationship with the presence of CAD was very strong.

Conclusion: 'The TG/HDL ratio emerges to have a significant predictive value for CAD' especially in younger Pakistani adults. Its easy measurement and robust relation with CAD make it an integral component of routine risk evaluation and management plans that would help provide timely care for this population.

Keywords: Coronary Artery Disease, Triglyceride-to-HDL Ratio (TG/HDL), Dyslipidemia

INTRODUCTION

Coronary Artery Disease (CAD) remains the leading cause of death around the world for men and women, regardless of whether their country is developed or developing¹. It is quite obstructive to medical scientific research as well as primitive health endeavors². As per World Health organization, CAD claimed 8.9 million lives in 2019. CAD seems to occur at a younger age in South Asians as compared to other ethnicities.³ The incidence of coronary atherosclerosis is exacerbated within this group because of dyslipidemia⁴.

Dyslipidemia, defined by raised cholesterol and triglyceride levels, 'low levels of high density lipoprotein cholesterol (HDL-C), and elevated levels of low density lipoprotein cholesterol (LDL-C), is a known risk factor for CAD'⁵. Hypertriglyceridemia, in particular, has been associated with the impairment of vascular function, such as the action of endothelial-derived nitric oxide (EDNO), which is key in thwarting atherosclerosis progression^{6,7}.

Like cholesterol, triglycerides are important risk factors for coronary artery disease. 'Recently, there has been a interest in the role of triglycerides as an independent marker of CAD'⁸. Many researchers have found that a greater risk of CAD is associated with low levels of HDL cholesterol in the blood plasma. Recently, several biological functions of HDL were discovered which show that it could be further more protective by being anti-atherogenic. It is known that healthy HDL induces anti-inflammatory, anti-apoptotic, and anti-thrombotic actions in the endothelium. Therefore, raising the levels of HDL cholesterol, particularly its functionality, seeks to reduce the risk of CAD⁹.

In recent years, lipoprotein ratios, such as the triglyceride-to-HDL cholesterol (TG/HDL) ratio, have been identified as superior predictors of CAD risk compared to traditional lipid measures. The TG/HDL ratio is a simple, non-invasive marker that is gaining recognition as an important predictor for CAD^{10,11}. Many studies have established a TG/HDL ratio cutoff value of 3.5 as an indicator of increased CAD risk^{12, 13}. Given these considerations, this study aims to explore the role of the TG/HDL ratio in predicting CAD in younger Pakistani adults.

MATERIAL AND METHODS

This 'cross-sectional comparative study took place at the Punjab Institute of Cardiology in Lahore' over nine-month duration from October 2009 to June 2010. Written informed consent was taken from all participants. 'The Ethical Committee of the Postgraduate Medical Institute, Lahore and the Advanced Studies and Research Board of the University of Health Sciences, Lahore provided ethical clearance for the study protocol'.

Study participants were split into two groups. Group 1 comprised 35 patients aged 21 to 45 years who were admitted to 'PIC for the first time with ST-segment elevation myocardial infarction (STEMI), non-ST-segment elevation myocardial infarction (NSTEMI), or unstable angina'. The 'diagnosis was confirmed based on the history of chest pain, changes in the electrocardiogram (ECG)' and chest leads, and increased cardiac enzymes associated with myocardial infarction including 'Troponin I, Troponin T, CK, and CK-MB'.

The control group for this study was composed of 35 subjects aged 21 to 45 years, with no medical problems. They were all recruited from the 'Exercise Tolerance Test (ETT) department of PIC and all had prior negative ETT results'. Those participants in both groups who had a 'prior history of CAD, diabetes mellitus, hypertension, smoking, renal impairment, non-cardiac chest pain, and family history of premature CAD were excluded from the study'.

A '5 ml blood sample was drawn from each subject after a period of fasting for 12 to 14 hours, using standard sterile' procedures'. The clotted blood samples were stored in 'centrifuge tubes for 25 - 60

minutes at room temperature' before being centrifuged for '10 minutes at 3000rpm'. The serum collected after centrifugation was 'aliquot into labeled tubes and refrigerated at 2-8°C until further analyzed'. 'Total fasting serum cholesterol and triglycerides' were quantified with standard kits on the 'Slim Chemistry Analyzer while HDL and LDL levels were determined by calculation' using the 'Friedewald equation'. Using SPSS version 16.0, the data acquired from both groups was inputted into a computer and analyzed. Differences in means for the control and patient groups were analyzed for significance by applying the Student's t-test for independent samples. 'The association between TG/HDL ratio and CAD was evaluated with a 2x2 contingency table and the odds ratio (OR) was calculated using the formula: $OR = \frac{a \times d}{b \times c}$ '. A p-value less than 0.05 was deemed as statistically significant.

RESULTS

A sample of 70 persons was chosen for the study as all of them complied with the selection and exclusion factors. 35 of them were the admitted patients to Punjab Institute of Cardiology (PIC) with first time occurrence of myocardial infarction (MI) or unstable angina. The rest aged matched 35 subjects were healthy controls. The patient group had a mean age of 37.2±6.3 years while the control group had a mean age of 35.1±6.1 years.

The mean serum total cholesterol levels were not significantly different between both groups CAD (193.49±38.9 mg/dl) and non-CAD (181.77±26.2 mg/dl). (p=0.14) CAD patients had significantly higher serum triglyceride levels (171.34±78.8 mg/dl) than the controls (106.66±31.3 mg/dl) with p-value of 0.001. CAD patients also had lower levels of HDL-C compared to the controls thereby resulting in a mean serum HDL-C concentration of 37.37±8.1 mg/dl as opposed to '42.54±8.5 mg/dl with p value of 0.01'. 'No significant difference' was found with LDL-C wherein the mean serum levels were 121.06±29.5 mg/dl for CAD patients and 115.6±21.5 mg/dl for controls (p=0.379).

The prevalence of CAD was strongly indicated with an elevated ratio of TG to HDL in the CAD group which measured at 5.02 +/- 3.3 as opposed to the measurement of 2.57 +/- 0.83 in the control group with a p value of 0.001. Within the CAD subgroup, 21 patients registered a TG/HDL ratio greater than or equal to 3.5 while the remaining 15 patients had normal ratios. Only 5 subjects out of 35 in the control group attained a TG/HDL ratio greater than 3.5 and 30 maintained a normal ratio. The measures that were calculated were an odds ratio of 8.4 along with a confidence interval of 95% at 2.6 to 26.7 and a p value of 0.0003 which proves to show a strong relation between higher the TG to HDL ratios to CAD.

Table-1: Differences between CAD patients and control subjects.

'Variables'	'Groups'		p-value
	'Patients (Mean ±SD)'	'Controls (Mean ±SD)'	
'TC (mg/dl)'	193.49±38.9	181.77±26.2	0.144
TGs (mg/dl)	171.34±78.8	105.66±31.3	0.001
HDL-C (mg/dl)	37.37±8.1	42.54±8.5	0.011
LDL-C (mg/dl)	121.06±29.5	115.6±21.5	0.379
TGs/HDL-C	5.02±3.3	2.57±0.83	0.001

Table-2 Calculation of Odds Ratio (OR) Contingency

Total subjects =70	TG/HDL	CAD patients (number)	Controls (number)	Odds Ratio (OR)	95% confidence interval	p-value
	≥3.5	a =21	c =05	8.4	2.6-26.7	0.0003
	<3.5	b =15	d =30			

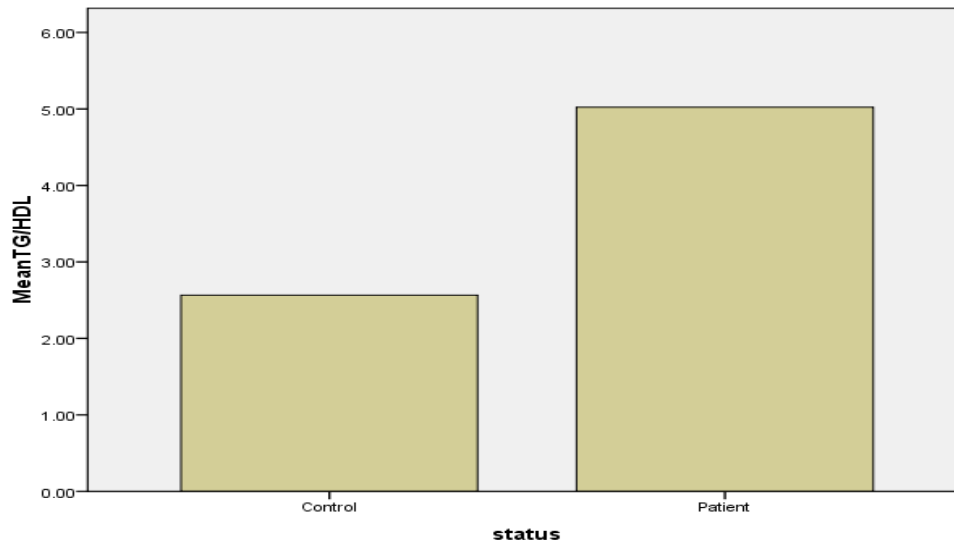


Figure 1: The bar chart presents the mean TG/HDL ratio for control and patient groups. Patients show a higher mean ratio of approximately 5.02, while controls have a lower mean of around 2.57. This visual difference highlights the significant elevation of the TG/HDL ratio in individuals with coronary artery disease. The chart aligns with the study's statistical results, which showed a p-value of 0.001, indicating a meaningful difference between the groups. These findings support the role of the TG/HDL ratio as a potential marker for early detection of coronary artery disease in younger adults.

DISCUSSION

The outcomes of this investigation regarding the 'triglyceride-to-HDL cholesterol (TG/HDL) ratio as a possible determinant of CAD among younger Pakistani adults were in line with evidence that suggests lipid ratios may be more discriminating towards the prediction of CAD than the conventional lipid levels'. This study was consistent with earlier studies illustrating the importance of the TG/HDL ratio in populations with unique dyslipidemic patterns like South Asians.

Hypertriglyceridemia has already been established as one of the CAD risk factors. In the present study, the mean serum triglyceride level for the CAD patients was 171.34 ± 78.8 mg/dl while for the controls it was 106.66 ± 31.3 mg/dl which was statistically significant (p-value = 0.001). These results are similar to other studies. For instance, a study in China conducted by Xiang Lie where 113 CAD patients were studied against 128 controls noted the CAD patients had significantly higher triglycerides (>0.01). Likewise, Islam ZU et al in Bangladesh showed higher triglyceride levels among acute coronary syndrome patients in comparison to controls (p-value = 0.01).^{14,15} These results corroborate with the findings of this study.

This study also observed that HDL cholesterol levels were significantly lower in CAD patients than in controls (p-value > 0.01). This was in line with previous studies. For example, Thakar H. et al. (2020) from New Delhi studying 150 patients with acute coronary artery syndrome and 110 healthy controls reported that, the average HDL level was 40.2 ± 9.6 mg/dl among the patients versus 45.4 ± 9.6 mg/dl among controls: which was statistically significant difference (p-value 0.001)¹⁶. Besides, Bilen et al. (2016) showed that South Asians seem to have a particular lipid profile which places them at greater risk of developing coronary heart disease (CHD) at a younger age associated with high triglycerides and low HDL-C level, which supports our study¹⁷.

Prior investigations, specifically by Yolanda and colleagues (2023) as well as Kosmas and colleagues (2023), highlight how the TG/HDL ratio outperforms other lipid parameters in predicting coronary artery disease (CAD). The association of an increased TG/HDL ratio with CAD is even more pronounced with an odds ratio of 8.4 (95% CI: 2.6-26.7, p=0.0003). This implies that patients with TG/HDL ratio more than

3.5 are likely to develop CAD nearly 8.4 times compared to patients with normal ratios, thus accentuating the efficacy of this index in clinical evaluation of CAD risk¹⁸⁻²⁰.

The research has some limitations, such as the cross-sectional nature of the study and the sample size. The TG/HDL ratio's predictive power for CAD should be tested in more extensive, longitudinal studies with varied populations and ages. Furthermore, understanding how lifestyle alterations affect CAD preventative measures could be beneficial.

CONCLUSION

As the present study demonstrates, the TG/HDL ratio may be one of the earliest indicators for predicting the risk of CAD. Since this ratio is a derived value, neither patients nor the healthcare system incurs any additional expenses. As a result, it is an uncomplicated and inexpensive measure for determining the likelihood of CAD in patients. The authors suggest incorporating the TG/HDL ratio into standard lipid panels to enhance the detection and management of dyslipidemia, ultimately improving CAD diagnosis and prevention strategies.

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