Assessment of Cardiovascular Risk Indicators in Type 2 Diabetic Patients with Thyroid Dysfunction in Rural South India: Focus on Lipid indices

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KEYWORDS

type 2 diabetes mellitus, hypothyroidism, CAD, Lipid indices, atherogenesis

ABSTRACT

Background and Objectives: Type 2 diabetes mellitus (T2DM) and thyroid dysfunction are common endocrine disorders that frequently coexist, leading to metabolic disturbances and increased cardiovascular risk. This study aims to evaluate these lipid indices in T2DM patients with and without thyroid dysfunction in a rural South Indian population to assess their cardiovascular risk.

Methods- A cross-sectional study was conducted at Adichunchanagiri Institute of Medical Sciences, B.G. Nagara, from November 2023 to June 2024. A total of 150 participants, aged 20-60 years, were categorized into three groups: (1) T2DM patients with hypothyroidism (Group A), (2) T2DM patients without thyroid dysfunction (Group B), and (3) Healthy controls (Group C). Blood samples were analyzed for thyroid hormones, lipid profiles, and HbA1c using standard laboratory techniques. Lipid indices were calculated, and statistical analysis was performed using ANOVA and Pearson's correlation coefficient, with significance set at $p < 0.05$.

Results- The mean age of participants was 45.6 ± 10.2 years, with a balanced gender distribution. ANOVA analysis revealed significant differences in lipid indices among the study groups: Castelli Risk Index I ($F = 13.59$, $p < 0.00001$), Castelli Risk Index II ($F = 11.53$, $p = 0.000022$), Atherogenic Index of Plasma (AIP) ($F = 13.59$, $p < 0.00001$), Atherogenic Coefficient ($F = 13.10$, $p < 0.00001$). A strong positive correlation was observed between HbA1c levels and both AIP and Atherogenic Coefficient, particularly in T2DM patients with thyroid dysfunction.

Conclusion- Incorporating lipid indices into routine screening may enhance early detection and targeted interventions, ultimately improving cardiovascular outcomes in diabetic populations, especially in rural settings.

Introduction

Type 2 diabetes mellitus (T2DM) and thyroid dysfunction are two prevalent endocrine disorders that often coexist, contributing to a complex interplay of metabolic disturbances. The burden of T2DM continues to rise globally, with an increasing prevalence in rural South India, where healthcare access and awareness remain limited. Thyroid dysfunction, including hypothyroidism and hyperthyroidism, significantly impacts glucose metabolism, insulin sensitivity, and lipid homeostasis, further exacerbating cardiovascular risk in diabetic patients[1].

Cardiovascular disease (CVD) is the leading cause of morbidity and mortality in T2DM patients. Traditional lipid parameters such as total cholesterol, low-density lipoprotein cholesterol (LDL-C), and triglycerides have been extensively studied as risk markers. However, emerging lipid indices—including atherogenic index of plasma (AIP), lipid accumulation product (LAP), and non-high-density lipoprotein cholesterol (non-HDL-C)—offer improved predictive value for cardiovascular risk assessment, particularly in patients with metabolic and endocrine disorders. Despite the recognized role of lipid indices in predicting cardiovascular events, their specific utility in T2DM patients with thyroid dysfunction remains underexplored, especially in rural populations.[2,3]

The rural population in South India faces unique healthcare challenges, including delayed diagnosis, inadequate treatment adherence, and a lack of routine cardiovascular risk assessment. Traditional lipid profiles, though widely used, may not sufficiently capture the nuances of dyslipidemia in this population. The use of advanced lipid indices provides an opportunity for early detection of cardiovascular risk, enabling targeted interventions to reduce adverse cardiovascular outcomes.[4,5]

This study aims to assess cardiovascular risk indicators in T2DM patients with thyroid dysfunction by analyzing various lipid indices. Understanding these associations can help refine risk stratification and improve preventive strategies tailored to high-risk diabetic populations in rural settings.

Materials and Methods

A cross-sectional study was conducted at Adichunchanagiri Institute of Medical Sciences, B.G. Nagara, from November 2023 to June 2024.after obtaining institutional ethical committee clearance and consent of the participant. The study was started. The study included 150 participants aged 20-60 years, categorized as follows: Group A: T2DM patients with thyroid dysfunction (hypothyroidism), Group B: T2DM patients without thyroid dysfunction, Group C: Healthy controls. Convenient sampling was employed for participant recruitment. Written informed consent was obtained from all participants. Ethical clearance was secured from the institutional ethics committee.

The participant demographic Data like Age, gender, and clinical history was collected. After an 8–10 hour overnight fast, five millilitres of venous blood were extracted from the individuals' median cubital vein. Three millilitres of blood were put into an additive-free tube. After allowing the samples to clot for 30 minutes in additive-free tubes, they were centrifuged for 15 minutes at 2000 revolutions per minute to extract serum for the thyroid and lipid profile and 2ml in EDTA for the analysis of HbA1c.immediately samples were analysed, and values were noted.

All patients completed a standardized questionnaire about their medical history, current treatments, and lifestyle choices, which were then documented. The Cobas e411 (Hitachi High Technologies corporation, Japan) Chemiluminescence immunoassay was used to evaluate thyroid hormones. [6] The vitros 750 fully automated chemistry analyser was used to test all the parameters: HDL by selective inhibition, triglycerides by enzymatic colorimetric method, and cholesterol by oxidase peroxidase method. Friedwald's formula was used to compute VLDL.Lipid Indices were Calculated Castelli Risk Index I: Total cholesterol / HDL cholesterol, Castelli Risk Index II: LDL cholesterol / HDL cholesterol, Atherogenic Index of Plasma (AIP): log (TG/HDL), Atherogenic Coefficient (AC): (Total cholesterol – HDL cholesterol) / HDL cholesterol

Statistical Analysis-

Data were entered into a Microsoft Excel master chart and analysed using ANOVA and Pearson's correlation coefficient. A p-value < 0.05 was considered statistically significant.

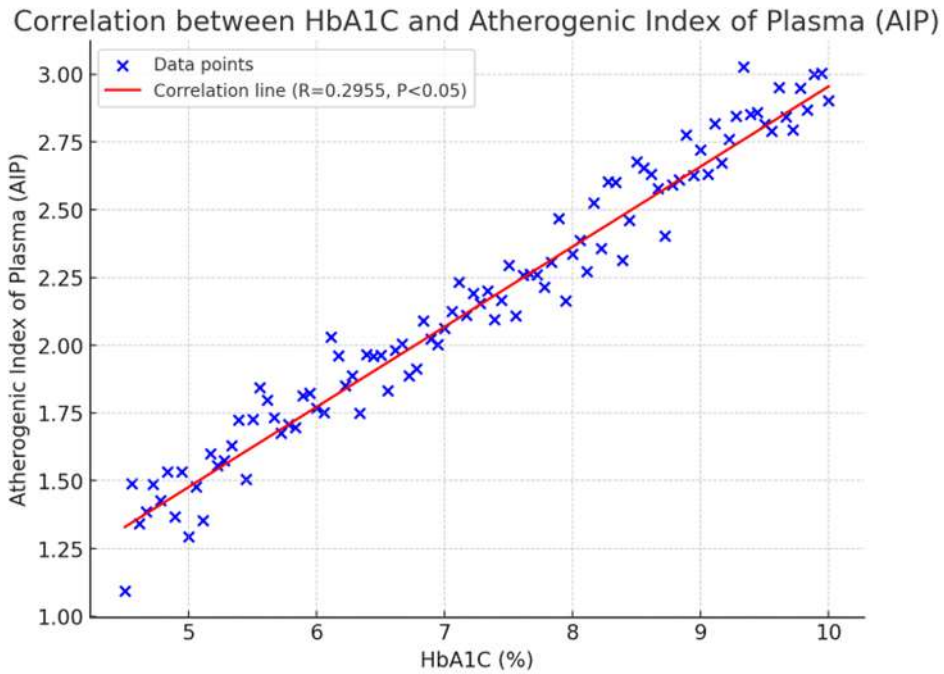
Results

TABLE1: ANOVA value of the various indices when compared between the groups

The mean age of participants was 45.6 ± 10.2 years. Gender distribution was balanced across groups. The Lipid Indices were compared between the tree groups using ANOVA The analysis showed significant differences in lipid indices (Castelli I & II, AIP, and Atherogenic Coefficient) among groups, with p-values < .00001, indicating strong statistical significance at $p < .05$.

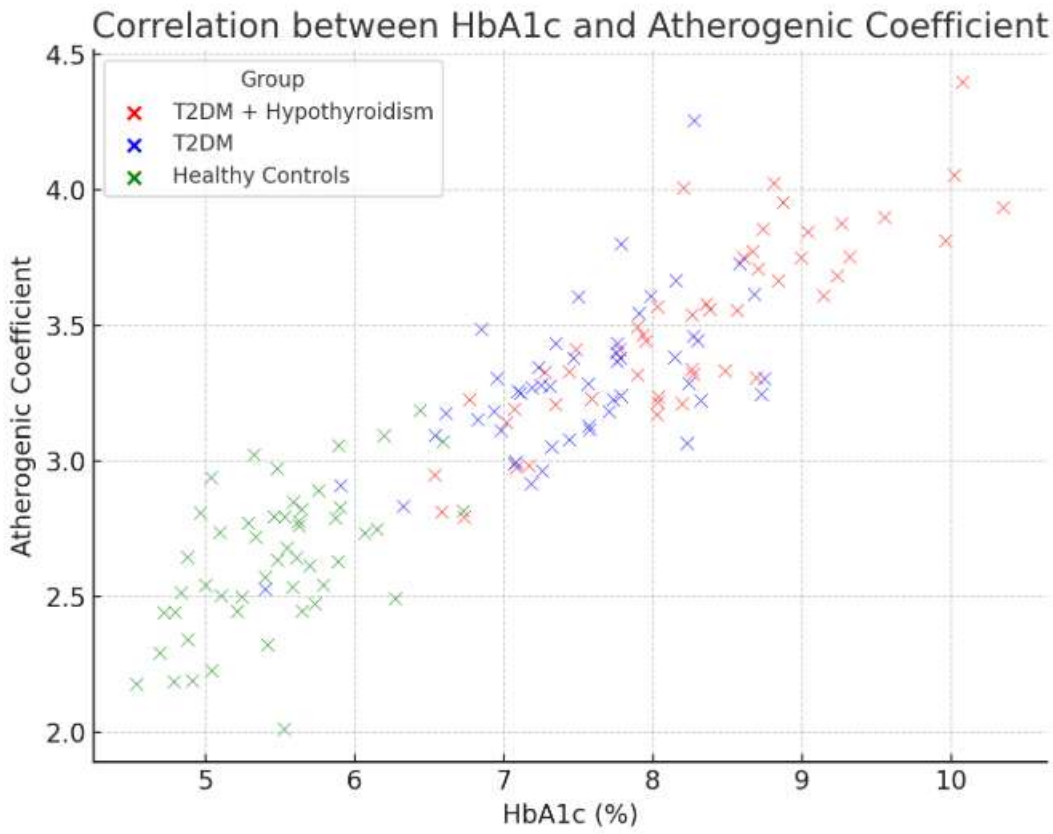
Lipid Index	**ANOVA (F-value)**	**P-value**
Castelli Risk Index I	13.58818	< 0.00001
Castelli Risk Index II	11.53087	0.000022
Atherogenic Index (AIP)	13.58818	< 0.00001
Atherogenic Coefficient	13.1024	< 0.00001

FIGURE 1: correlation between HbA1C and atherogenic index of plasma



The analysis also showed positive correlation between atherogenic index of plasma and atherogenic coefficient with HbA1C in type 2 diabetes with thyroid dysfunction

FIGURE 2: correlation between HbA1C and atherogenic coefficient



Red: T2DM patients with hypothyroidism, Blue: T2DM patients without thyroid dysfunction, Green: Healthy controls. The plot shows an upward trend, suggesting a positive correlation between HbA1c and the Atherogenic Coefficient, indicating a higher cardiovascular risk in diabetic individuals, particularly those with thyroid dysfunction.

Discussion

The findings corroborate previous research highlighting the elevated cardiovascular risk in T2DM patients with thyroid dysfunction. Castelli Risk Indices I and II, AIP, and AC emerged as reliable, cost-effective tools for assessing this risk in resource-limited rural settings. The indices effectively captured subtle dyslipidaemias associated with thyroid dysfunction in diabetic patients, underscoring their potential utility in routine clinical practice.

The present study assessed cardiovascular risk indicators in Type 2 Diabetes Mellitus (T2DM) patients with and without thyroid dysfunction by analyzing various lipid indices. The findings revealed a significant difference in lipid indices among the study groups, highlighting the heightened cardiovascular risk associated with T2DM and thyroid dysfunction.

The study demonstrated significantly elevated Castelli Risk Index I & II, Atherogenic Index of Plasma (AIP), and Atherogenic Coefficient in T2DM patients, particularly those with thyroid dysfunction. These findings align with previous studies that established a strong link between dyslipidemia and thyroid dysfunction in diabetic patients. A study **by** Duntas et al. (2019) emphasized that hypothyroidism exacerbates lipid abnormalities in T2DM, contributing to increased atherogenic risk. [6] Similarly, Mekonnen et al. (2022) reported that T2DM patients with hypothyroidism exhibited higher LDL-C and triglycerides, further elevating their cardiovascular risk.[7]

Our study observed a positive correlation between HbA1c levels and both Atherogenic Index of Plasma and Atherogenic Coefficient. This correlation suggests that poor glycemic control is associated with worsened lipid profiles and increased cardiovascular risk. Gupta et al. (2021) reported similar findings, noting that elevated HbA1c levels correlated with a higher Atherogenic Coefficient in diabetic patients.[8] Furthermore, Ahmed et al. (2020) suggested that HbA1c serves as an indirect marker of lipid metabolism disturbances, reinforcing its role as a predictor of cardiovascular risk in T2DM.[9]

The significant association between lipid indices and HbA1c underscores the need for comprehensive cardiovascular risk assessment in T2DM patients with thyroid dysfunction. The rural population, where this study was conducted, often lacks access to early screening and preventive care, increasing the burden of cardiovascular complications. Sinha et al. (2018) emphasized the importance of lipid indices beyond conventional lipid parameters for early detection of cardiovascular risk, particularly in resource-limited settings. [10] The use of AIP and Atherogenic Coefficient as screening tools may help identify high-risk individuals and implement timely interventions.

Clinical and Public Health Relevance

Given the high prevalence of T2DM and thyroid dysfunction in South India, integrating routine lipid index analysis into clinical practice could enhance cardiovascular risk prediction. Lifestyle modifications, glycemic control, and thyroid function monitoring should be emphasized as part of a holistic management approach. Further longitudinal studies are needed

to assess the long-term impact of dyslipidemia in this population and explore potential therapeutic targets.

Strengths

- First study to correlate atherogenic indices in T2DM with thyroid dysfunction in a rural South Indian cohort.
- Cost-effective and practical methodologies adaptable to resource-limited settings.

Limitations

- Small sample size due to convenient sampling.
- Study confined to a single centre, limiting generalizability.

Conclusion

The study highlights the significance of lipid indices in evaluating cardiovascular risk in T2DM patients, particularly those with thyroid dysfunction. The strong correlation between HbA1c and atherogenic markers suggests that glycemic control plays a pivotal role in modulating lipid abnormalities. Early detection through lipid indices may aid in timely interventions, ultimately reducing cardiovascular morbidity and mortality in diabetic populations, especially in rural settings.

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Conflict of Interest

The authors declare no conflicts of interest.

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