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Research Article

# ASSOCIATION OF SERUM ADIPONECTIN IN NON-DIABETIC HEALTHY YOUNG ADULT OF FIRST-DEGREE RELATION OF T2DM INDIVIDUALS

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**ABSTRACT**

**Objective:** Type 2 diabetes mellitus (T2DM) is a leading metabolic disorder, with 1st-° relation (FDR) of affected individuals exhibiting heightened risk due to genetic and environmental factors. Adiponectin is an adipocyte-derived hormone. It has a central function in regulating metabolism, insulin sensitivity, or secretion. To evaluate how adiponectin is associated in healthy, non-diabetic young adults who are FDR of patients with type 2 diabetes, further adding to our knowledge of adiponectin's influence on diabetes susceptibility and prevention among these individuals.

**Methods:** There were 100 healthy FDR of T2DM patients and 100 age- and sex-matched controls without a family history of diabetes. Fasting blood samples were collected for analysis of glucose, lipid profile, and serum adiponectin. During the screening period, anthropometric parameters were analyzed using a standard technique. Measurements were conducted using standard biochemical kits and statistically analyzed using Statistical Package for the Social Sciences 25.

**Results:** In this research, no significant difference was found between group 1 and group 2 regarding age or lipid profile. FDR exhibited significantly lower adiponectin levels (4.67±1.68 µg/mL) compared to controls (8.65±1.51 µg/mL, $p<0.001$).

**Conclusion:** The reduced adiponectin in FDRs suggests early metabolic alterations and supports its utility as an early biomarker for T2DM risk assessment. Monitoring adiponectin concentrations in high-risk individuals could facilitate timely interventions, especially in genetically predisposed populations.

**Keywords:** Adiponectin, First-degree relation, Type 2 diabetes mellitus.

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## INTRODUCTION

Type 2 diabetes mellitus (T2DM) is a complex metabolic disease. It is characterized by chronic hyperglycemia resulting from insulin resistance and progressive pancreatic β-cell failure [1-3]. It is a global health concern with significant morbidity and mortality due to associated complications such as cardiovascular disease, obesity, and metabolic diseases [4]. Family history is a strong, independent risk factor for progression of T2DM, with 1st-° relation (FDR) of affected individuals having a 2–4 times increased risk of disease onset. This increased risk is partially explained by genetic predisposition and lifestyle factors [3,5].

Adiponectin is a protein hormone. It is predominantly secreted by adipocytes and plays an important role in glucose regulation and lipid metabolism. Unlike other adipokines, adiponectin levels are paradoxically reduced in obesity and T2DM, contributing to the pathogenesis of impaired insulin sensitivity or insulin secretion. Adiponectin enhances insulin sensitivity by promoting Beta-oxidation in skeletal muscle and liver and inhibiting hepatic gluconeogenesis through activation of AMP-activated protein kinase pathways. In addition, it possesses anti-inflammatory and anti-atherogenic properties that protect against cardiovascular complications [2,6-10].

In the recent past, the epidemiological transition in India has recorded a shocking increase in lifestyle diseases, primarily diabetes, both in the urban and rural settings. This transition is found in the Northern Indian state of Himachal Pradesh, situated in the sub-Himalayan region. It is identified that out of permanently settled tribal persons in both the tribal and urban areas, 59% of the urban tribal population were obese and 7.8% were diabetic [11].

Multiple studies reveal that adiponectin levels are significantly decreased in individuals with T2DM and those at high risk, including FDR who are normoglycemic but genetically predisposed. These reduced adiponectin levels in FDRs suggest early metabolic dysfunction before the clinical onset of diabetes, making adiponectin a potential biomarker for identifying individuals at risk. Furthermore, adiponectin levels have been shown to correlate inversely with insulin resistance, obesity, and other metabolic syndrome components, indicating its role in metabolic homeostasis [1,12-16].

In the context of Himachal Pradesh, India, where genetic and environmental factors contribute to the rising burden of T2DM, studying adiponectin levels in healthy FDR can provide insights into early pathophysiological changes and aid in preventive strategies. Understanding the association of adiponectin with other metabolic parameters among FDR may help implement targeted lifestyle or therapeutic interventions to delay or prevent T2DM onset [15,17,18].

Thus, the present study aims to analyse the association of adiponectin in non-diabetic healthy young adults of FDR of T2DM individuals, contributing to the growing evidence on adiponectin's role in diabetes risk and prevention in FDR of T2DM Individuals.

## MATERIALS AND METHODS

### Materials

*Study design*

This research was carried out between March 2023 and April 2025 as a case–control study in the biochemistry department. We included 200 subjects of both sexes. The subjects' ages were between 18 and 25 years

old. Subjects having age <18 and >25 years and already diagnosed with DM were excluded from this study. The subjects were recruited from the MM Medical College and Hospital, Solan, H.P., after getting the approval from the Ethics Committee (MMMCH/IEC/23/629). All procedures followed the ethics guidelines, and each subject was given informed consent and completed a screening questionnaire before taking part in the research.

In this research, 200 subjects were divided into two groups:

- Group 1: 100 healthy young adults without a family history of T2DM.
- Group 2: 100 non-diabetic healthy young adults of FDR of T2DM.

**Methods**

*Biochemical measurement*

After 8–12 h of overnight fasting, approximately 8 mL of blood sample was collected in the hospital from all the subjects. Blood will be collected from an antecubital vein in a fluoride vial (for fasting blood sugar) and a plain vial (for lipid profile, fasting insulin, and adiponectin). Biochemical investigation of fasting blood glucose (FBG) and lipid parameters was analyzed using Roche diagnostics kits on an autoanalyzer (Cobas C-311). The calculated parameter, very low-density lipoprotein cholesterol, was calculated using the Friedwald equation. Adiponectin levels were measured using Elabscience enzyme-linked immunosorbent assay kits (Catalog no: E-EL-H6122).

*Anthropometric parameter*

Bodyweight and height were measured without shoes in the morning using a pre-calibrated height scale and weight scale, respectively. The body mass index (BMI) for all study participants was calculated by dividing their weight in kilograms by the square of their height measured in meters.

**Statistical analysis**

The statistical analysis was analyzed by Statistical Package for the Social Sciences 25. All the data were expressed by the mean±standard deviation. An independent t-test was used to compare groups mean. Pearson correlation test was used to analyze the correlation between adiponectin and anthropometric parameters (BMI), age, FBG, lipid profile, and a $p<0.01$ was considered statistically significant.

**RESULTS**

In this research, 100 FDR of T2DM subjects and 100 FDR without a family history of T2DM were included. Table 1 represents the demographic and biochemical characteristics in FDR of type 2 diabetes subjects (group 2) and subjects without a family history of T2DM (group 1)

There was no statistically significant difference in age between the FDR of T2DM patients and those without a family history of T2DM. Both groups had similar ages and similar levels of lipid profiles (Table 1). When comparing the two groups, it was found that the FDR of T2DM had significantly lower levels of adiponectin, and also significantly higher FBG and BMI were observed in 1st-° relation of T2DM.

In this study, we found there was no significant association between adiponectin and lipid parameters or BMI in group 1. There was a significant positive correlation observed among adiponectin and age ($p<0.05$), FBG ($p<0.05$). In group 1, there was a significant positive correlation between adiponectin and FBG ($p<0.01$) (Table 2).

**DISCUSSION**

In this study, we found that adiponectin was significantly lower in healthy FDR of T2DM patients compared to healthy young adults without a family history of T2DM in Himachal Pradesh. This finding aligns with prior research indicating hypoadiponectinemia as a characteristic feature in individuals with a genetic predisposition to T2DM, even before overt hyperglycemia manifests. Reduced adiponectin concentrations in FDRs likely reflect early metabolic alterations related to insulin resistance and beta-cell dysfunction, which are key pathogenic factors in the development of T2DM [16,19].

**Table 1: Demographic and biochemical features of non-diabetic healthy 1st-° relation of T2DM (group 2) and healthy young adults without a family history of T2DM (group 1)**

| Demographic or biochemical features | Group 1 (n=100) | Group 2 (n=100) |
|---|---|---|
| Age (years) | 20.46±1.79 | 20.500±1.71 |
| BMI (kg/m$^2$) | 18.03±2.54 | 21.42±2.53* |
| Total cholesterol | 157.66±27.88 | 158.51±33.06 |
| Triglycerides | 99.74±37.94 | 98.48±36.58 |
| LDL-cholesterol | 91.68±25.0 | 94.9±22.0 |
| HDL-cholesterol | 43.87±8.74 | 43.58±7.851 |
| Fasting blood glucose | 90.34±6.21 | 93.71±6.21* |
| Adiponectin | 8.65±1.51 | 4.67±1.68* |

*Data are significant at P<0.001. T2DM: Type 2 diabetes mellitus, BMI: Body mass index

**Table 2: Adiponectin comparison with other variables in healthy young adults of 1st-° relation of T2DM (group 2) and healthy young adults without a family history of T2DM (group 1)**

| Variable | Group 1 (n=100) | | Group 2 (n=100) | |
|---|---|---|---|---|
| | r | Statistical significance | R | Statistical significance |
| Age (years) | 0.293 | NS | −0.229** | p=0.02 |
| BMI (KG/M$^2$) | 0.052 | NS | −0.167 | NS |
| Total cholesterol | −0.058 | NS | 0.037 | NS |
| Triglycerides | 0.018 | NS | −0.111 | NS |
| LDL-cholesterol | −0.085 | NS | −0.012 | NS |
| HDL-cholesterol | 0.129 | NS | 0.115 | NS |
| Fasting blood glucose | 0.293* | p=0.003 | 0.248** | p=0.013 |

LDL: Low-density lipoprotein, HDL: High-density lipoprotein. *Correlation is significant at the 0.01 level (2-tailed). **Correlation is significant at the 0.05 level (2-tailed). T2DM: Type 2 diabetes mellitus, BMI: Body mass index

Adiponectin is recognized for its insulin-sensitizing, anti-inflammatory, and anti-atherogenic properties. It promotes Beta-oxidation and decreases hepatic glucose production, thereby improving glucose homeostasis. We observed lower adiponectin levels in FDRs correlate with a higher FBG level compared to controls, suggesting compromised insulin sensitivity or beta-cell function in this group. This supports the role of adiponectin as an early biomarker for T2DM risk in normoglycemic individuals with a family history of T2DM [1,12,20,21].

Interestingly, we did not find a significant difference between FDR and controls in anthropometric measures (BMI) or lipid profiles, and adiponectin did not significantly correlate with lipid parameters or BMI in the FDR group. This indicates that adiponectin reduction in FDRs may be independent of obesity or dyslipidemia, highlighting a genetic or familial predisposition's influence on adiponectin regulation and diabetes risk. The positive correlation observed between adiponectin and fasting glucose in both groups may appear paradoxical, but it is consistent with previous studies observing complex regulation of adiponectin in different metabolic states and its compensatory response to glucose metabolism alterations [16,12,21].

This study's findings emphasize the potential clinical utility of adiponectin measurement in identifying individuals at high risk of T2DM, particularly among young, healthy FDRs. Early identification may facilitate targeted preventive interventions to delay or prevent T2DM onset. Moreover, since adiponectin is modifiable by lifestyle factors and pharmacological agents, it represents a promising therapeutic target [2,18].

## CONCLUSION

In this study, decreased adiponectin in healthy young FDRs of T2DM individuals these outcomes underscores the hypothetical effect of adiponectin as an early biomarker for diabetes risk among healthy FDRs, even before clinical or biochemical signs of hyperglycemia or dyslipidemia manifest. Regular monitoring of adiponectin levels in this high-risk population, along with early lifestyle or preventive interventions, may aid in delaying or preventing the onset of T2DM. Further large-scale longitudinal studies are needed to confirm adiponectin's utility in diabetes risk prediction and prevention in diverse Indian populations.

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## CONFLICTS OF INTEREST

The authors state that there are no conflicts of interest related to the research, writing, or publication of this manuscript

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## INFORMED CONSENT

Each participant provided written informed consent before taking part in this research.

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