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Original Article

MODERATE CORRELATION OF FASTING BLOOD SUGAR WITH DIFFERENT LIPID PARAMETERS MAY A SIGNAL FOR INSULIN RESISTANCE IN NORMAL POPULATION

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ABSTRACT

Objective: Diabetic patients often show an increased risk of dyslipidemia and cardiac problems, which usually appear to worsen with age. In the present study the correlation of fasting blood sugar (FBS) with lipid profile parameters was analysed in non-diabetic normal population of Indore, Madhya Pradesh, India.

Methods: This study included the analyses of data obtained from 726 subjects, who came to Bombay Hospital (Indore, India) for general health check up. The Pearson's correlation analysis was done, first in overall population and then in different sex and age groups of the same population.

Results: In the whole population, FBS showed, a significant positive correlation with triglyceride (r= 0.353, P<0.0001), very low density lipoprotein (r= 0.353, P<0.0001), total cholesterol to high density lipoprotein (HDL) ratio (r= 0.187, P<0.0001); but a negative correlation with HDL (r= -0.136, P<0.001) and no correlation with TC (r= 0.045). Male and female sub-populations showed similar correlation pattern. But, individuals of different age groups exhibited different patterns of correlation. Males of higher age group and females of lower age group appeared to be more susceptible.

Conclusion: The data demonstrated a moderate correlation between FBS and lipid parameters that may provide a signal for an increase in the risk of insulin resistance, cardiac abnormalities and other metabolic syndromes in sample population. So, a strong need for general health status screening and metabolic management is felt.

Keywords: Cardiac risk ratio, Fasting blood sugar, Triglyceride, High density lipoprotein, Correlation.

INTRODUCTION

Diabetes mellitus (DM) is an endocrine metabolic disorder that is also observed to be associated with increased incidences of cardio-vascular disease (CVD), atherosclerosis and metabolic syndrome (MS) that aggravate with time [1]. One report shows a threefold growth in the diabetic prevalence in urban and rural areas [2] that has become major cause of morbidity and mortality [3]. Moreover, dyslipidemia alone reported to cause more than 4 million deaths per year in the world [4]. Furthermore, recent studies demonstrated that persistent hyperglycaemia and hyperlipidemia may alter normal metabolism that result in insulin insensitivity, atherosclerosis, obesity and CVD [3, 5, 6]. Although, chronic diabetes has already been reported to be associated with increasing risk of CVD, micro and macro vascular complications and atherosclerosis [7,8]; with reference to normal non-diabetic individuals the relation of FBS with different lipid parameters has not been documented till now, particularly in central Indian population. With these concepts, in this study the relationship of FBS with various lipid parameters was analysed in healthy urban population of Indore, central India. In addition, the impact of sex and age was also studied in different subgroups of the same population.

MATERIALS AND METHODS

The study included subjects who had attended the general health check up program at Executive Health Scheme (EHS) department, Bombay hospital, Indore, India; where, patient's physical and medical history was taken and maintained in medical records. These data were screened manually and total 726 individuals those having no medical history of diabetes, CVD and any other MS were chosen randomly. Individuals of both sexes (467 men and 259 women) were classified into three different age groups, such as group1, 2 and 3 having subjects of 20-39, 40-54 and 55-80 years of age respectively.

Overnight fasted blood samples were collected in plain vacutainer tubes. The values of FBS, total cholesterol (TC), high density lipoprotein (HDL) and triglycerides (TG) were estimated directly by automated analyser (Xpand Analyzer, Siemens Healthcare Diagnostics Inc., Tokyo, Japan), while, low density lipoprotein (LDL), very low density lipoprotein (VLDL), TC/HDL and LDL/HDL ratios were calculated out using standard formulas [9]. Prior to analysis, the analyser was calibrated with calibrators provided by the manufacturer. Controls were run at both normal and pathological concentrations for each analyte. During the course of the study there was no change in the equipment, reagents, calibration standards and controls.

Statistical analysis

The analysis was performed using Prism software, version 5.1 for windows, Inc., La Jolla, CA, USA. The P<0.05 was considered as statistically significant. A simple correlation analysis (Pearson's test) was utilized to calculate the correlations of FBS with other studied factors.

RESULTS

FBS was found to be positively correlated with TG (P<0.0001, r=0.354), TC/HDL (P<0.0001, r= 0.187) and VLDL (P<0.0001, r= 0.354) and negatively correlated with HDL (P<0.001, r= -0.136); while no significant relation was observed between FBS and TC (r= 0.045) in studied whole population as well as in individual sex groups. Increased level of LDL and decreased HDL resulted in a high LDL /HDL ratio, which was also observed to be positively correlated with FBS in both sexes (P<0.0001). The overall population also showed a significant correlation of FBS with LDL (P<0.05, r= -0.078) but not in individual sex groups (Table 1). Additionally, different values of correlation coefficient (r, -0.192 to +0.44) and constricted range of 95% confidence interval indicated moderate degree of relation with a reliable Gaussian distribution of population.

In group 1 males, FBS showed a positive correlation with TC (P<0.05, r= 0.247), but not with other lipid parameters. While, in males of group 2 and group 3, FBS showed a significant positive correlation with TG (P<0.0001, for both), TC/HDL (P<0.0001 and P<0.001) and VLDL (P<0.0001, for both), a negative correlation was

found with HDL (P<0.01 and P<0.05) respectively (Table 2).Reverse findings were obtained in female population. Table 3 reveals that group 1females exhibited a significant positive correlation between FBS and lipid parameters (eg. TC/HDL, LDL/HDL and VLDL).

Interestingly, in group 2 and 3 females FBS did not show any association with TC, LDL, HDL, TC/HDL and LDL/HDL, although a significant correlation was observed between FBS and TG (P<0.0001 and P<0.001 respectively).

Table 1: Correlation analysis of fasting blood sugar (FBS) with each studied parameters of all sample population (males and females).

	Parameter	TC	HDL	LDL	VLDL	TC/HDL	LDL/HDL	TG
All	No. of XY Pairs	724	721	724	724	721	721	723
	Pearson r value	0.045	-0.136	-0.078	0.354	0.187	0.01778	0.3536
	95% CI	-0.02 to 0.11	-0.21 to -0.06	-0.15 to -0.005	0.28 to 0.42	0.11 to 0.25	-0.05 to 0.09	0.28 to 0.41
	P value	Ns	<0.001	<0.05	< 0.0001	< 0.0001	ns	< 0.0001
All male	No. of XY Pairs	465	464	465	465	464	464	465
	Pearson r value	0.058	-0.143	-0.090	0.361	0.207	-0.013	0.3614
	95% CI	-0.03 to 0.14	-0.23 to -0.05	-0.179 to 0.001	0.279 to 0.438	0.118 to 0.293	-0.10 to 0.078	0.27 to 0.43
	P value	Ns	<0.01	ns	< 0.0001	< 0.0001	ns	< 0.0001
All female	No. of XY Pairs	259	257	259	259	257	257	258
	Pearson r value	0.022	-0.136	-0.056	0.372	0.159	0.07193	0.3717
	95% CI	-0.09 to 0.14	-0.25 to -0.014	-0.17 to 0.065	0.26 to 0.47	0.037 to 0.27	-0.05 to 0.19	0.26 to 0.47
	P value	Ns	<0.05	ns	< 0.0001	<0.05	ns	< 0.0001

FBS, fasting blood glucose; TC, total cholesterol; HDL, high density lipoprotein; LDL, low density lipoprotein; VLDL, very low density lipoprotein; TC/HDL, ratio of TCand HDL; LDL/HDL, ratio of LDL and HDL; TG, triglyceride; r, correlation coefficient; CI, Confidence interval. ns= non significant.

Table 2: Correlation analysis of fasting blood sugar (FBS) with each studied parameters in different groups of male population. (G1= group1, 20-34y, G2= group2, 35-54y, G3= group3, 55-75y)

	Parameter	TC	HDL	LDL	VLDL	TC/HDL	LDL/HDL	TG
G1m	No. of XY Pairs	84	84	84	84	84	84	84
	Pearson r value	0.247	0.0429	0.200	0.187	0.135	0.129	0.187
	95% CI	0.035 to 0.43	-0.17 to 0.25	-0.014 to 0.39	-0.028 to 0.38	-0.081 to 0.34	-0.087 to 0.33	-0.023 to 0.38
	P value	0.05	Ns	ns	ns	ns	ns	ns
G2m	No. of XY Pairs	228	227	228	228	227	227	228
	Pearson r value	0.026	-0.183	-0.144	0.388	0.284	-0.071	0.38
	95% CI	-0.10 to 0.15	-0.30 to -0.054	-0.27 to -0.015	0.27 to 0.49	0.16 to 0.40	-0.19 to 0.059	0.27 to 0.49
	P value	ns	<0.01	<0.05	< 0.0001	< 0.0001	ns	< 0.0001
G3m	No. of XY Pairs	153	153	153	153	153	153	153
	Pearson r value	0.065	-0.202	-0.091	0.44	0.228	0.043	0.44
	95% CI	-0.094 to 0.22	-0.35 to -0.045	-0.24 to 0.068	0.30 to 0.56	0.073 to 0.37	-0.11 to 0.20	0.30 to 0.56
	P value	ns	<0.05	ns	< 0.0001	<0.01	ns	< 0.0001

FBS, fasting blood glucose; TC, total cholesterol; HDL, high density lipoprotein; LDL, low density lipoprotein; VLDL, very low density lipoprotein; TC/HDL, ratio of TCand HDL; LDL/HDL, ratio of LDL and HDL; TG, triglyceride; r, correlation coefficient; CI, Confidence interval. ns= non significant.

Table 3: Correlation analysis of fasting blood sugar (FBS) with each studied parameters in different groups of female population. (G1= group1, 20-34y, G2= group2, 35-54y, G3= group3, 55-75y)

	Parameter	TC	HDL	LDL	VLDL	TC/HDL	LDL/HDL	TG
G1f	No. of XY Pairs	56	55	56	56	55	55	55
	Pearson r value	0.182	-0.192	0.155	0.283	0.325	0.309	0.278
	95% CI	-0.084 to 0.42	-0.43 to 0.076	-0.11 to 0.40	0.022 to 0.50	0.066 to 0.54	0.048 to 0.53	0.013 to 0.50
	P value	ns	ns	ns	<0.05	<0.05	<0.05	<0.05
G2f	No. of XY Pairs	122	121	122	122	121	121	122
	Pearson r value	-0.032	-0.124	-0.140	0.395	0.101	-0.021	0.395
	95% CI	-0.21 to 0.14	-0.29 to 0.055	-0.31 to 0.037	0.23 to 0.53	-0.078 to 0.27	-0.19 to 0.15	0.23 to 0.53
	P value	ns	ns	ns	< 0.0001	ns	ns	< 0.0001
G3f	No. of XY Pairs	68	68	68	68	68	68	68
	Pearson r value	-0.059	-0.169	-0.102	0.408	0.193	0.107	0.408
	95% CI	-0.29 to 0.18	-0.39 to 0.071	-0.33 to 0.13	0.18 to 0.58	-0.046 to 0.41	-0.13 to 0.33	0.18 to 0.58
	P value	ns	ns	ns	<0.001	ns	ns	<0.001

FBS, fasting blood glucose; TC, total cholesterol; HDL, high density lipoprotein; LDL, low density lipoprotein; VLDL, very low density lipoprotein; TC/HDL, ratio of TCand HDL; LDL/HDL, ratio of LDL and HDL; TG, triglyceride; r, correlation coefficient; CI, Confidence interval. ns= non significant.

DISCUSSION

The values of correlation coefficients indicated a moderate to weak degree of correlation of FBS with different lipid parameters, in different groups and subgroups of male and female population. However, a significant positive correlation of FBS with serum TG, VLDL, and TC/HDL and negative correlation with HDL indicated possible risk of induction of T2DM, CVD and their associated metabolic abnormalities in individuals of both sexes. Still, the percent and extent of relationship of these parameters with FBS was found to be different in individuals of different sex and age groups, but broadly it appeared that these non-diabetic individuals possibly are at pre-diabetic stage, which aggravated with age and observed to be prominent in men population. Since, no earlier study has been documented relating to these parameters, these results can be compared with other investigations in which long term

hyperglycaemia was observed to be correlated with the serum lipids [2,3,5,10]. Both carbohydrate and lipid metabolism are interconnected with their physiological pathways. Obviously alteration in one affects the other. Clinical study, on tribal population of Andhra Pradesh, showed a strong link between serum sugar and lipid levels in diabetic patients [11]. Similar results were also reported by Idogun et al. [12] and Albrki et al. [13] in different populations. However, earlier no such correlations were observed in non-diabetic healthy individual [6,8, 10]. In contrast to these findings, our test population exhibited a significant correlation of FBS with studied parameters, suggesting their prediabetic and deregulated metabolic condition. It appears that, Indian's genetic composition makes them more susceptible for diabetes and associated CVD. Of course dietary factors and physical activity also contribute significantly. Gotto [14] has found that increased TG itself can induce CVD in normal as well as in diabetic patients. and raised TG with hyperglycaemia support atherogenic state [7]. Besides this, parallel increase in TG worsens these complications by increasing serum LDL and decreasing HDL [7,11]. In addition, excess fat consumption may result in increased fat depot in liver, muscles and visceral organs that promote lipogenesis and leads to obesity. Our results showed increased values of TC/HDL and LDL/HDL again indicating an increased possibility of CVD and ischemic heart disease in our sample population, which was prominent in males, as also observed earlier [15,16]. Some anti-diabetic drugs are reported to have cardio-protective efficiency [17,18]. Some data also illustrated a negative impact of the antidiabetic drug on cardiac functions [19]. Along with this fact some anti-hyperlipidemic drug therapies also found to serve as diabetogen [8, 15, 16]. Thus, progression of diabetes may induce CVD and vice-versa. Consequently, these altered metabolic markers further negatively influence other cellular signalling processes including inflammatory pathways [20], increased hepatic flux of free fatty acids, intravascular lipolysis [21] and pancreatitis [20,21]. In the present study, normal individuals showed a significant correlation of FBS with lipid parameters, indicating the need to identify these border lined pre-diabetic individuals and then to take intensive interventional efforts with regular health check up [10,20,22]. Although, the present study was conducted involving limited number of human samples, this appears to be the first report demonstrating statistically significant alterations in public health status with respect to hyperglycaemia and CVDs. Furthermore, strong need for awareness programs to bringing about dietary changes, promotion of regular exercise and increased physical activity which may serve as effective ways to reduce/prevent the incidences of altered metabolism and the constantly increasing burden of diabetes and CVD in general population [2,4,20,23].

CONCLUSION

In conclusion, this study in normal population of both sexes showed fairly positive correlation of FBS with different cardiac risk factors. Although, FBS had no direct correlation with TC and LDL/HDL, a negative association was observed between FBS and HDL, which may indicate an increased risk for CVD, not due to increased TC but due to decreased HDL level. Additionally, in the given population, age dependent analysis indicated that males of higher age group and females of lower age group were at highest risk. Finally, there is a need for large scale metabolic screening and it is suggested that the people should be made aware for their health status and to improve their routine life.

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REFERENCES

1. Ibrahim R. Diabetes mellitus type2: review of oral treatment options. Int J Pharm Pharm Sci 2010;2:1-30.
2. Anjana RM, Pradeepa R, Deepa M, Datta M, Sudha V, Unnikrishnan R et al. Prevalence of diabetes and prediabetes (impaired fasting glucose and/or impaired glucose tolerance) in urban and rural India: phase I results of the Indian Council of Medical Research-India diabetes (ICMR-INDIAB) study. Diabetologia. 2011;54: 3022-7.
3. Sawant A, Mankeshwar R, Shah S, Raghavan R, Dhongde G, Raje H, et al. Prevalence of metabolic Syndrome in Urban India. Cholesterol 2011;2011:1-7.
4. Pandit K, Goswami S, Ghosh S, Mukhopadhyay P, Chowdhury S. Metabolic syndrome in South Asians. Ind J Endocrinol Metab 2012;16:44-5.
5. Durgawale P, Patil S, Shukla PS, Sontakke A, Kakade S, Yadav S. Evaluation of reference intervals of serum lipid profile from healthy population in western Maharashtra. Ind j Clin Biochem 2009;24:30-5.
6. Gupta R, Sharma KK, Gupta A, Agrawal A, Mohan I, Gupta VP et al. Persistent high prevalence of cardiovascular risk factors in the urban middle class in India: Jaipur Heart Watch-5. Indian Heart J 2012;60:11- 6.
7. Haffner SM. Insulin resistance, inflammation, and the prediabetic state. Am J Cardiol 2003;18:18-26.
8. Sattar N. Revisiting the links between glycaemia, diabetes and cardiovascular disease. Diabetologia. 2013;56: 686-95.
9. Parmar HS, Kar A. Protective role of Citrus sinensis, Musa paradisiaca, and Punica granatum peels against diet-induced atherosclerosis and thyroid dysfunctions in rats. Nutr Res 2007;27: 710–18.
10. Del PS. Glucose and LDL lowering: the need for intensive therapy. Curr Vasc Pharmacol 2012;10: 687-9.
11. Samatha P, Venkateswarlu M, Siva Prabodh V. Lipid Profile Levels in Type 2 Diabetes Mellitus from the Tribal Population of Adilabad in Andhra Pradesh, India. Clin Diagnos Res 2012;6: 590-2.
12. Idogun ES, Unuigbe EI, Ogunro PS, Akinola OT, Famodu AA. Assessment of the serum lipids in Nigerians with type 2 diabetes mellitus complications. Pak. J. Med. Sci. (Part 1) 2007;2: 708-12.
13. Albrki WM, Elzouki AN Y, EL-Mansoury ZM, Tashani OA. Lipid profiles in Libian type 2 diabetes. J Sci Appls 2007; 1:18-23.
14. Gotto AM. Triglyceride as a risk factor for coronary artery disease. Jr Am J Cardiol 1998;82: 22-5.
15. Lorenzo C, Hartnett S, Hanley AJ, Rewers MJ, Wagenknecht LE, Karter AJ, Haffner SM. . Impaired fasting glucose and impaired glucose tolerance have distinct lipoprotein and apolipoprotein changes: the insulin resistance atherosclerosis study. J Clin Endocrinol Metab 2013;98: 1622-30.
16. Penno G, Solini A, Bonora E, Fondelli C, Orsi E, Zerbini G, Trevisan R, Vedovato M, Gruden G, Laviola L,Nicolucci A, Pugliese G. Gender differences in cardiovascular disease risk factors, treatments and complications in patients with type 2 diabetes: the RIACE Italian multicentre study. J Intern Med. 2013; 274:176-91.
17. Panda S, Kar A. Periplogenin-3-O- -D-Glucopyranosyl -(1→6)- -D-Glucopyaranosyl- -(1→4) -D-Cymaropyranoside, Isolated from Aegle marmelos Protects Doxorubicin Induced Cardiovascular Problems and Hepatotoxicity in Rats. Cardiovasc Therap 2009; 27:108–16.
18. Sadikot SM, Singh V. Managing diabetes in India: paradigms in care--outcomes and analysis in a comprehensive, clinical practice survey of Indian physicians. J Indian Med Assoc 2011;109: 844-8.
19. Enas EA. Dyslipidemia in the Asian Indian population: unique aspects and implications for treatment. Am Assoc Physicians of Ind Origin 2002; 1-10.
20. Sparks JD, Sparks CE, Adeli K. Selective hepatic insulin resistance, VLDL overproduction, and hypertriglyceridemia. Arterioscler Thromb Vasc Biol 2012;32: 2104-12.
21. Klop B, Elte JW, Cabezas MC. Dyslipidemia in obesity: mechanisms and potential targets. Nutrients. 2013;5: 1218-40.
22. Mohan, Pradeepa R. Epidemiology of diabetes in different regions of india. Health Administrator 2009; 22:1- 18.
23. Dixit PK, Mittal S. A comprehensive review on anti-diabetic agents of herbal origin. Int J Pharm Pharm Sci 2013; 5:29-32.