Evaluation of Non-HDL-C and Calculated Lipid Profile Ratios among Pre-Diabetic Individuals

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Authors' contributions

This work was carried out in collaboration among all authors. All authors read and approved the final manuscript.

Original Research Article

ABSTRACT

Introduction: The worldwide prevalence of diabetes mellitus is rapidly increasing. The major concern is the complexity and mortality that are secondary to the complications of diabetes mellitus. One among the complications is dyslipidaemia which leads to atherosclerotic diseases. Pre-diabetes is a mid-state between non-diabetes and diabetes mellitus. They have a greater chance of progressing into the disease. Dyslipidaemia, a major aetiological factor for atherosclerosis, is also noted in pre-diabetic stage, report studies. This study was a cross-sectional study involving 26 non-diabetic controls, 26 prediabetic and 26 diabetic cases. The participants were of 18-45 years of age. The data was collected over a period of three months. The groups were classified based on their HbA1c concentration. The blood samples were analysed for fasting lipid profile and the parameters, Non-HDL-C, TC/HDL-C and LDL-C/HDL-C obtained by using respective methods. The obtained lipid profile parameters, Non-HDL-C, TC/HDL-Cand LDL-C/HDL-C were found to be increased in pre-diabetic subjects and diabetic subjects when compared to the healthy non-diabetic controls. The parameters also showed a positive correlation and was statistically highly significant among the three groups. There was a positive association observed among the groups for the calculated lipid profile parameters, Non-HDL-C, TC/HDL-C and LDL-C/HDL-C and were found to be directly proportional to HbA1c.

Keywords: Non-HDL-C; Total cholesterol / HDL-C; LDL-C / HDL-C and pre-diabetes.

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1. INTRODUCTION

Diabetes mellitus is one of the diseases familiar to human beings since the ancient ages. The disease has a heterogeneous etiology like genetic predisposition, lifestyle and the environmental factors. In the recent times the prevalence and incidence of diabetes mellitus has increased among the developing countries as well.

As per International Diabetes Federation (IDF) around 415 million diabetes mellitus patients were confirmed worldwide in 2015 and is feared to rise to 592 million cases in 2035 [1]. Diabetes mellitus cases in India was around 69.1 million and in Tamil Nadu it was 10.4 million in 2010, reports ICMR-INDIAB study [2].

Diabetes mellitus (DM) on a long-term basis results in the malfunction and irreversible damage to various organs [3]. The disease itself is preceded by a condition called as pre-diabetes. The condition is between the normoglycemic and hyperglycaemic levels of diabetes mellitus. There is a 50% chance for pre-diabetics to develop diabetes mellitus, reports a study [4]. Among the complications of diabetes mellitus, Cardio vascular disease (CVD) is the most common with around 80% of all-inclusive death in diabetes mellitus [5]. The risk is equally shared by pre-diabetes as well [6].

The major predisposing factor of CVD in diabetes mellitus is considered as dyslipidaemia which leads to the quickening of atherosclerosis. The importance of lipid profile ratios like Total cholesterol / HDL-C (TC/HDL-C) and Low Density Lipoprotein-Cholesterol / HDL-C (LDL-C/HDL-C) had been illustrated in various studies conducted [7]. Another parameter which gained clinical importance in the recent years is the Non-High Density Lipoprotein-Cholesterol (Non-HDL-C) in dyslipidaemic complications [8]. LDL-C/HDL-C and TC/HDL-C ratio can also be considered as potential markers for predicting glycaemic control in diabetes mellitus patients, reports a study [9]. Hence, this study was aimed at studying the lipid profile derived parameters like Non-HDL-C, TC/HDL-C and LDL-C/HDL-C among pre-diabetes and to compare the same with diabetes and non-diabetes.

2. MATERIALS AND METHODS

The data was collected retrospectively from the Clinical laboratory of the Department of Biochemistry at Sree Balaji Medical College Hospital over a period of three months.

Group-B 26pre-diabetics
Group-C 26 diabetics between the age group18-45

The participants with HbA1c values between 5.7 – 6.4 % were grouped together in Group-B and HbA1c ≥ 6.5 % were grouped under Group-C.

The Group-B participants were found to have pre-diabetic HbA1c incidentally concentration.

The Group-C participants were known Type-2 Diabetes mellitus patients on treatment being followed the General Medicine department. Patients with known dyslipidaemia and on treatment for the same were excluded from the study.

Serum samples from the study participants and the non-diabetic controls were collected by following the institutional ethical guidelines. Informed and written consent were obtained in the local language. Strict aseptic measures were followed in the sample collection procedure. The collected samples were analysed for HbA1c and lipid profile parameters like Total Cholesterol, HDL-C and LDL-C. The lipid profile parameters were analysed on the BS 480 Mindray and HbA1c was measured in BS 390 Mindray were based on their respective methods [Table 1]. Both are fully automated Biochemistry analysers.

The Non-HDL-C was calculated from the formula:

Non-HDL-C = Total Cholesterol - HDL-C.

The lipid profile ratios like TC/HDL-C and LDL-C/HDL-C were calculated from the lipid profile parameters. The normal ranges of Non-HDL-C, TC/HDL-C and LDL-C/HDL-C were obtained from the laboratory reference range.

Table 1. Parameters with their methods of estimation

Parameter	Method
HbA1c in %	Immunoturbidimetry
Total Cholesterol (mg/dl)	CHOD-POD
HDL-C (mg/dl)	Direct
LDL-C (mg/dl)	Direct

All the three groups, Group-A, Group-B and Group-C had their means and standard deviations (SD) calculated. Statistical Package for the Social Sciences (SPSS) version 17

software was used to perform the statistical analysis. Analysis of variance (ANOVA) waste method of comparison used to find the statistical significance and correlation of Non-HDL-C, TC/HDL-Cand LDL-C/HDL-C among the three groups (non-diabetics, pre-diabetics and diabetics). P ≤ 0.05 was considered significant.

3. RESULTS

HbA1c had a mean of5.4% in control Group-A. The pre-diabetic individuals in Group-B had a mean HbA1c of 6.05% whereas, Group-C diabetic subjects had 8.09% as mean HbA1c [Table 2]. The HbA1cvalues were used to divide the subjects into two groups namely, pre-diabetes and diabetes respectively as Group-B and Group-C.

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The parameters Non-HDL-C, TC/HDL-C and LDL-C/HDL-C were calculated from the lipid profile parameters for all the participants of the three groups.

The mean and SD of Non-HDL-C was 125.57±29.35 in Group-A controls. 144.10± 40.35and 161.60 ± 32.59 were the means and SD for Group-B and Group-C respectively. An increase in Non-HDL-C levels was observed in pre-diabetic and diabetic patients than the control group.

TC/HDL-C had a mean of 4.11 among pre-diabetics and 5.32 among diabetes patients, which shows an increase when compared to the non-diabetics with a mean of 3.32. The same trend was also noted with the LDL-C/HDL-C, with a mean of 2.1, 2.43 and 3.76 among non-diabetics, pre-diabetics and diabetics respectively.

Statistical analyses by ANOVA and Pearson's correlation were performed to determine the relationship between the parameters. P value < 0.01was considered as highly significant. The results obtained clearly show increased Non-HDL-C, TC/HDL-Cand LDL-C/HDL-C to a greater extent in Diabetes mellitus patients, lesser extent in Pre-diabetes group when compared to the non-diabetic controls, with a highly significant p < 0.01 [Table 2].

4. DISCUSSIONS

The study included three groups, non-diabetics, pre-diabetics and diabetics based on the HbA1c values. Lipid profile parameters were estimated from the fasting samples. Non-HDL-C, TC/HDL-C and LDL-C/HDL-C were calculated from the lipid profile. The means of the calculated lipid profile ratios showed a positive correlation among the groups and was found to be statistically highly significant in ANOVA study.

Another study reported TC/HDL-C ratio as the major predictor of vascular complications like atherosclerosis. The ratio was considered as the Hazard ratio [7]. In diabetes mellitus, Non-HDL-C can be considered as a better predictor of CVD, reports a study [8]. These studies concurred with the current study as the Non-HDL-Cand TC/HDL-C were found to be increased in pre-diabetes and diabetes. Triglyceride/HDL-C ratio was also associated with the risk of diabetes mellitus among elderly in China, a recent study reports [10]. The advantage of the current study is that, TC/HDL-C does not require a fasting sample.

The LDL-C/HDL-C ratio is termed as the Atherogenic index. The ratio was found to be positively correlated with the cardio vascular risk factors in two different populations, Malaysia and Iran [11,12]. This was in concordance with the current study as it showed a gradual increase in pre-diabetes and diabetes with a high statistical significance. There were various other studies conducted in other parts of India which showed similar results [13,14].

Table 2. The HbA1cvalues were used

Parameters	Normal range	Group - A	Group - B	Group - C	P value
HbA1c	< 5.7 %	5.40 ± 0.25	6.05 ± 0.26	8.09 ± 1.26	**<0.01**[*]
NON-HDL-C	< 130 mg/dl	125.57 ± 29.35	144.10± 40.35	161.60 ± 32.59	**<0.01**[*]
TC/HDL	3-5	3.32± 0.96	4.11 ± 0.92	5.32 ± 1.45	**<0.01**[*]
LDL/HDL	1.5-3.5	2.10± 0.57	2.43 ± 0.86	3.76 ± 0.78	**<0.01**[*]

*Values of Non-HDL-C, TC/HDL-C and LDL-C/HDL-Care expressed in mean ± standard deviation. The values are statistically significant based on the 'P' value. *P-value < 0.01*

The LDL-C/HDL-C ratio showed no significant increase in prediabetics when compared to the non-diabetic controls, reports a study [15]. This contrasted the current study.

Hence, there shall be further studies conducted on a larger population to understand the correlation of the lipid profile ratios with the complications of diabetes mellitus.

6. CONCLUSION

The study concludes with an increase in lipid profile calculated parameter and ratios like, Non-HDL-C, TC/HDL-C and LDL-C/HDL-C among diabetes mellitus compared to those with pre-diabetic range of HbA1c and controls. The parameters shall be used as predictors for atherosclerosis among pre-diabetes individuals during their follow-up visits to avoid major complications of diabetes mellitus.

7. LIMITATIONS OF THE STUDY

The study population shall be enlarged as it was relatively less.

CONSENT

As per international standard or university standard, Participants' written consent has been collected and preserved by the author(s).

ETHICAL APPROVAL

The ethical approval of the health care institution were strictly adhered to during the conduct of the study.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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