Original Article

IAHS Medical Journal
Volume 05 Issue 01 June 2022; 12-15

Serum Triglyceride and Total Cholesterol in Association with IGT: A Case Control Study among Bangladeshi Adults in Jashore City

Marufa Akhter[1*] Subhra Prakash Datta[2] Mokerroma Ferdous[3] Hasnat Silvi Era[4]

ABSTRACT

Background: *Existing researches demonstrated that hyperglycemia was associated with elevated serum Triglyceride (TG) and Total Cholesterol (TC). It is imperative to identify prediabetic conditions like Impaired Glucose Tolerance (IGT) for prevention or delay in the development of Type 2 Diabetes Mellitus (T2DM). It is also quite comprehensible that early diagnosis of IGT provides opportunity for effective interventions like dietary and lifestyle modification.The primary objective of this study was to investigative the association of serum TG and TC with IGT in an urban area of Bangladesh.*

Materials and methods: *This study was an observational study with a case-control design carried out on a total of 102 IGT subjects and 150 age, Body Mass Index (BMI) and Waist-Hip Ratio (WHR) matched control subject, over 2 years of time.Biochemical tests including Fasting Plasma Glucose (FPG) plasma glucose2 hours after 75 grams glucose load (2 h PG) serum TC and serum TG using slandered procedure. IBM SPSS Statistics 25 version was used for statistical analysis.*

Results: *Serum TG level was significantly high in IGT cases when compared with controls.Serum TC was also different in cases when compared to controls, but was not significant statistically.*

Conclusion: *Higher level of serum TG is associated with IGT. The association of high serum TC and IGT was not decisive.*

Key words: Impaired glucose tolerance (IGT); Total cholesterol; Triglyceride.

Introduction

The Expert Committee on the Diagnosis and Classification of Diabetes Mellitus identified a group of people whose glucose levels did not meet the criteria for diabetes but were too high to be considered normal.[1] The term "Prediabetes" used for individuals with Impaired Fasting Glucose (IFG) and/or Impaired Glucose Tolerance (IGT). WHO recommended for the diagnostic criteria for IGT as Fasting Plasma Glucose (FPG) < 7.0 mmol/L and 2 hours after 75 grams glucose load (2h PG) between ≥7.8 and <11.1mmol/l[2]. Prediabetes conditions like IGT should not be considered as a discrete clinical entity but is a risk factor for future diabetes and/or adverse outcomes like Cardiovascular Disease (CVD). It is well established that IGT is associated with obesity, dyslipidemia with high Triglycerides (TG) and/or low High Density Lipoprotein Cholesterol (HDL-C) and hypertension. The prevalence of IGT varies between populations and across different age groups. Prevalence rates in order of 10% or more are common and it is typically more common among women than in men.[3] In the population of Indian sub-continent, the prevalence of IGT is higher and does not vary much with age.[4] Studies on prediabetic subjects have shown that both the basic defects of Type 2 Diabetes Mellitus (T2DM) i.e. insulin secretory abnormality and insulin resistance, are present in Bangladeshi IFG and IGT subjects in variable degrees.[5] A study in Mauritius indicate that among IGT subjects, 30% reverted to normal, 35% remain as IGT, 5% changed to IFG and 30% developed T2DM within 11 years.[6] The McMaster review reported that, the annualized Relative Risk (RR) with IGT progressing to T2DM was increased 6-fold compared with people with normal glucose tolerance. This RR was even higher in people with combined IFG and IGT (12-fold). The RR of all-cause mortality is 1.48-fold higher in people with IGT compared with people with normal glucose tolerance. The RR of a fatal cardiovascular outcome was 1.66-fold higher.[7]

1. Associate Professor of Biochemistry
Ad-din Sakina Women's Medical College Jashore.
2. Senior Lecturer of Community Medicine
Institute of Applied Health Sciences (IAHS) Chattogram.
3. Assistant Professor of Biochemistry
Jashore Medical College, Jashore.
4. Lecturer of Biochemistry
Jashore Medical College, Jashore.

*Correspondence : **Dr. Marufa Akhter**
Cell : +88 01715 21 99 63
Email : drmarufabio@gmail.com

Date of Submission : 16th May 2022
Date of Acceptance : 2nd June 2022

IAHS Medical Journal
Volume 05 Issue 01 June 2022; 12-15

Dyslipidemia can be defined by abnormal level of serum TG and Total Cholesterol (TC). The association of TG, TC and IFG/IGT is still not decisive. Existing researches demonstrated that hyperglycemia was associated with elevated serum TG and TC.[8,9] T2DM is one of the most common chronic diseases, causes serious morbidity and mortality and also imposes a heavy economic burden worldwide. Therefore, it is necessary to identify high-risk individuals and establish an effective and feasible prevention program for T2DM. It is imperative to identify prediabetic conditions like IGT for prevention or delay in the development of T2DM. It is quite comprehensible that early diagnosis of IGT provides opportunity for dietary and lifestyle modification, which has verified and effective role in normalizing postprandial glucose and inhibiting progression to diabetes. Among the people who should come under the screening process for detection of IGT, people with dyslipidemia and obesity are crucial.[10] The pathophysiology as well as risk factors of the disorder has shown considerable heterogeneity according to racial, environmental, demographic, socioeconomic, and cultural factors.[11] The primary objective of this study was to investigative the association of serum TG and TC concentrations with IGT in an urban area of Bangladesh.

Materials and methods

This study was an observational study with a case-control design carried out on a total of 102 IGT subjects admitted or attended in the outpatient department of Ad-Din Sakina Women's Medical College Hospital, Jashore, Bangladesh over a period of 2 years, from 20th February 2020 to 19th February 2022. Voluntarily agreed adult subjects with age ranging from 30 to 68 years, were included after taking informed consent. A total number of 150 control subjects from the same hospital were recruited in the study. Subjects with pregnancy and serious co-morbid diseases (Severe infection, liver and kidney diseases, stroke, myocardial infarction, major surgery, mal-absorption etc) were not included in the study. History of using lipid lowering agents and drugs significantly affecting glucose metabolism (Glucocorticoids, oral contraceptives containing levonorgestrel or high-dose estrogen, phenytoin, high-dose thiazide diuretics etc) was considered as exclusion criterion.All subjects underwent standard procedures of anthropometric measurements like body weight, height, Waist Circumference (WC) and Hip Circumference (HC). The two groups were matched for age, Waist Hip Ratio (WHR) and Body Mass Index (BMI) [Table I]. Blood from IGT (case) and control subjects was drawn after an overnight fasting of 8-14 hours. Blood samples were collected by venipuncture to assess the biochemical tests including FPG, 2 h PG, serum TC and serum TG. Serum TC was measured by enzymatic endpoint method (Cholesterol Oxidase/ Peroxidase) and TG by enzymatic colorimetric method. Data were expressed as mean ± Standard Deviation (SD) and/or median wherever appropriate. Comparison of mean values between two groups were tested using either Student's t-test (Unpaired) or Mann-Whitney 'U' Test. Chai Square Test and Fisher's Exact Test was done for categorical data, wherever appropriate. WHR was calculated by dividing WC by HC. BMI was calculated as, BMI = weight (Kg) ÷ height^2 (m). All statistical measures were performed using IBM SPSS Statistics 25 version.

Results

Among the case (IGT) and control subjects, male and female were 51.0%, 49.0% and 60.0%, 40.0% respectively. In this study the clinical characteristics of the subjects with IGT and controls are shown in Table I. Two groups were matched for age (p=0.873), WHR (p=0.772) and BMI (p=0.612). The case (IGT) group showed no significant difference in age, WHR and BMI compared to controls (Table I). Mean ± Standard Deviation (SD) of age, WHR and BMI of case (IGT) and control were (46.99 ± 8.80, 0.922 ± 0.067, 25.68 ± 3.32) and (47.43 ± 10.042, 0.924 ± 0.059, 25.77 ± 3.79) respectively. Median values of age, WHR and BMI of case and control group were (45.00, 0.933, 25.85) and (46.00, 0.929, 25.21) respectively.

Table I Characteristics of subjects

Variables	Case (IGT)	Control	sig. (p value)
Age (Years)	46.99 ± 8.80 (45.00)	47.43 ± 10.04 (46.00)	0.873
WHR	0.922 ± 0.067 (0.933)	0.924 ± 0.059 (0.929)	0.772
BMI (kg/m^2)	25.68 ± 3.32 (25.85)	25.77 ± 3.79 (25.21)	0.612

BMI (Body Mass Index) WHR (Waist Hip Ratio) results were expressed as mean ± SD and median values enclosed in parenthesis. p> 0.05, it signifies that subjects of case and control group were age, BMI and WHR matched.

In the present study, serum TC of case (Patients with IGT) was different significantly when compared to that of the control group, serum TG was also significantly high [Table II]. Mean ± SD values of TC in the cases was 189.44 ± 45.23 mg/dl vs. 171.74 ± 52.54 mg/dl in the controls (p<0.05). TG level in the cases was 181.28 ± 98.48 mg/dl vs. 135.66 ± 63.77 mg/dl in the controls (p<0.05).

IAHS Medical Journal
Volume 05 Issue 01 June 2022; 12-15

Table II Result of total case and control data

Lipids	Case (IGT)	Control	p value
TC in mg/dl	189.44 ± 45.23 (185.50)	171.74 ± 52.54 (163.00)	0.005
TG in mg/dl	181.28 ± 98.48 (164.00)	135.66 ± 63.77 (132.00)	0.000

TC:Total Cholesterol, TG: Triglyceride.

Results were expressed as mean ± SD and median values enclosed in parenthesis. For TC, independent sample t-test and for TG, Mann-Whitney U test was performed and the test of significance at 5% significance level.

In this present study, it was found significantly higher frequencies (Prevalence) of high (Borderline high as per ATP III classification) serum TC and TG level among cases compared to control subjects [Table III].[12] In our study the percentages of subjects with high serum TC (≥200 mg/dl) among cases and controls were 37.3% vs. 28.0%, but the difference was not significant statistically (p>0.05). In case of TG the percentages of subjects with higher level (≥150 mg/dl) were 54.9% vs. 30.0% among case and controls, and the difference was statistically significant (p<0.05).

Table III Frequency (%) table of lipid abnormalities

Variables	High serum TC level (≥200mg/dl)	High serum TG level (≥150mg/dl)
Case (IGT)	37.3%	54.9%
Control	28.0%	30.0%
p-value (Chi-square test)	0.121	0.000
OR (At 95% CI)	1.53	2.84

TC: Total Cholesterol, TG: Triglyceride. OR: Odds Ratio, CI: Confidence Interval.

High level of different serum cholesterol level mentioned were actually "borderline high" cut-off values according to the ATP III classification[12]. p value < 0.05 denotes the level of significance.

High level of serum TG [Odds Ratio (OR), 2.84 at 95% Confidence Interval (CI)] was proved to be associated with IGT in this study. Although subjects with higher level of TC were found to be prevalent among cases (IGT group), the difference was not significant statistically (p>0.05).

Discussion

This study investigated the association of serum TG and TC with IGT in an urban Bangladeshi IGT subjects. The present study reveals that mean± SD value of serum TC was higher in IGT subjects when compared with control subjects (189.44 ± 45.23 mg/dl vs. 171.74 ± 52.54 mg/dl). The difference between the mean TC values between case and control was statistically significant (p=0.005). This study also demonstrated higher frequencies of high level (≥200 mg/dl) of TC among IGT subjects (Case) when compared with control subjects (37.3% vs. 28.0%), but the difference in frequency was not significant statistically (p=0.121).In this situation, researchers were not convinced about the association of higher level of TC with IGT from the current study.

The present study also reveals that mean ± SD value of serum TG was higher in IGT subjects when compared with control subjects (181.28 ± 98.48 mg/dl vs. 135.66 ± 63.77 mg/dl). The difference between the mean TC values between case and control was statistically significant (p=0.000). This study also demonstrated higher frequencies of high level (≥150 mg/dl) of TG among IGT subjects (Case) when compared with control subjects (54.9% vs. 30.0%), and the difference in frequency was significant statistically (p=0.000). The study result was decisive about the association of high serum TG with IGT (OR = 2.84).

Jing Cui et al. in their population-based cross-sectional study in china showed that serum TG and TC were independently and positively associated with IGT.[13] In our study the result was similar in case of serum TG but was not conclusive about serum TC. V V Salomaa et al. in their study demonstrated that hyper triglyceridemia is common in subjects with IGT and is often associated with high TC, which is also consistent with the present study, particularly in case of serum TG.[14] Primary objective was to investigate the association between serum TC and TG with IGT and to evaluate the possibility to use serum TC and TG values as clinical predictor for IGT. It is well accepted that elevated levels of TC and TG are good clinical markers to predict diabetic risks.[15] Rasmussen SS et al. in their study also showed that along with some confounding factors, hyper triacylglycerolaemia is a significant determinants to develop IGT in individuals and reduction of hyper triacylglycerolaemia markedly reduced the risk of T2DM.[16] This study demonstrated association of high serum TG with IGT, but the association of serum high TC with IGT was not conclusive. Scarcity data regarding IGT vs. serum TC and TG level warrant much more research from different perspective, particularly in Bangladeshi population. It is quite obvious from the present study that subjects with high serum TC and particularly high TG should come under screening for IGT, which might prevent or delay in the development of T2DM as well as reduced cardiovascular outcome.

Conclusion

Higher level of serum TG is associated with IGT. Subjects with high level of serum TG (150 mg/dl) was more frequent among IGT patients. The study result

IAHS Medical Journal
Volume 05 Issue 01 June 2022; 12-15

suggested higher level of TC (200 mg /dl) was also more frequent among IGT subjects, but the result was not conclusive due to lack of statistical significance. Patients (asymptomatic for T2DM) with high serum TG should be screened for IGT and other prediabetic conditions.

Acknowledgement
The authors thank all the participants and laboratory team members for their excellent cooperation and helping attitude for conduction of the study.

Disclosure
All the authors declared no competing interest.

References

1. Genuth S, Alberti KG, Bennett P, et al. Expert Committee on the Diagnosis and Classification of Diabetes Mellitus. Follow-up report on the diagnosis of diabetes mellitus. Diabetes Care. 2003;26:3160–3167.

2. Definition and diagnosis of diabetes mellitus and intermediate hyperglycemia: Report of a WHO/IDF Consultation. World Health Organization. 2006.

3. Abdul-Ghani MA, Jenkinson CP, Richardson DK et al. Insulin secretion and action in subjects with impaired fasting glucose and impaired glucose tolerance. Results from the Veterans Administration Genetic Epidemiology Study. Diabetes. 2006;55:1430-1435.

4. DECODA Study Group. Age- and sex-specific prevalence of diabetes and impaired glucose regulation in 11 Asian Cohorts. Diabetes Care. 2003;26:1770–1780.

5. Shefin S, Faruque M, Hafizur R et al. Insulin secretory capacity and insulin sensitivity in the normoglycemic first degree relatives of Bangladeshi subjects with prediabetes. J Diabetol.2013;4(2):5.

6. Soderberg S, Zimmet P, Tuomilehto J et al. High incidence of type 2 diabetes and increasing conversion rates from impaired fasting glucose and impaired glucose tolerance to diabetes in Mauritius. J Intern Med. 2004;256:37–47.

7. McMaster University Evidence Based Practice Center. Diagnosis, prognosis and treatment of impaired glucose tolerance and impaired fasting glucose. Evidence Report 128.
www.ahrq.gov.

8. Kompoti M, Mariolis A, Alevizos A et al. Elevated serum triglycerides is the strongest single indicator for the presence of metabolic syndrome in patients with type 2 diabetes. CardiovascDiabetol. 2006;5:21.

9. Rhee EJ, Han K, Ko SH et al. Increased risk for diabetes development in subjects with large variation in total cholesterol levels in 2,827,950 Koreans: A nationwide population-based study. PLoS One. 2017; 12(5):e0176615.

10. American Diabetes Association. Classification and Diagnosis of Diabetes: Standards of Medical Care in Diabetes: Standards of Medical Care in Diabetes – 2019. Diabetes Care 2019;42(Supplement_1):S13–S28.

11. Roglic G. WHO Global report on diabetes: A summary. Int J Non-Commun Dis. 2016;1: 3–8.

12. Grundy SM, Becker D, Clark LT, et al. Detection, evaluation, and treatment of high blood cholesterol in adults (Adult Treatment Panel III). Circulation. 2002;106(25):3143-3421.

13. Cui J, Sun J, Wang W et al. Triglycerides and total cholesterol concentrations in association with IFG/IGT in Chinese adults in Qingdao, China. BMC Public Health. 2018;18:444.

14. V VSalomaa, J Tuomilehto, M Jauhiainen et al. Hypertriglyceridemia in Different Degrees of Glucose Intolerance in a Finnish Population-Based Study. Diabetes Care. 1992;15(5):657-665.

15. Akehi Y , Tsutsumi Y, Tatsumoto A et al. Serum -glutamyltransferase, triglyceride and total cholesterol are possible prediabetic risk markers in young Japanese men. Endocr J. 2010;57(11):981-989.

16. Rasmussen SS, Glumer C, Sandbaek A et al. Determinants of progression from impaired fasting glucose and impaired glucose tolerance to diabetes in a high-risk screened population: 3-year follow-up in the ADDITION study, Denmark. Diabetologia. 2008;51(2):249–257.