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Original Research Article

Comparative Evaluation of Lipid Profiles in Diabetic Tribal and Non-Tribal Populations of Both Genders in Southern Rajasthan

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Abstract:

Background: The relationship between diabetes and cardiovascular disease (CVD) is intricate and multifactorial. Dyslipidemia, characterized by abnormal lipid profiles, significantly increases cardiovascular risk in diabetic individuals. Understanding how factors such as gender, lifestyle, and tribal status affect lipid profiles is crucial for targeted health interventions. This study aims to compare lipid profiles and cardiovascular risk among diabetic tribal and non-tribal populations in southeast Rajasthan, focusing on gender differences.

Methodology: This cross-sectional study included diabetic subjects from tribal and non-tribal communities in southeast Rajasthan, categorized into four groups: tribal women, tribal men, non-tribal women, and non-tribal men. Lipid profiles—total cholesterol, triglycerides, HDL, and LDL—were measured for each group. Additionally, cardiovascular risk was assessed using atherogenic indices, including the atherogenic index, atherogenic coefficient, atherogenic lipid profile, cardiac heart disease ratio, and cardiac risk ratio. The results were compared across the four groups to evaluate variations in cardiovascular risk.

Results: Non-tribal men showed the highest cardiovascular risk, followed by non-tribal women, tribal men, and tribal women. Elevated lipid values and atherogenic indices in non-tribal men indicated a greater predisposition to CVD. Non-tribal women exhibited higher cardiovascular risk than tribal women, despite both groups engaging in domestic work. This was attributed to less physical activity and more sedentary lifestyles among non-tribal women. Tribal women, who performed both domestic tasks and rigorous job work, had the lowest cardiovascular risk. Across all groups, men demonstrated a higher risk of CVD compared to women, likely due to more sedentary work patterns.

Conclusion: The study reveals significant differences in cardiovascular risk among diabetic tribal and non-tribal populations, with non-tribal men being most at risk. Tribal women had the lowest risk, likely due to their active lifestyle. The findings underscore the importance of physical activity in reducing cardiovascular risk, particularly for non-tribal men and women who lead more sedentary lives. Lifestyle modifications, including increased physical activity, could mitigate cardiovascular risk in these populations.

Keywords: Cardiovascular diseases, Tribal females, Diabetes, Lipid profile.

Introduction

Type 2 diabetes has emerged as a widespread epidemic, primarily driven by the sedentary lifestyle of modern society. Reduced physical activity, imbalanced diets filled with metabolic inhibitors like junk food, and increased stress have become inseparable from daily life, resulting in a rise in various health conditions.

Beyond lifestyle, type 2 diabetes also has a genetic component, making its onset multifactorial. [1] It is commonly preceded by prolonged periods of impaired glucose tolerance or mild disturbances in glucose metabolism. These glycemic irregularities and insulin resistance significantly heighten the risk, not only for type 2 diabetes but also for cardiovascular morbidity and mortality. According to The DECODE Study Group [2], vascular complications arising from type 2 diabetes include nephropathy, retinopathy, stroke, peripheral vascular disease (PVD), and coronary artery disease (CAD).

In addition, type 2 diabetes can adversely affect the heart muscle, leading to both diastolic and systolic heart failure. Although the precise mechanisms underlying the increased cardiovascular risk in diabetic patients are not entirely clear, evidence indicates that hyperglycemia contributes to

myocardial damage following ischemic events. However, hyperglycemia alone is not the only factor at play; conditions like pre-diabetes and metabolic syndrome, even in normoglycemic individuals, can also elevate the risk of cardiovascular diseases (CVD). [3,4]

Given these risks, assessing cardiovascular health in diabetic patients is crucial. Lipid profiles, which include total cholesterol (TC), triglycerides (TG), high-density lipoproteins (HDL), low-density lipoproteins (LDL), and very low-density lipoproteins (VLDL), along with several atherogenic indices and risk ratios (such as the atherogenic index, atherogenic coefficient, atherogenic lipid profile, Castelli's Risk Index I, and Castelli's Risk Index II), provide early warning signs of existing cardiovascular risk. These metrics are critical for identifying and mitigating cardiovascular risk in diabetic individuals. [5]

In India, type 2 diabetes has already caused widespread morbidity and mortality, yet awareness of the disease and its complications remains limited. Rajasthan, particularly its southeast region, is home to various tribal communities, including Bhil, Bhil Garasia, Dholi Bhil, Mewasi Bhil, and Rawal Bhil, who reside in the Aravalli ranges. [6]

Historically, these tribes led non-sedentary, nature-dependent lifestyles. However, with the passage of time, lifestyle patterns have changed, leading to more sedentary behaviors. Despite their different backgrounds, the alarming rise in type 2 diabetes in both tribal and non-tribal populations highlights the urgent need for comparative research to better understand and address the disease's impact across these groups. This forms the basis of the current study on cardiovascular risk among diabetic populations in southeast Rajasthan.

Materials and Methods

This study focused on diabetic individuals aged 40–50 years residing in both tribal and non-tribal areas of southeast Rajasthan. The subjects were selected from primary health centers, general government hospitals, and private hospitals (with more than 50 beds) across Udaipur district. Relevant data were collected through a structured format, and blood samples were obtained after obtaining patient consent.

1. **Collection of Blood Samples**

Blood samples were collected through venipuncture from all subjects. Approximately 10–14 ml of blood was drawn, and collection tubes were arranged in a specific sequence to prevent cross-contamination of additives. The tubes were ordered as follows:

- First: Blood culture bottle or tube (yellow or yellow-black top)
- Second: Coagulation tube (light blue top)
- Third: Non-additive tube (red top)
- Last draw: Additive tubes in this order: SST (red-gray or gold top), sodium heparin (dark green top), PST (light green top), EDTA (lavender top), and oxalate/fluoride (light gray top).

All samples were properly labelled with at least two unique identifiers, and tubes were filled to the specified volume to maintain the proper blood-to-additive ratio. After collection, the samples were centrifuged to separate serum before coagulation.

2. Biochemical Estimation were using standard kit [7-11]
3. Lipid Ratios
Lipid ratios were calculated to assess cardiovascular risk:

- Atherogenic Index (AI) = log10 (TG/HDL)
- Atherogenic Coefficient (AC) = (TC - HDL)/HDL
- Atherogenic Lipid Profile (ALP) = TG/HDL
- Cardiac Heart Disease Ratio (CHDR) = TC/HDL
- Cardiac Risk Ratio (CRR) = LDL/HDL

Statistical Analysis

Data were analyzed using an Erba Transasia auto analyzer, and results were expressed as mean ± SD. Statistical significance was assessed using one-way ANOVA followed by Dunnett's test, with a significance level of $p < 0.05$, 0.01, and 0.001.

Results and Discussion

Sedentary behavior and physical inactivity are key modifiable risk factors for cardiovascular disease (CVD) and all-cause mortality, particularly in diabetic patients. Lack of physical activity is also linked to several other health conditions, including certain cancers, osteoporosis, obesity, type 2 diabetes, and hypertension. In the context of southeast Rajasthan, where both tribal and non-tribal populations coexist, these differences in lifestyle provide a unique opportunity to study lifestyle-mediated diseases such as diabetes and CVD. Tribal communities typically engage in more physically demanding activities, which may influence their cardiovascular risk compared to the more sedentary non-tribal populations.

In this study, diabetic patients from four groups—tribal women (TW), tribal men (TM), non-tribal women (NTW), and non-tribal men (NTM)—from Bhilwara, Chittorgarh, and Udaipur were selected for comparative cardiovascular risk assessment. All subjects were between 40-50 years old and had been diagnosed with diabetes for 5-10 years. The average glycated hemoglobin (HbA1c) levels among the groups were 11.4% in TW, 11.87% in TM, 10.86% in NTW, and 11.32% in NTM,

showing a similar glycemic control across the groups. Lipid profile analysis revealed that total cholesterol (TC) levels were higher in non-tribal subjects, with NTM showing the highest value at 196.91 mg/dL, followed by NTW (194.12 mg/dL), TM (175.21 mg/dL), and TW (169.36 mg/dL). Although none of the subjects had TC levels above the critical 200 mg/dL threshold, non-tribals were closer to this limit. Triglyceride (TG) levels followed a similar pattern, with NTM showing the highest values. High-density lipoprotein (HDL) levels were similar across all groups, around the prescribed standard of 40 mg/dL, although none reached the optimal 60 mg/dL.

Low-density lipoprotein (LDL) levels were notably higher in non-tribal subjects (119.01 mg/dL in NTW and 120.11 mg/dL in NTM), exceeding the optimal range and indicating higher cardiovascular risk. In contrast, LDL levels in tribal subjects were lower, with TW at 94.9 mg/dL and TM at 99.73 mg/dL. Very low-density lipoprotein (VLDL) levels were also marginally higher in non-tribal men (34.21 mg/dL) compared to the other groups.

Overall, the comparison of lipid profiles showed worse cardiovascular risk markers in non-tribal subjects, who had higher TC, TG, LDL, and VLDL values. Non-tribals were at borderline risk for TC and VLDL, while their LDL levels exceeded the normal range. Tribal subjects exhibited better lipid profiles, though they too were near borderline levels for LDL and VLDL. These findings suggest that the more active lifestyle of tribal populations may offer some protection against cardiovascular risk compared to their non-tribal counterparts.

Table 1: Comparative assessments of lipid profile in diabetic tribal and non-tribal populations of southeast Rajasthan

Parameters	Tribal Female	Tribal Male	Non- Tribal Female	Non- Tribal Male
HbA1c (%)	11.4 ± 0.80**	11.87 ± 0.66*	10.86 ± 0.33***	11.32 ± 0.33**
TC (mg/dL)	169.36 ± 0.33	175.21 ± 1.20	194.12 ± 1.00	196.91 ± 1.10
TG (mg/dL)	155.33 ± 0.66	157.72 ± 1.66	159.4 ± 1.33	171.07 ± 1.20
HDL (mg/dL)	43.4 ± 0.64*	43.94 ± 0.24**	43.24 ± 0.66**	42.58 ± 0.20*
LDL (mg/dL)	94.9 ± 1.20	99.73 ± 1.10	119.01 ± 1.10	120.11 ± 0.66*
VLDL (mg/dL)	31.06 ± 0.70**	31.54 ± 0.33	31.88 ± 0.80	34.21 ± 0.64
AI	0.05 ± 0.03	0.05 ± 0.01***	0.05 ± 0.01*	0.06 ± 0.01
AC	3.12 ± 0.24	3.27 ± 0.24*	3.85 ± 0.30	4.08 ± 0.14
ALP	3.85 ± 0.54***	3.86 ± 0.80	4.01 ± 0.10*	4.43 ± 0.54***
CRI-I	4.12 ± 0.33*	4.27 ± 0.41	4.85 ± 0.66	5.08 ± 0.33
CRI-II	2.35 ± 0.66	2.5 ± 0.54	3.05 ± 0.14	3.2 ± 0.33

The findings of the present study indicate that tribal women have the lowest cardiovascular risk. This is largely attributed to their involvement in dual work processes, including domestic chores and non-sedentary, physically demanding job tasks. None of the tribal women were engaged in sedentary office work, highlighting the protective effect of an active lifestyle against cardiovascular disease (CVD) risk. [12] In contrast, less-active non-tribal women, primarily employed in office jobs, have a higher risk of developing CVD [13-16], as supported by previous studies. This increased risk can also lead to higher mortality rates in these populations. [17-19]

A comparison of cardiovascular risk indices between tribal (T) and non-tribal (NT) subjects reveals notable differences. While the atherogenic index was found to be equal in both groups, all other cardiovascular risk indices were higher in non-tribal subjects. The atherogenic coefficient (AC) in non-tribal subjects was 24.13% greater than in tribal subjects, and the atherogenic lipid profile (ALP) in non-tribals exceeded that of tribal subjects by 9.46%. Castelli's Risk Index I (CRI-I), also known as the cardiac heart disease ratio (CHDR), was 4.96 in non-tribals, which was 18.37% higher compared to tribal subjects. Similarly, Castelli's Risk Index II (CRI-II) or cardiac risk ratio (CRR) was 28.92% higher in non-tribal subjects, further indicating a greater cardiovascular risk in this group.

When comparing the lipid profile on a gender basis, women generally showed better cardiovascular health outcomes than men. Both groups had average total cholesterol (TC) and triglycerides (TG) levels well below 200 mg/dL, indicating normal values. However, men had higher levels of TC by 2.38% and TG by 4.47% compared to women. High-density lipoprotein (HDL) levels were nearly the same between genders, differing only by 0.16%, but both groups had HDL levels 33.33% below the optimal value of 60 mg/dL. Low-density lipoprotein (LDL) levels in men were 2.78% higher than in women, while very low-density lipoprotein (VLDL) values in men exceeded those in women by 4.45%. The LDL levels in men were above the optimal range, and VLDL values were at the margin of the optimal range, suggesting a higher predisposition to cardiovascular disease in men. [17-19]

In the context of Indian culture, women involved in dual activities, combining domestic and work-related physical tasks, appear to have a natural protection against CVD when compared to men. Sedentary behaviour is more prevalent among non-tribal men, who are more likely to work in office settings and rely on personal vehicles for transportation, leading to a more lethargic lifestyle. Tribal men, on the other hand, engage in more physically active jobs, which contributes to lower cardiovascular risk in this group. [20]

The study's findings align with existing evidence that physical activity plays a critical role in reducing cardiovascular risk, even in the presence of other potentially harmful behaviours and conditions. Mechanisms contributing to the protective effects of physical activity include its positive impact on cardiac function, glucose homeostasis, and lipid metabolism. These results further emphasize the importance of maintaining an active lifestyle to reduce CVD risk and promote better overall health. [21-23]

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