MAK HILL Publications International Journal of Tropical Medicine

Research Article
doi: 10.59218/makijtm.2024.2.1.6

Glycemic Control and Dyslipidemia in Type 2 Diabetes: Observations from an Indian Tribal Population

[1]Shashank Tyagi, [2]Himanshu Singh, [3]Madhav Kadam and [4]Smita Doharey

[1]Department of Biochemistry, SRVS Government Medical College, Shivpuri, Madhya Pradesh, India

[2]Department of Internal Medicine, MGM Medical College, Indore, Madhya Pradesh, India

[3]Department of Biochemistry, NSC Government Medical College, Khandwa, Madhya Pradesh, India

[4]Department of Pathology, SRVS Medical College, Shivpuri, Madhya Pradesh, India

ABSTRACT

Diabetes and dyslipidemia frequently occur together and are linked with various cardiovascular risk factors. Effective glycemic control is crucial for preventing long-term cardiovascular complications. Despite the common occurrence of diabetes and dyslipidemia in India, there is limited evidence on the pattern of dyslipidemia and its management, especially in rural populations. This study aimed to evaluate the current glycemic status and lipid profile of individuals living in a rural tribal area of India. This cross-sectional study was conducted in a tribal area of India. Fasting blood sugar, 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) levels were analyzed in diabetic patients. Correlation analysis between HbA1c and lipid parameters was performed. The mean HbA1c level was slightly higher in patients with diabetes mellitus (DM) for less than 5 years compared to those with DM for more than 5 years. Mixed dyslipidemias were common, with abnormalities observed in TG, LDL-C, VLDL-C, HDL-C and total CH levels. HbA1c levels exhibited significant positive correlations with serum CH, TG, LDL-C and VLDL-C levels and a significant negative correlation with HDL-C levels. In addition to being a reliable indicator of long-term glycemic control, HbA1c can serve as a predictor of dyslipidemia. Early detection and management of dyslipidemia based on HbA1c levels can help prevent cardiovascular complications, potentially saving lives.

OPEN ACCESS

Key Words
Diabetes, dyslipidemia, hemoglobin, lipid-profile

Corresponding Author
Smita Doharey,
Department of Pathology, SRVS Medical College, Shivpuri, Madhya Pradesh, India
smita.doharey132@gmail.com

Author Designation
[1]Professor and Head
[2]Ex Senior Resident
[3]Assistant Professor
[4]Senior Resident

Received: 24 December 2023
Accepted: 20 February 2024
Published: 27 February 2024

Citation: Shashank Tyagi, Himanshu Singh, Madhav Kadam and Smita Doharey, 2024. Glycemic Control and Dyslipidemia in Type 2 Diabetes: Observations from an Indian Tribal Population. Int. J. Trop. Med., 19: 1-6, doi: 10.59218/makijtm.2024.2.1.6

Copy Right: MAK HILL Publications

INTRODUCTION

The prevalence of dyslipidemia in India ranges from 10.0-93.0%[1,2], with dyslipidemia being a recognized major risk factor for macrovascular complications in individuals with type-2 diabetes mellitus (T2DM)[1-4]. However, a notable gap in Indian epidemiological research is the lack of large-scale studies delineating dyslipidemia patterns[5]. Indian and migrant South Asian populations typically exhibit higher triglyceride levels and lower high-density lipoprotein (HDL) cholesterol compared to Western populations, with total cholesterol levels being lower in comparison to studies from the US and UK[6-8]. Despite the common occurrence of diabetes and dyslipidemia in India, evidence regarding dyslipidemia patterns and management adequacy, particularly in rural settings, is limited. Long-standing macro- and microvascular complications are prevalent among Indian diabetic populations compared to other racial and ethnic groups[9].

Assessing diabetes control using glycated hemoglobin (HbA1c) serves as a reliable indicator of the quality of diabetes care available to the population. Although few studies have assessed diabetes care quality in India, they typically focus on clinic outpatients or sample individuals from small, geographically distinct urban areas[10-14]. Adequate glycemic control is crucial for preventing long-term diabetes complications. HbA1c measurement is universally accepted as the most reliable indicator of long-term glycemic control, reflecting an individual's blood glucose levels over the preceding 2-3 months. Various national and international diabetes organizations have established targets for good glycemic control, recommending HbA1c levels below 7.0% or 6.5%[15,16]. This situation is exacerbated in developing countries; a recent population-based study from China revealed that only 39.7% of treated diabetes patients achieved adequate glycemic control[17,18]. Previous studies from India have similarly highlighted the challenge of poor glycemic target achievement among diabetic patients, although these studies are predominantly clinic-based[19].

Given the lack of information regarding the current glycemic status and dyslipidemia prevalence among the rural tribal population of India, this non-interventional study was conducted to compare findings with earlier similar studies.

MATERIALS AND METHODS

This cross-sectional study was conducted among patients who were either known diabetics or self-reported as having diabetes according to ADA guidelines, or were currently using medications for diabetes (insulin or oral hypoglycemic agents). A total of 123 patients with T2DM voluntarily participated in the study while seeking treatment. They were assessed for HbA1c levels and dyslipidemias.

The recruitment criteria included T2DM patients aged 30 to 65 years of both sexes who had been receiving treatment for diabetes for at least 6 months. Patients with comorbidities such as acromegaly, chronic renal failure, Cushing's syndrome, dyslipidemia, endocrinopathies such as gestational diabetes, hyperthyroidism, hypothyroidism, and/or pancreatitis were excluded from the study. After enrollment, participants underwent a detailed medical history and general physical examination, with findings recorded using a predetermined form.

Statistical analysis was performed using IBM SPSS Statistics for Windows, Version 22. Continuous variables were assessed for normality and expressed as Mean±standard deviation. Correlation studies between HbA1c and lipid profile parameters including total cholesterol (CH), triglycerides (TGs), high-density lipoprotein (HDL), low-density lipoprotein (LDL) and very-low-density lipoprotein (VLDL) were conducted using Pearson correlation (r) test, with significance set at $p<0.05$.

RESULTS

In the investigation, 123 individuals diagnosed with diabetes participated, with a predominance of males and adherents to the Hindu faith, followed by Muslims and Christians (Fig. 1 and Table 1). The average age of the study cohort was 52.7±8.9 years, with males averaging 52.4±8.5 years and females 53.1±10.7 years. The average duration of diabetes was 3.05±2.21 years, with males exhibiting a mean of 2.7±1.69 years and females 3.39±2.65 years.

The current investigation revealed an overall prevalence of dyslipidemias of 82.61%, with approximately 65.85% of patients (n = 81) exhibiting

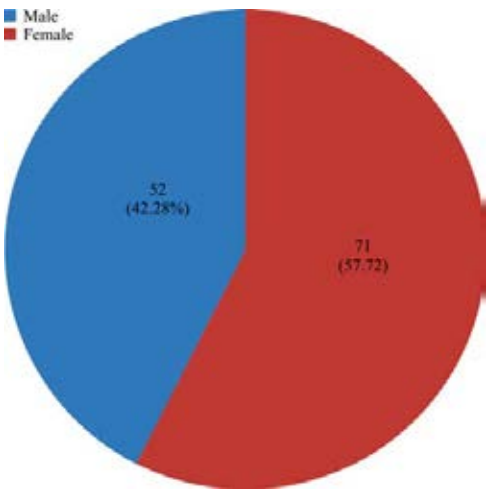

Fig. 1: Gender distribution among study participants

Table 1: Socio-demographic and clinical parameters of study participants

	Male		Female	
Variables	n	Percentage	n	Percentage
Age				
<40 years	8	6.50	6	4.88
40-60 years	43	34.96	32	26.02
>60 years	20	16.26	14	11.38
Religion				
Hindu	55	44.72	40	32.52
Muslim	13	10.57	8	6.50
Christian	3	2.44	4	3.25
Duration of T2DM				
<2 years	36	29.27	26	21.14
2-5 years	27	21.95	20	16.26
>5 years	8	6.50	6	4.88

Table 2: Lipid Profile parameters in study participants

Serum Component (mg dL^{-1})	Value (Mean±SD)
Total Cholesterol (CH)	191.05±46.78
Triglycerides (TG)	186.42±77.92
High-Density Lipoprotein (HDL)	41.95±7.57
Low-Density Lipoprotein (LDL)	115.95±41.65
Very Low-Density Lipoprotein (VLDL)	36.97±15.47

Table 3: Derangements in Lipid Profile parameters in study participants

Lipid Profile Derngement	n	Percentage
Elevated CH	38	30.89
Elevated TG	81	65.85
Low HDL	61	49.59
Elevated LDL	79	64.23
Elevated VLDL	80	65.04

Table 4: Correlation of age with various parameters (Pearson's correlation)

Parameter	r	p-value
HTN as co-morbidity	0.212	<0.05
Serum TG	-0.245	<0.05
Serum VLDL	-0.318	<0.05

Table 5: Correlation of HbA1c with various parameters (Pearson's correlation)

Parameter	r	p-value
Total Cholesterol (CH)	0.218	<0.05
Triglycerides (TG)	0.294	<0.05
High-Density Lipoprotein (HDL)	-0.239	<0.05
Low-Density Lipoprotein (LDL)	0.312	<0.05
Very Low-Density Lipoprotein (VLDL)	0.217	<0.05

elevated serum triglyceride (TG) levels, while 65.04% (n = 80) and 64.23% (n = 79) displayed elevated serum very-low-density lipoprotein (VLDL) and low-density lipoprotein (LDL) levels, respectively. However, only 30.89% (n = 38) of diabetic patients exhibited cholesterol (CH) levels well above the normal range (Table 2 and 3).

The age of diabetic patients demonstrated a positive correlation with the presence of hypertension as a comorbidity but exhibited a negative correlation with both serum TG and serum VLDL levels (Table 4).

The mean glycated hemoglobin (HbA1c) level in the study population was 7.31±1.76, with males at 7.07±1.83 and females at 7.45±1.79. A notable 62.60% (n = 77) of diabetic patients had HbA1c levels above the normal range. Furthermore, HbA1c levels exhibited significant positive correlations with serum cholesterol, TG, LDL and VLDL levels, while demonstrating a significant negative correlation with serum high-density lipoprotein (HDL) levels (Table 5). The mean HbA1c, average blood glucose and serum TG values among patients diagnosed within the last year were notably higher compared to other patient groups.

DISCUSSION

The prevalence of dyslipidemias in the current study aligns with various previous studies, which have reported an overall prevalence ranging from 10.0% to 93.0%[1,2,20,21]. These previous studies have also indicated combined dyslipidemias as the most common type, with elevated triglyceride (TG) and low-density lipoprotein (LDL) levels being found outside recommended ranges[12,13,19,22,23]. Some studies have additionally highlighted decreased serum high-density lipoprotein (HDL) levels as the most common type of dyslipidemias in diabetes mellitus (DM) patients[1,3,5,6]. However, contrary to the present study, Ahmed *et al*.[24] reported normal serum HDL levels in DM patients.

In the present study, it was observed that about 63% of DM patients had uncontrolled diabetes with abnormal HbA1c levels, a finding consistent with previous studies by Unnikrishnan *et al*.[10] and Menon *et al*.[12]. However, Saydah *et al*.[4] reported a higher proportion (92.7%) of DM patients with abnormal HbA1c values, while Nagpal and Bhartia[13], Raheja et al.[10] from the Diab-Care-Asia study and Chuang *et al*.[25] reported abnormal HbA1c levels of approximately 42, 50 and 55%, respectively, in their studies. The mean HbA1c level reported in the present study is comparable to the findings of the ICMR-INDIAB study by Unnikrishnan *et al*.[10] and Menon *et al*.[12], while Mohan *et al*.[11] and Raheja *et al*.[10] reported much higher mean HbA1c levels of 9.2 and 8.9±2.1%, respectively.

Furthermore, the age of diabetic patients in the present study showed a significant positive correlation with the presence of hypertension as a co-morbidity, consistent with findings from studies by Misra and Shrivastava[26] and Pradeepa *et al*.[19]. Serum lipid profile levels among diabetics in the present study indicated a negative correlation between patient age and serum TG levels and serum very low-density lipoprotein (VLDL) levels. This observation might suggest better awareness and compliance with lipid-lowering medications among the elderly diabetic population in the present study.

The abnormal lipid profile parameters observed in Type 2 DM may be related to insulin resistance, which could be associated with diabetic dyslipidemia and hypertension. Insulin-dependent enzyme lipoprotein lipase (LPL), along with insulin resistance, appears to lead to increased serum TG levels, while serum HDL levels may be further reduced in DM due to elevated hepatic lipase activity catalyzing serum HDL levels[1,27,28]. Various studies have reported different relationships between glycemic control in DM and serum lipid levels. While some studies have reported a positive correlation between HbA1c and serum lipid

profiles of DM patients[24], others have found no correlation between serum HbA1c and serum lipid profiles of DM patients[12].

In the present study, a significant relation was found between HbA1c level and serum lipid parameters including TG, LDL and HDL levels, consistent with findings from Ahmed *et al*.[24] and Hussain *et al*.[29]. Begum *et al*.[30] also showed significant correlations between HbA1c value and serum levels of total cholesterol (TC), TG and HDL-C, similar to findings in the present study, but no significant correlation of HbA1c value with LDL level was observed in DM patients in their study. Unnikrishnan *et al*.[10] from the ICMR-INDIAB study reported that increased duration of diabetes was associated with increased complications in DM patients, similar to findings in our study, whereas findings from the study by Raheja *et al*.[10] reported a correlation of HbA1c values with the duration of diabetes, which is not coherent with our study.

CONCLUSION

The study highlights poor glycemic control in a rural tribal area of India, where only approximately one-third of diabetic patients exhibited satisfactory glycemic control. Diabetic dyslipidemias were prevalent among a substantial number of patients with uncontrolled diabetes, posing a serious risk of macro- and microvascular complications. The lack of awareness about this silent disease until it manifests with noticeable complications hampers patients' adherence to regular treatment in rural areas. In addressing this issue, mass awareness campaigns supported by both governmental and non-governmental entities could play a crucial role in sensitizing both diabetic patients and medical professionals.

REFERENCES

1. Tagoe, D.N.A. and P. Amo-Kodieh, 2013. Type 2 diabetes mellitus influences lipid profile of diabetic patients. Ann. Biol. Res., 4: 88-92.
2. Hetal, P., J.D. Lakhani, J. Dadhania and A. Trivedi, 2012. The prevalence and pattern of dyslipidemia among type 2 diabetic patients at rural based hospital in Gujarat, India. Indian J. Clin. Pract., 22: 640-648.
3. Farmer, J.A., 2008. Diabetic dyslipidemia and atherosclerosis: Evidence from clinical trials. Curr. Diabetes Rep., 8: 71-77.
4. Saydah, S.H., 2004. Poor control of risk factors for vascular disease among adults with previously diagnosed diabetes. JAMA, 291: 335-342.
5. Chandra, K.S., M. Bansal, T. Nair, S.S. Iyengar and R. Gupta *et al*., 2014. Consensus statement on management of dyslipidemia in Indian subjects. Indian Heart J., 66: S1-S51.
6. Mckeigue, P., 1989. Coronary heart disease in south asians overseas: A review. J. Clin. Epidemiol., 42: 597-609.
7. Enas, E.A., 2000. Coronary artery disease epidemic in Indians: A cause for alarm and call for action. J. Indian Med. Assoc., 98: 697-702.
8. Enas, E.A., T.S. Dharmarajan and B. Varkey, 2015. Consensus statement on the management of dyslipidemia in Indian subjects: A different perspective. Indian Heart J., 67: 95-102.
9. Misra, A. and N.K. Vikram, 2003. Clinical and pathophysiological consequences of abdominal adiposity and abdominal adipose tissue depots. Nutrition, 19: 457-466.
10. Unnikrishnan, R., R.M. Anjana, M. Deepa, R. Pradeepa and S.R. Joshi *et al*., 2014. Glycemic control among individuals with self-reported diabetes in India-the icmr-indiab study. Diabetes Technol. Ther., 16: 596-603.
11. Mohan, V., S. Shah and B. Saboo, 2013. Current glycemic status and diabetes related complications among type 2 diabetes patients in India: Data from the a1chieve study. J. Assoc. Physicians India, 61: 12-15.
12. Menon, V.U., U. Guruprasad, K.R. Sundaram, R.V. Jayakumar, V. Nair and H. Kumar, 2008. Glycaemic status and prevalence of comorbid conditions among people with diabetes in kerala. Natl. Med. J. India, 21: 112-115.
13. Nagpal, J. and A. Bhartia, 2006. Quality of diabetes care in the middle- and high-income group populace. Diabetes Care, 29: 2341-2348.
14. Raheja, B.S., A. Kapur, A. Bhoraskar, S.R. Sathe and L.N. Jorgensen *et al*., 2001. Diabcare asia--india study: Diabetes care in India--current status. J. Assoc. Physicians India, 49: 717-722.
15. ADA., 2011. Executive summary: Standards of medical care in diabetes-2012. Diabetes Care, 35: S4-S10.
16. Jellinger, P.S., J.A. Davidson, L. Blonde, D. Einhorn and G. Grunberger *et al*., 2007. Road maps to achieve glycemic control in type 2 diabetes mellitus: ACE/AACE diabetes road map task force. Endocr. Pract., 13: 260-268.
17. Xu, Y., W. Lisi, J. He, Y. Bi and M. Li *et al*., 2013. China non-communicable disease surveillance group. prevalence and control of diabetes in Chinese adults. JAMA, 310: 948-959.
18. Hoerger, T.J., J.E. Segel, E.W. Gregg and J.B. Saaddine, 2008. Is glycemic control improving in U.S. adults? Diabetes Care, 31: 81-86.
19. Mohan, V., R. Pradeepa, R. Anjana, S. Joshi and A. Bhansali *et al*., 2015. Prevalence of generalized and abdominal obesity in urban and rural India-the ICMR-INDIAB study (phase-i) [ICMRNDIAB-3]. Indian J. Med. Res., 142: 139-150.

20. Jayarama, N., M. Reddy and V. Lakshmaiah, 2012. Prevalence and pattern of dyslipidemia in type 2 diabetes mellitus patients in a rural tertiary care centre, southern India. Glob J. Med. Public Health, 1: 24-28.
21. Misra, A., K. Luthra and N.K. Vikram, 2004. Dyslipidemia in Asian Indians: Determinants and significance. J. Assoc. Physicians India, 52: 137-142.
22. Mehta, S., A. Kashyap and S. Das, 2009. Diabetes mellitus in India: The modern scourge. Med. J. Armed Forces India, 65: 50-54.
23. Mohan, V., S. Shanthirani, R. Deepa, G. Premalatha, N.G. Sastry and R. Saroja, 2001. Intra urban differences in the prevalence of the metabolic syndrome in southern India - the chennai urban population study (CUPS No. 4). Diabetic Med., 18: 280-287.
24. Ahmed, N., J. Khan and T.S. Siddiqui, 2008. Frequency of dyslipidaemia in type 2 diabetes mellitus in patients of Hazara division. J. Ayub. Med. Coll. Abbottabad, 20: 51-54.
25. Chuang, L.M., S.T. Tsai, B.Y. Huang and T.Y. Tai, 2002. The status of diabetes control in Asia-a cross sectional survey of 24 317 patients with diabetes Mellitus in 1998. Diabetic Med., 19: 978-985.
26. Misra, A. and U. Shrivastava, 2013. Obesity and dyslipidemia in south Asians. Nutrients, 5: 2708-2733.
27. ADA., 2018. Pharmacologic approaches to glycemic treatment: Standards of medical care in diabetes—2019. Diabetes Care, 42: S90-S102.
28. Detection, E.P.O., Evaluation and THBCIA., 2001. Executive summary of the third report of the national cholesterol education program (NCEP) expert panel on detection, evaluation and treatment of high blood cholesterol in adults (adult treatment panel III). Jama: J. Am. Med. Assoc., 285: 2486-2497.
29. Hussain, A., I. Ali, M. Ijaz and A. Rahim, 2017. Correlation between hemoglobin a1c and serum lipid profile in Afghani patients with type 2 diabetes: Hemoglobin a1c prognosticates dyslipidemia. Ther. Adv. Endocrinol. Metab., 8: 51-57.
30. Begum, A., S.R. Irfan, M.R. Hoque, S.H. Habib and S. Parvin *et al*., 2019. Relationship between HbA1c and lipid profile seen in Bangladeshi type 2 diabetes mellitus patients attending BIRDEM hospital: A cross-sectional study. Mymensingh Med. J., 28: 91-95.