Original Article

Profile of type 2 diabetes mellitus patients attending family medicine clinic in a rural tribal locality in India

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Abstract

Objective: Diabetes prevalence has been predicted to reach 578 million worldwide in 2030 and is estimated to increase by 51% (700 million) in 2045. Type 2 diabetes mellitus (T2DM) is frequently associated with various cardiovascular (CV) risk factors secondary to associated dyslipidemias and good glycemic control is key for the prevention of long-term CV complications; this study was conducted to assess present glycemic status and lipid profile of the population residing in a rural tribal locality of Jharkhand (India). **Materials and Methods:** This cross-sectional study was conducted as a project for Fellowship in diabetes course by the Department of Endocrinology, DEDU, CMC Vellore. Whole blood and sera were analyzed for fasting blood sugar (FBS), glycated-hemoglobin (HbA1c), total cholesterol (CH), triglycerides (TGs), high-density-lipoprotein-cholesterol (HDL-C), low-density-lipoprotein-cholesterol (LDL-C), and very-low-density-lipoprotein-cholesterol (VLDL-C). A correlation test of HbA1c with lipid ratios and individual lipid indexes was done. **Results:** The mean Hb1Ac level was uncontrolled as 7.24 ± 1.80 and, interestingly, was marginally higher [7.31 ± 1.92 Vs 6.92 ± 1.16] in patients with T2DM <5 years as compared to those with T2DM >5 years. Mixed dyslipidemias were common with abnormal TG, LDL, VLDL, HDL, and total CH values. Hb1Ac levels showed a significant positive correlation with serum CH, TG, LDL, and VLDL levels, while a significant negative correlation with HDL levels in the study. **Conclusion:** Apart from being a reliable indicator of long-term glycemic control, HbA1c can also be used as a surrogate marker of dyslipidemia, and thus early diagnosis and treatment of dyslipidemia can prevent life-threatening cardiovascular complications that can be particularly useful in resource-poor rural tribal locality settings.

Keywords: Diabetes, Hb1Ac, lipid profile

Introduction

Diabetes mellitus global prevalence was estimated to be 9.3% (463 million people) in the year 2019, projected to rise to 10.2% (578 million) by 2030 and 10.9% (700 million) by 2045, which is frequently associated with various other cardiovascular (CV) risk factors.[1,2] Various studies have shown that the overall prevalence of dyslipidemia in India ranges from 10.0% to 93.0%.[2-5] It is well-established that dyslipidemia is a major risk factor for macrovascular complications in patients with type 2 diabetes mellitus (T2DM).[4-9] But, the important shortcoming of Indian epidemiological studies is the lack of large studies with details of patterns of dyslipidemia.[10] When compared with the Western populations, Indians and migrant South Asians tend to have higher TG levels and lower HDL cholesterol, while total cholesterol levels are lower when compared with studies from United States and United Kingdom.[11-13] Although diabetes and dyslipidemia commonly coexist in India, there is a lack of evidence on the pattern of dyslipidemia and whether dyslipidemia is adequately managed or not, particularly in rural populations in a real-world setting. Long-standing macro and microvascular complications are also common in Indian diabetics as compared to other races and ethnic groups.[16] In Asian Indians, abdominal obesity has been recognized as an important risk factor for

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CVD.[14-16] According to the ICMR-INDIAB study, the prevalence of abdominal obesity varied from 16.9% in Jharkhand to 36.3% in Chandigarh.[17]

A strong familial clustering of diabetic nephropathy in Indian T2DM was reported.[18] Strong clustering of cardiovascular risk factors or syndrome X – namely central obesity, hyperinsulinemia, dyslipidemia, hypertension, and glucose intolerance has been found in various studies.[18-22] Assessment of the level of diabetes control in a population using glycated hemoglobin (HbA1c) is a good indicator of the quality of diabetes care available to the population. Although few studies have assessed the quality of diabetes care in India, they either have confined themselves to clinic outpatients or have sampled individuals from small, geographically discrete urban areas.[23-27] Good glycemic control is key for the prevention of long-term complications of diabetes. Measurement of HbA1c is now universally accepted as the most reliable indicator of long-term-glycemic control because it accurately reflects individual's blood glucose levels over the preceding 2–3 months, but in rural settings, particularly in this part of India, this novel marker is infrequently used by local practitioners due to lack of awareness and logistic reasons. Various national and international diabetes organizations have defined targets for good glycemic control as an HbA1c level of below 7.0% or below 6.5%.[28,29] The situation is worse in developing countries, as a recent population-based study from China showed that only 39.7% of patients treated for diabetes had adequate glycemic control.[30,31] Previous studies from India have also highlighted the problem of poor attainment of glycemic targets among patients with diabetes; however, the majority of these studies have been clinic-based. In phase 1 of the INDIAB study, mean HbA1c levels were highest in Chandigarh (9.1 ± 2.3%), followed by Tamil Nadu (8.2 ± 2.0%), Jharkhand (8.2 ± 2.4%), and Maharashtra (8.0 ± 2.1%).[17] Good glycemic control (HbA1c <7%) was observed only in 31.1% of urban and 30.8% of rural subjects.[17] The Diabcare-Asia Study assessed diabetic patients recruited from 230 centers across 12 Asian countries; the Indian component of the study included 2,269 subjects from 26 centers, and the mean HbA1c level was found to be 8.9 ± 2.1%, with more than 83.0% of participants having HbA1c levels above 7.0%.[32] Association has also been noted of higher triglyceride levels with higher HbA1c levels as a likely reflection of poor glycemic control preceding hypertriglyceridemia.[17]

In view of the scarcity of information regarding the present glycemic status and dyslipidemia of the population residing in this rural tribal locality of Jharkhand, this noninterventional study was conducted to compare the findings of this study with earlier similar studies in the region.

Materials and Methods

This cross-sectional study was conducted between August 2019 to June 2020 in patients who were known as diabetic or Self-reported as having diabetes based on ADA guidelines or current use of medications for diabetes (insulin or oral hypoglycemic agents). A total of 105 patients participated voluntarily as they presented in the Private Clinic (OPD) of Dr Sumit Kumar, of which 97 patients diagnosed with T2DM were assessed during their treatment for Hb1Ac and dyslipidemias. The sample size was calculated using formulae based on mean ± standard deviation from similar phase 1 of the INDIAB study.[17] Ethical clearance and acceptance of the protocol of the research project were given by the Department of Endocrinology and Metabolism, CMC Vellore, as part of the project for the award of the Fellowship in Diabetes (DFID) course. "Written informed consent" was taken from the participant, and their participation was completely voluntary, and their right to refuse to participate in the study was respected.

Criteria for recruitment included T2DM patients between 30 and 65 years of age from both sexes with a history of treatment for diabetes for at least 6 months. Diabetic patients with co-morbidities like dyslipidemia, Gestational diabetes, Hypothyroidism, Chronic renal failure, Pancreatitis, or endocrinopathies like acromegaly, Cushing's syndrome, hyperthyroidism, etc., were excluded from the study. After enrollment, participants were subjected to detailed history and general physical examination, and findings were recorded in a predesigned proforma.

Statistical analysis of the data was done using Statistical Package for the Social Sciences software, IBM SPSS (Statistics for Windows) Version 28.0. Armonk, NY: IBM Corp; 2021. Continuous variables were checked for normality, and results were expressed as mean ± standard deviation. Correlation studies between HbA1c and lipid profile parameters such as CH, TGs, HDL, LDL, and VLDL were done by Pearson correlation (r) test. The "*P* value" <0.05 was taken as significant (S).

Results

Out of 105 patients with diabetes, 3 were diagnosed with T1DM (male/female ratio = 1:2), and 05 patients were diagnosed with gestational diabetes mellitus [Figure 1a]. The rest of 97 patients of T2DM [male: 56 and female: 41] were enrolled in the study [Figure 1b]. Most of T2DM patients were Hindus, followed by Muslims and Christians [Figure 2]. The mean age of the study population was 53.8 ± 9.9 years [male: 53.5 ± 9.4 and female: 54.2 ± 10.6 years [Figure 3].

The mean duration of diabetes was 3.06 ± 2.18 years, of which 11.3% (n = 11) of patients had DM since >5 years, while 38.1% (n = 37) had DM for 2-5 years and 50.5% (n = 49) had DM <2 years. The mean duration of diabetes in male and female DM patients was 2.8 ± 1.73 and 3.41 ± 2.67 years, respectively [Figure 4].

The mean Hb1Ac of the study population was 7.24 ± 1.80 [male: 7.13 ± 1.81 vs. female: 7.38 ± 1.81]. The mean Hb1Ac was interestingly higher in patients with DM <5 years than

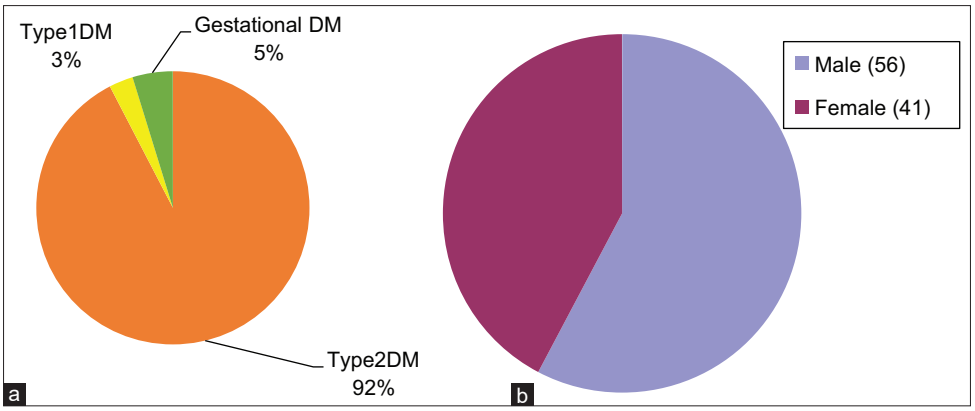

Figure 1: (a) Composition of Diabetes patients in the study (n = 105) (b) Gender composition of T2DM patients in the study (n = 97)

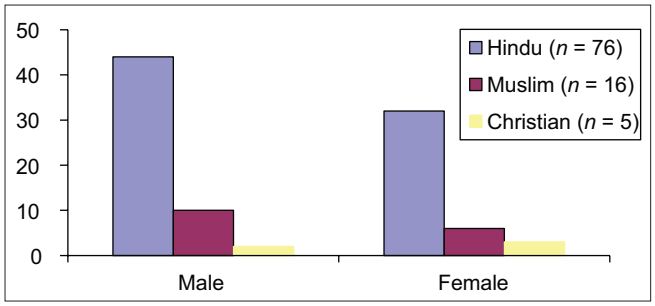

Figure 2: Religion wise distribution of T2DM patients in the study (n = 97)

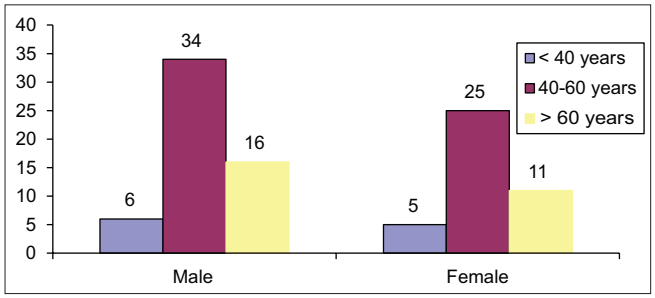

Figure 3: Age wise distribution of T2DM patients in the study (n = 97). [mean age = 53.8 ± 9.9 years (male: 53.5 ± 9.4 and female: 54.2 ± 10.6 years)]

DM >5 years [7.31 ± 1.92 vs. 6.92 ± 1.16]. The mean average glucose level of venous blood in the study was 163.69 ± 50.62 mg/dl [male: 160.68 ± 50.78 mg/dl and female: 167.80 ± 50.72 mg/dl]. The mean average glucose level of venous blood was marginally higher with DM duration <5 years than DM >5 years [165.72 ± 53.85 mg/dl vs. 154.78 ± 32.53 mg/dl]. The mean Hb1Ac was also higher in DM patients who were irregular in treatment and follow-up in the last 6 months than those who were regular in treatment and follow-up [8.75 ± 1.50 vs. 6.08 ± 0.97].

About 65.9% of patients [n = 64] had high serum TG levels, while 64.9% [n = 63] and 63.9% [n = 62] had elevated serum VLDL and LDL levels, respectively, but only 30.9% [n = 30] of DM patients had CH levels well above normal range [Figure 5].

The mean serum CH, TG, HDL, LDL, and VLDL levels in the study population were 190.11 ± 47.65 mg/dl, 186.98 ± 77.39 mg/dl, 42 ± 7.81 mg/dl, 115.38 ± 41.28 mg/dl, and 37.21 ± 15.61 mg/dl respectively. The mean serum HDL levels in patients with DM for more than 5 years were interestingly marginally lower than in patients diagnosed and treated for diabetes for less than 5 years [39.5 ± 3.55 mg/dl vs. 42.57 ± 8.40 mg/dl]. The mean HDL level was also lower in patients who presented with some neurological complication [39.98 ± 6.09 mg/dl Vs. 44.53 ± 8.99 mg/dl] than those with no complication at presentation.

In the present study, 55.7% (n = 54) DM patients presented with some neurological complication as pain, paresthesia, numbness, etc., The mean duration of diabetes in patients who presented with complications was 3.74 ± 2.48 years. The mean Hb1Ac value in patients presenting with some complication was 8.18 ± 1.77, with average venous blood glucose value of 190.07 ± 49.87 mg/dl. The mean Hb1Ac, average blood glucose, and serum TG values of those patients who were diagnosed during the last 1 year were 7.56 ± 2.27, 172.84 ± 63.53 mg/dl, 210.76 ± 95.53 mg/dl, respectively, which were the highest compared to any group of patients who had diabetes with duration of illness more than 1 year in the study.

Age of DM patients showed a positive correlation with the presence of hypertension as their co-morbidities which was significant at 0.05 level (two-tailed) in the Pearson coefficient test (r = 0.215 and P value = 0.035) while showing a negative correlation with both serum TG and serum VLDL levels both significant at 0.01 levels (two-tailed) [Figure 6a and b].

Duration of diabetes (in years) in DM patients showed a positive correlation with neurological complications at presentation in the study (r = 0.349 and "P value" <0.01). Duration of diabetes (in years) in DM patients showed a negative correlation with the Hb1Ac values in these patients but was non-significant (r = -0.142 and P value = 0.164). Hb1Ac values in diabetic patients in the study also showed a positive correlation with the presenting complications in these patients (r = 0.588; P value < 0.01).

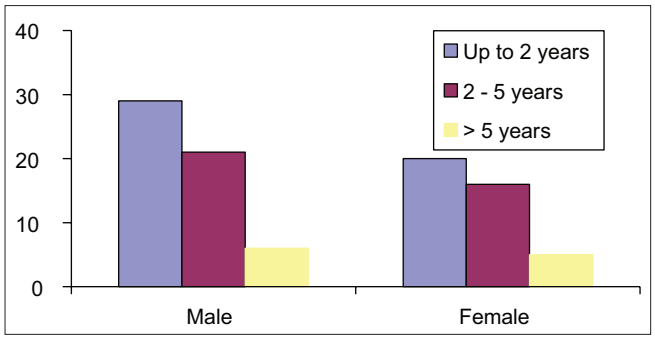

Figure 4: Mean duration of Diabetes in T2DM patients enrolled for the study (*n* = 97)

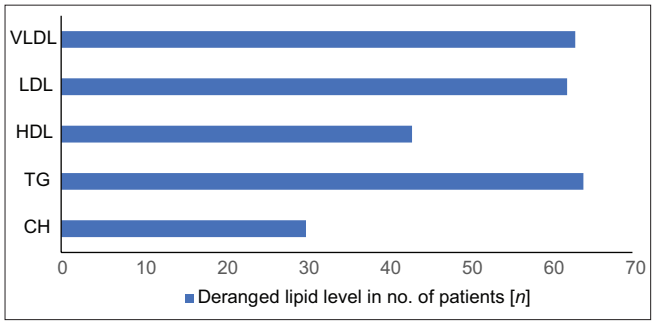

Figure 5: Serum Lipid Profile Levels of T2DM patients [*n*] in the study

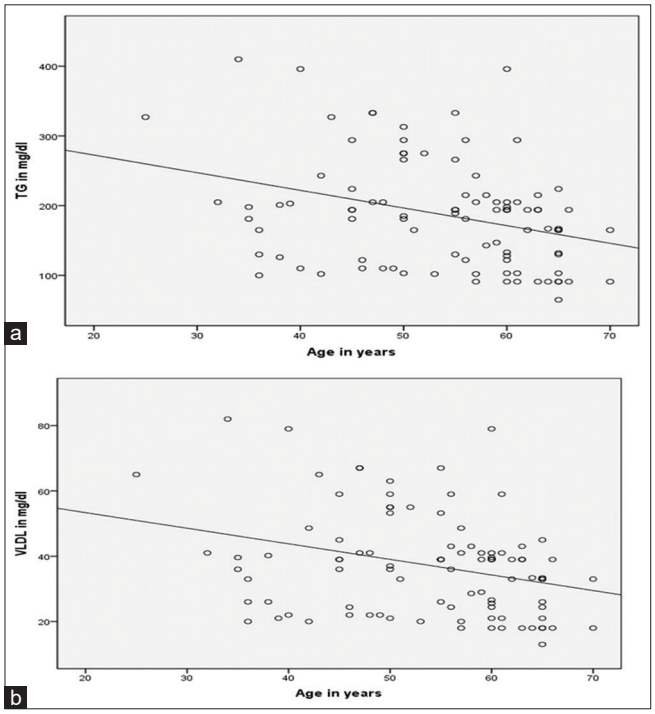

Figure 6: (a) Significant correlation of age with serum TG in T2DM patients in the study. (b) Significant correlation of age with serum VLDL in T2DM patients in the study

Hb1Ac levels showed a significant positive correlation with serum cholesterol, serum TG, serum LDL, and serum VLDL levels in the study, while Hb1Ac levels showed a significant negative correlation with serum HDL levels [Figure 7a-e].

Hb1Ac levels also showed a significant positive correlation with neurological complications (numbness or pain or paresthesia), as complained by DM patients in the study [Figure 8].

Discussion

DM patients have been shown to have around two to fourfold increased risk of cardiovascular, peripheral vascular, and cerebrovascular disease, which happens to be the leading causes of morbidity and mortality in this population. Many studies have shown an association between cardiovascular diseases and diabetic dyslipidemia, which is characterized by hypertriglyceridemia, low levels of HDL cholesterol, dense LDL-cholesterol particles, and postprandial lipemia.[2-6,33-37]

The prevalence of dyslipidemias in the present study (82.5%) was comparable with studies done on DM patients by previous studies.[3-5] Various studies have shown that the overall prevalence of dyslipidemias in India ranges from 10.0% to 93.0%.[2]

Previous studies have also reported almost similar findings, which reported combined dyslipidemias as the most common type with TG and LDL levels outside recommended levels in most of studies.[3-11,15,17,18,20,26,27] Although decreased serum HDL level was reported as the most common abnormality in some other studies.[5-8,10,11,15] Contradictory to the present study, Ahmad N *et al.*[38] in the study on DM patients reported normal serum HDL levels. Abnormal lipid profile parameters observed in T2DM might have been related to insulin resistance, which might be associated with diabetic dyslipidemia and hypertension. Lipoprotein lipase (LPL), an insulin-dependent enzyme that, together with insulin resistance, appears to lead to an increase in serum TG levels, while serum HDL levels may be further reduced in DM due to elevated hepatic lipase activity that catalyzes serum HDL levels.[5]

In the present study, it was observed that uncontrolled diabetes with abnormal Hb1Ac levels was present in 62.88% of DM patients, which was comparable with a previous study done by Unnikrishnan R *et al.*[23] and Menon VU *et al.*,[26] while Saydah SH *et al.*[9] reported that 92.7% of DM patients had abnormal Hb1Ac values whereas Nagpal J *et al.*,[27] Raheja BS *et al.*[25] from Diab-Care-Asia study and Chuang LM *et al.*[32] reported abnormal Hb1Ac levels of around 42%, 50%, and 55%, respectively, in their study.

The reported mean Hb1Ac level in the present study is comparable with the findings of ICMR-INDIAB study by Unnikrishnan R *et al.*[23] and Menon VU *et al.*,[26] whereas mean Hb1Ac levels reported by Mohan V *et al.*[24] and Raheja BS *et al.*[25] are much higher as 9.2% and 8.9 ± 2.1%, respectively. Unnikrishnan R *et al.*[23] also reported that the highest mean Hb1Ac values were found in the younger age group compared to the older age group, which is consistent with the findings in our study while contradictory to our findings, Mohan V *et al.*[24] reported that diabetes control was worse in those with a longer duration of diabetes (9.9 ± 5.5 years).

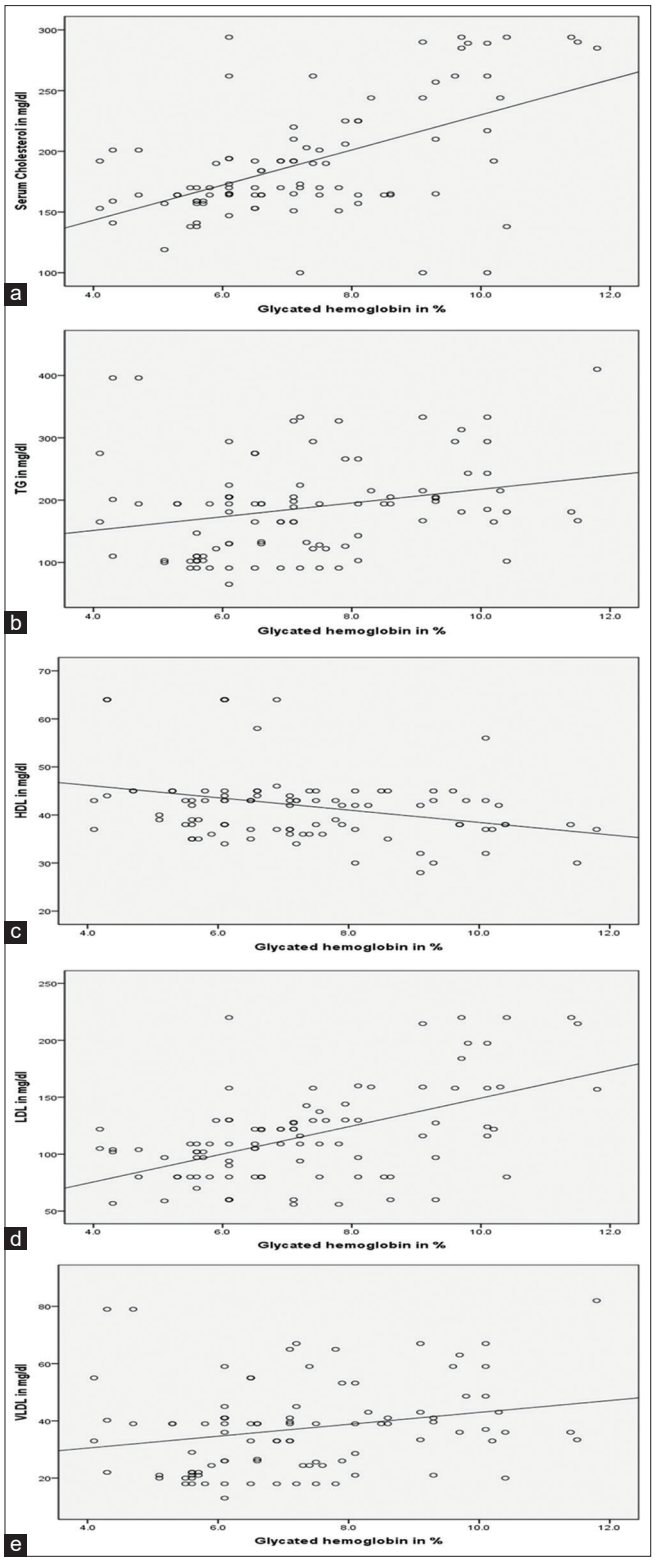

Figure 7: (a) Significant correlation of Hb1AC with serum cholesterol in T2DM patients in the study. (b) Significant correlation of Hb1AC with serum TG in T2DM patients in the study. (c) Significant correlation of Hb1AC with serum HDL in T2DM patients in the study. (d) Significant correlation of Hb1AC with serum LDL in T2DM patients in the study. (e) Significant correlation of Hb1AC with serum VLDL in T2DM patients in the study

The age of the diabetic patients in the present study showed a significant positive correlation with the presence of hypertension as their co-morbidities which is consistent with findings of studies done by Misra A *et al.*[14-16] and Pradeepa R *et al.*[17]

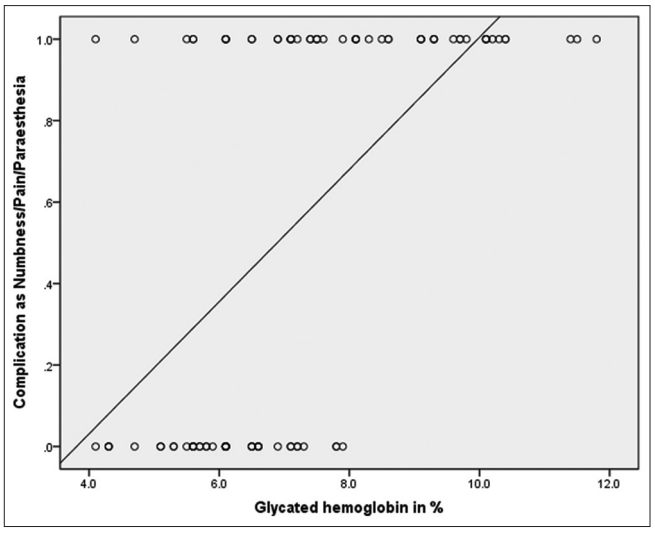

Figure 8: Significant correlation of Hb1AC with the presence of complications in T2DM patients

Serum lipid profile levels among diabetics in the present study showed that the age of the patients had a negative correlation with both the serum TG levels and the serum VLDL levels which were both significant at 0.01 levels (two-tailed) [Figure 7a and b], which might be suggesting a better awareness and compliance with lipid-lowering medications in elderly diabetic population in the present study.

Different studies reported different relationships between glycemic control of DM and serum lipid levels. In some studies, there was a positive correlation between HbA1c and serum lipid profiles of DM patients.[38] However, in some studies, no correlation was reported between serum HbA1c and serum lipid profiles of DM patients.[26] In the present study, significant relation between HbA1c level and serum lipid parameters including TG, LDL, and HDL levels ("*P* value" <0.05) is consistent with the findings ofAhmed N *et al.*[38] and Hussain A *et al.*,[39] whereas Begum A *et al.*,[40] although showed significant correlations between HbA1c value and serum levels of TC, TG, and HDL-C similar to findings in the present study but no significant correlation of HbA1c value with LDL level was present in DM patients in their study.

Unnikrishnan R *et al.*,[23] from the ICMR-INDIAB study reported that increased duration of diabetes was associated with increased complications in DM patients like findings in our study, whereas findings from the study by Raheja BS *et al.*,[25] reported the correlation of Hb1Ac values with duration of diabetes which is not coherent with our study.

Conclusion

Our results show that glycemic control in a rural tribal locality of Jharkhand is poor, with only around a third of DM patients

in the study exhibiting good glycemic control and a significant proportion having HbA1c levels >7.0%. Diabetic dyslipidemias exists in many patients with uncontrolled DM patients with a grave risk of developing macro-and-microvascular complications. In this challenging scenario, aside from being a reliable indicator of long-term glycemic control, HbA1c can also be used as a surrogate predictor of dyslipidemia and, thereby, early diagnosis and treatment of dyslipidemia, preventing life-threatening complications in DM patients.

Limitation of the study

Although the present study is not exhaustive, it provides a glimpse into the glycemic status and dyslipidemia of the population residing in the locality. Due to the limitation of resources, only those patients who could afford the biochemical tests for lipid profile and Hb1Ac were included in the study. This limited the chance of the study population being representative of the total local general population, and most of the participants were representing people from middle to high socioeconomic class, but some patients from lower socioeconomic status also participated in the study but were mostly irregular in their treatment and follow-up due to logistic reasons. Examination of complications in these patients was limited to only clinical examinations as specialized test facility was unavailable in the locality.

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Nil.

Conflicts of interest

There are no conflicts of interest.

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