

Original Research Article

Prevalence and pattern of dyslipidemia in newly detected type 2 diabetes mellitus and its correlation with anthropometric parameters

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ABSTRACT

Background: Globally 425 million people have diabetes mellitus (DM) of which 90% are type 2 DM. India carries nearly 70 million cases of DM. India is called the diabetes capital of the world. The escalating epidemic of type 2 diabetes has been attributed to increasing obesity and longevity. Due to the additive cardiovascular risk of hyperglycemia and hyperlipidemia, lipid abnormalities should be aggressively detected and treated as a part of comprehensive diabetic care. The study aimed at detecting the occurrence and pattern of dyslipidemia in newly-detected type 2 diabetic patients in a tertiary care hospital in South India.

Methods: This cross-sectional study was conducted over a period of eighteen months. It comprised of 50 newly detected diabetics above the age of 18 years who satisfied the inclusion and exclusion criteria.

Results: Fifty patients were included in the study which included 18 males and 32 females. The body mass index (BMI) was abnormal in 62% (as per the Asian criteria) and in 42% (as per the WHO criteria). The waist circumference (WC) was found to be high in 82% and 70% as per the Asian and the WHO criteria, respectively. Forty six percent of the population was found to have elevated total cholesterol levels. LDL was increased in 70% of the study population while triglycerides were elevated in 40%, total cholesterol in 46% and low HDL in 76% of the patients.

Conclusions: A significant correlation was found between the fasting blood sugars (FBSs) and serum triglycerides. There was a positive correlation noted between the dyslipidemia and the anthropometric parameters recorded.

Keywords: Newly detected diabetes, Dyslipidemia, Body mass index, Waist circumference, Anthropometry in diabetics, Type 2 diabetes mellitus

INTRODUCTION

Diabetes is an iceberg disease, where much of the cases are largely undiagnosed or undetected. India is considered to be the diabetic capital of the world. Macrovascular complications in type 2 DM are coronary artery disease, cerebrovascular accidents and peripheral

vascular disease which are the major causes of morbidity and mortality in type 2 DM. Altered lipid metabolism and abnormal lipid levels are major contributors to macrovascular diseases. Despite its enormous global importance, accurate population based data with specific dyslipidemic patterns for the Asian population are lacking. Due to the additive cardiovascular risk of

hyperglycemia and hyperlipidemia, lipid abnormalities should be aggressively detected and treated as a part of comprehensive diabetic care. In view of this, this study was done to detect the occurrence and pattern of dyslipidemia in newly detected diabetic patients in a tertiary health care hospital in South India. An attempt was also made to relate the dyslipidemia to anthropometric parameters.

Objectives

The study was aimed to evaluate the occurrence and analyse the pattern of dyslipidemia in newly detected type 2 diabetics. It also assessed the relationship between anthropometric parameters and dyslipidemia.

METHODS

Fifty cases of newly detected diabetics presenting to the Father Muller medical college hospital, Mangalore, during the study period (September 2012 to March 2014) were included in the study.

Selection criteria

We included all newly detected type 2 DM who were >20 years of age. The exclusion criteria ruled out patients with acute metabolic complications, diabetic ketoacidosis, hyperglycemic hyperosmolar syndrome, acute illness, acute myocardial infarction, cerebrovascular accidents, alcohol dependence (according to the ICD-10 criteria), hypothyroidism (clinical/abnormal thyroid function test/thyroid replacement therapy), liver disorders (clinical findings/>3 ULN LFT), renal disease (of non-diabetic etiology), known inherited disorders of lipids, secondary dyslipidemia, pregnancy and drugs (beta blockers, steroids, hypolipidemic drugs, oral contraceptives, anti-coagulants).

After fulfilling the criteria in the study, a written consent was obtained from the study subjects. Ethical clearance was obtained for this study. Each participant was evaluated for BMI, WC and clinical features of dyslipidemia (which included arcus senilis, xanthelasma and xanthomas). A detailed clinical evaluation including history and physical examination was done on each subject.

Body weight was recorded using a digital weighing scale and the height was measured against a stadiometer. BMI was then calculated as weight (in kilograms) divided by squared height in meter. Waist circumference was measured mid-way between the iliac crest and lowermost margin of ribs at minimum respiration. The cut-offs applied were as follows,

WHO criteria

The WHO criteria was normal BMI: 18-24.9 kg/m²; overweight: >25 kg/m²; obesity: >30 kg/m²; WC was considered abnormal if >102 cms (for men) and >88 cms (for women).

Asian criteria

The Asian criteria was normal BMI: 18-22.9 kg/m²; overweight: 23-24.9 kg/m²; obesity: ≥25 kg/m²; WC was considered abnormal if >90 cms (for men) and >80 cms (for women).

Venous blood samples were obtained for glycosylated-hemoglobin, post-prandial blood sugar (PPBS), renal function test (serum creatinine) and liver function test (alanine transaminase and aspartate transaminases). Whenever there was a clinical suspicion of hypothyroidism, serum thyroid stimulating hormone (TSH) was done. Urine microscopy and urine albumin-creatinine ratio was obtained in all subjects. All patients were subjected to a fundoscopic evaluation to evaluate for diabetic retinopathy.

The data obtained was collected and the occurrence and pattern of dyslipidemia was analysed by frequency, mean, standard deviation and Chi-square test using SPSS for Windows version 22.0 (SPSS, Inc., Chicago, IL).

RESULTS

A total of fifty patients who were newly diagnosed with type 2 DM were included in the study. Among the 50 participants, 18 (32%) were males and 32 (64%) were females. There was a female to male ratio of 1.7:1 among the participants.

All patients included were above the age of 18 years. However, the mean age in this study was 53.6 years. On analysis of the dietary profile and lifestyle pattern, 98% were non-vegetarian while 58% of the participants led a sedentary lifestyle in comparison to the 42% who had an active lifestyle. The demographic and clinical data of the participants is presented in Table 1.

The BMI was analysed according to the Asian and the WHO classification. According to the Asian classification, one-fifth of the study population were found to be overweight while 42% were found to be obese. While, as per the WHO classification, only 28% were found to be overweight and a mere 14% were found to be obese. Similarly, when the measured WC was analysed, 86% were found to be abnormal (according to the Asian classification) but only 70% were found to be abnormal (as per the WHO classification). The anthropometric profile of the cases are shown in Figure 1.

Table 1: Demographic and clinical profile of participants.

Demographic and clinical characteristics	N=50 (%)
Mean age at presentation (in years)	53.6±13.9
Age category (in years)	
<40	10 (20)
41-50	14 (28)
51-70	19 (38)
>70	7 (14)
Gender	
Male	18 (36)
Female	32 (64)
Lifestyle pattern	
Active	21 (42)
Sedentary	29 (58)
BMI (mean) (in kg/m ²)	25.08±4.81
Waist circumference (mean) (in cms)	96.03±10.13
Fasting blood glucose (mean) (in mg/dl)	161.65±66.4
Post prandial blood glucose (mean) (in mg/dl)	206±90.3
HbA1c (mean)	8.07±1.94
Serum triglycerides (mean) (in mg/dl)	154±88.9
Serum cholesterol(mean) (in mg/dl)	200.9±48.1
Serum LDL (mean) (in mg/dl)	127±41.49
Serum HDL (mean) (in mg/dl)	40.2±14.5

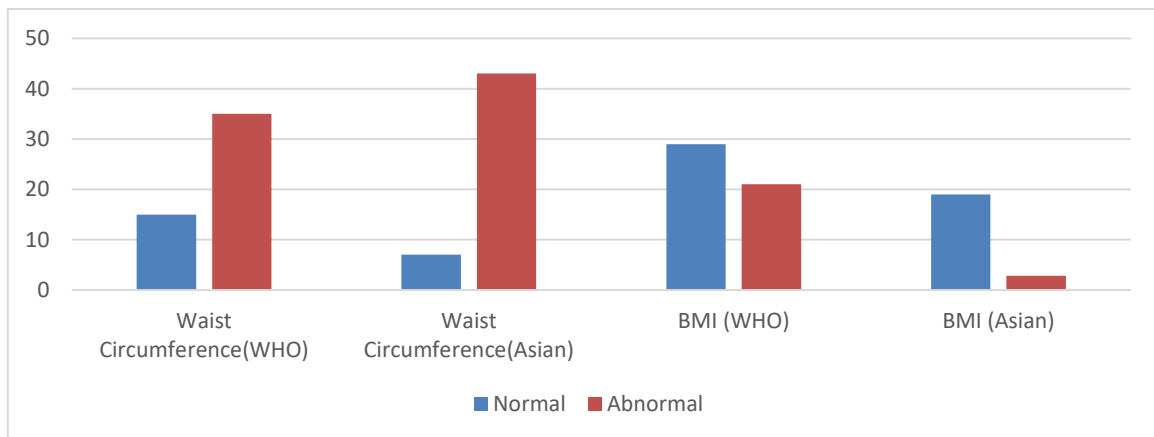


Figure 1: Anthropometric profile in newly detected type 2 diabetics; significant abnormality noted in the waist circumference in comparison to the BMI.

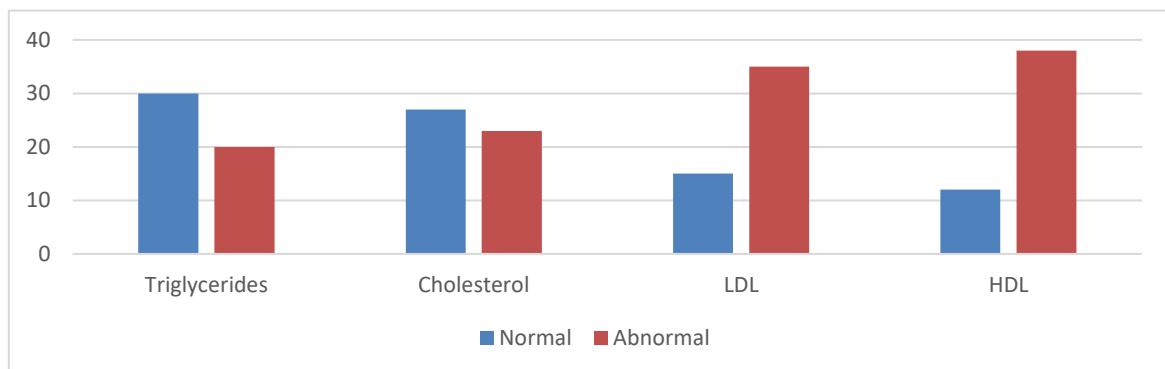


Figure 2: Cross-section of the lipid profile noted in the study; the most significant lipid abnormality was the low HDL followed by the elevated LDL.

The FBS values obtained from the study were analysed. Around one-third (30%) of the population had values between 126-150 mg/dl, twenty six percent had an FBS between 150-200 mg/dl. Only 8% had FBS above 200 mg/dl and another 8% had FBS above 250 mg/dl.

The PPBS values of the participants were found to have a distribution as follows. A PPBS between 200-250 mg/dl was found in 18%, between 251-300 mg/dl among 12%, between 301-350 mg/dl among 2%, between 351-400 mg/dl among 6% and only 4% above 400 mg/dl. Twelve percent of the newly detected diabetics had a normal FBS with an elevated PPBS, while 40% of the newly detected diabetics had an elevated FBS with a normal PPBS.

The glycated hemoglobin values showed elevated values (>6.5) among all the participants. A majority of the participants (76%) had values between 6.5-8, while only 8% and 16% had values from 8-10 and >10, respectively.

The triglyceride levels among the study participants were found to be elevated in 40% of the population. The total cholesterol levels were elevated in 46%, while LDL was abnormal in 70% and HDL was abnormal in 76% of the population. Figure 2 shows the profile of the serum lipid levels among the newly detected type 2 diabetics.

Abnormal urine albumin-creatinine ratio was found in 30% of the study. None of the participants showed evidence of diabetic retinopathy on fundoscopy.

A significant co-relation was found between FBS and the serum triglycerides with a Karl-Pearson correlation coefficient of 0.22 and a p value of <0.05. A significant correlation was also found between serum total cholesterol and serum triglycerides (p=0.009) as well as serum total cholesterol and serum LDL (p=0.00). There was also a significant correlation between serum HDL and serum triglycerides (p=0.035).

There was also a significant correlation (p<0.05) found between the FBS and the urine albumin-creatinine ratio. There was a significant correlation noted between the WC and the total cholesterol (p=0.005) as well as the WC and serum triglycerides (p=0.034). There was a significant correlation noted between the weight and serum LDL (p=0.027).

DISCUSSION

This study was aimed at analyzing the pattern of dyslipidemia in newly detected type 2 DM and to study the correlation between anthropometric parameters and diabetic dyslipidemia. Among the participant, there was a female to male ratio of 1.7:1. A study done in urban India in over ten thousand patients, showed a sex ratio of 1:1.³ Thus, the significance of the sex ratio in our study cannot be commented upon as the sample size in our study was small.

The mean age in our study was 53.6 years. Among the participants 38% (19) were between the 51-70 years age group as they were the largest group. In a study done in South India on the prevalence of diabetics, the Chennai urban rural epidemiology study (CURES), the maximum clustering (33.6%) and found to be between 60-69 years age group.⁴ Similarly, in a study done to assess the prevalence of type 2 DM in rural Kerala, a majority of the cases were found to be above the age of 60 years.⁵

More than 50% of our subjects were leading a sedentary life. Analysis of BMI and WC using both the WHO and Asian criteria showed differences in the prevalence of obesity. While applying the WHO criteria, a fewer number of participants were overweight or obese (46%) compared to the Asian criteria which showed 62% of the participants as overweight or obese. Almost 18% of our participants would have been labelled normal if only the WHO criteria was used. Also, when the Asian criteria was applied, the number of obese people was three times higher (21 versus 7). Similarly, the WC was found to be abnormal in 70% of our study subjects as per the WHO criteria but an additional 16% (86%) had a higher WC when the Asian criteria was applied.

There was substantial evidence from studies which indicate that Asians have a high risk of type 2 diabetes and cardiovascular risk at a BMI which was not even considered overweight according to the WHO criteria.⁶ A study done in Delhi also showed increased prevalence of cardiovascular risk among individuals who were considered non-obese according to the WHO criteria.⁷

Fasting hyperglycemia was more common than post-prandial hyperglycemia in our study subjects. About 72% (N=36) had fasting hyperglycemia and 40% showed isolated fasting hyperglycemia. Conversely, post-prandial hyperglycemia was seen in only 42% of the study subjects while a mere 12% showed isolated post-prandial hyperglycemia.

In a study done in Bangladesh, the usefulness of FBS, PPBS and HbA1c was compared in newly detected diabetics and known diabetics.⁸ It was found that FBS has a stronger association with hemoglobin glycation as compared to PPBS in DM. However, in contrast a systemic review and meta-analysis done on over 126 articles found a stronger association between PPBS and HbA1c as well as the overall glycemic control.⁹ This difference could be because our study focused on newly-detected diabetics only while the systemic review was done on studies which included known diabetics.

All our subjects had an elevated HbA1c. This could be attributed to our inclusion criteria which was based on the ADA recommendations 2009, which advocated the use of HbA1c as the third option to diagnose type 2 diabetes. A large community-based study in Chandigarh assessed the utility of HbA1c in the diagnosis of type 2 diabetes mellitus and found a significant specificity between the

HbA1c and the detection of type 2 diabetes.¹⁰ Glycated hemoglobin (HbA1c) has a greater stability and lesser biological variability in comparison to blood glucose levels and hence was a more consistent marker of hyperglycemia. Further, it did not need a fasting status and is not affected by acute perturbations like stress or exercise.¹¹

In our study subjects, the lipid profile was typical of an atherogenic dyslipidemia with low HDL levels (76%) being the most common lipid abnormality. A high LDL level was the next common (70%) lipid abnormality. There was also a significant correlation between the baseline weight recorded and the serum LDL levels ($p=0.027$). In contrary to a typical diabetic dyslipidemia where hypertriglyceridemia was expected to be predominant, only 40% of our study subjects were found to have a triglyceride value over 150 mg/dl. The median value of serum triglycerides was 127 mg/dl which a more representative value of the study population rather than the mean value (as there could be a skewed mean value due to a single high value of serum triglycerides in the study population). There was a significant correlation between the waist circumference and the serum total cholesterol ($p=0.005$) and serum triglycerides ($p=0.034$) noted in our study.

In a South-East Asian study on diabetic dyslipidemia done on newly detected diabetics, the most common dyslipidemia was found to be hypertriglyceridemia (81%) closely followed by low HDL (77.5%).¹² In a study on diabetic dyslipidemia in a representative population from three Indian states, low HDL was the most common lipid abnormality (72.3%).¹³ This is similar to the findings in our study and it could be due to the similar population in both the studies.

In a multi-centric study done on newly-detected diabetics in India (CINDI), it was found that the prevalence of dyslipidemia in newly-detected diabetics was 27%.¹⁴ However, details of diabetic dyslipidemia and anthropometry were not done in this study.

In another study on newly-detected type 2 diabetics done in urban Mysore city, women were found to be slightly overweight at the time of diagnosis when compared to the men (according to the Asian criteria). The BMI of the entire study population in this study was in the range of 23-27. Similarly, the WC in males was between 80-100cms and in females between 80-90 cms which was normal as per the Asian criteria for waist circumference. Thus the study concluded that significant obesity was not a common occurrence in their study population.¹⁵ However, this did not correlate with our findings as our study found a significant correlation between the anthropometric parameters and dyslipidemia.

Almost all (except one participant) in our study consumed a non-vegetarian diet. Being residents of the coastal district, most of them consumed fish regularly. A

majority of them consumed fish at least thrice a week among which sardines were the commonly consumed variety. Many epidemiological studies done on type 2 diabetics have shown a lesser prevalence of DM in coastal Indian cities like Mumbai (9.3% in 2001) and Chennai (13.5% in 2001) than in non-coastal cities like Hyderabad (16.6% in 2001).¹⁶ Thus, the coastal fish-consuming population in our study could also be having a protective effect from dyslipidemia and insulin resistance. This trend was also confirmed by statistics from the NCD risk factor surveillance which showed prevalence of type 2 DM to be 8.7% in the coastal city of Chennai compared to 10.5% in the non-coastal city of Delhi.¹⁷ This difference could be attributed to the food habits in these two regions particularly the higher rate of fish consumption by the coastal Indian population.

In a study done in Finland on the protective effects of omega-3 fatty acids in sardines, it has been proven that fish derived omega-3 fatty acids help reduce the risk of type 2 diabetes. Also, a protective range of omega-3 fatty acids have been found in the Asian population consuming food rich in omega-3 fatty acids.¹⁸ In our study, the lower than expected triglyceride levels could be attributed to the protective effect of omega-3 (fish-derived among the coastal population) on the serum triglyceride levels. A meta-analysis on the benefits of fish oil in diabetic dyslipidemia revealed that though fish oil did not favourably affect the glycemic control in diabetics, it lowers the triglyceride levels by almost 30%.¹⁹ This concurred the evidence found from our study as well.

A higher than normal urine albumin creatinine excretion was seen in 30% of our study subjects. Even though there was a positive correlation between the urine albumin excretion and fasting plasma glucose values, it did not have a statistical significance. In addition, the absence of diabetic retinopathy in our study subjects favoured hyperglycemia associated renal filtration as the explanation for the elevated serum albumin excretion. Population based studies done in Finland, show the prevalence of microalbuminuria in newly detected diabetics as 29%.²⁰ In an Indian study, 21% of the patients were found to have microalbuminuria (assessed by urine albumin creatinine ratio) at the point of initial diagnosis.²¹ These findings are comparable to our study where we found 30% of the newly-detected type 2 diabetics showing microalbuminuria.

Limitations

One of the foremost limitations of this study was its small sample size. Due to this, the findings of this study cannot be extrapolated to a larger population. Also, this was a cross-sectional study and patients were not followed up. Hence, there was paucity in details of outcomes in these patients in terms of future microvascular and macrovascular complications developed.

CONCLUSION

This study ascertained a positive correlation noted between FBS and serum triglycerides, thereby favouring an atherogenic dyslipidemia among the study population. It also showed a remarkable association between the dyslipidemia and the anthropometric parameters recorded. This shows that anthropometric parameters, which are often neglected in routine clinical evaluation play an important role in the early identification of dyslipidemia among newly detected type 2 diabetics. The unique feature among the spectrum of dyslipidemia was the higher frequency of low HDL among the study group rather than the high TG as expected in the Indian population. Thus, this study concludes that quick and inexpensive anthropometric parameters could point to the existence of lurking diabetic dyslipidemia in newly-detected type 2 diabetics, thereby propelling early detection and treatment of future cardiovascular complications.

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Conflict of interest: None declared

Ethical approval: The study was approved by the Institutional Ethics Committee

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