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Research Article

A Prospective Study Evaluating the Correlation of Body Mass Index, Waist–Hip Ratio, and Lipid Profile with Newly Diagnosed Type 2 Diabetes Mellitus Patients in Adult Population

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ABSTRACT

Background: Type 2 diabetes mellitus (T2DM) is a major public health problem characterized by metabolic disturbances, including obesity and dyslipidemia. Anthropometric indices such as body mass index (BMI) and waist–hip ratio (WHR) are simple indicators of adiposity and may correlate with lipid abnormalities, thereby predicting cardiovascular risk in newly diagnosed diabetic patients.

Aim: To evaluate the correlation of BMI, WHR, and lipid profile parameters in adult patients with newly diagnosed type 2 diabetes mellitus attending a tertiary care center in Bihar.

Methodology: This prospective observational study included 100 newly diagnosed T2DM patients aged ≥18 years attending the outpatient department. Anthropometric measurements, including BMI and WHR, were recorded using standardized methods. Fasting blood samples were analyzed for lipid profile parameters, including total cholesterol, triglycerides, LDL, HDL, and VLDL. Data were analyzed using SPSS version 20. Pearson's correlation coefficient and appropriate statistical tests were applied, with $p < 0.05$ considered statistically significant.

Results: The majority of patients were overweight or obese, with a high prevalence of increased WHR indicating central obesity. Dyslipidemia was common, characterized by elevated total cholesterol, triglycerides, LDL, and reduced HDL levels. BMI and WHR showed significant positive correlation with total cholesterol, triglycerides, and LDL, and negative correlation with HDL. WHR demonstrated a stronger association with lipid abnormalities than BMI.

Conclusion: BMI and WHR, particularly WHR, are reliable and cost-effective indicators for predicting dyslipidemia and cardiovascular risk in newly diagnosed T2DM patients and should be routinely incorporated into clinical assessment.

Keywords: Type 2 diabetes mellitus, Body mass index, Waist-hip ratio, Dyslipidemia, Anthropometry

INTRODUCTION

Type 2 diabetes mellitus (T2DM) has emerged as one of the most significant non-communicable diseases worldwide, posing a major public health burden, particularly in developing countries like India. The prevalence of diabetes is rising at an alarming rate due to rapid urbanization, sedentary lifestyle, dietary transition, and increasing obesity, making India one of the global epicenters of diabetes. T2DM is characterized by insulin resistance, impaired insulin secretion, and chronic hyperglycemia, which subsequently leads to long-term complications such as cardiovascular disease, nephropathy, neuropathy, and retinopathy [1].

Obesity and central adiposity play a pivotal role in the pathogenesis of T2DM. Anthropometric indices such as body mass index (BMI), waist circumference, and waist–hip ratio (WHR) are commonly used markers to assess generalized and central obesity. These markers are not only simple and cost-effective but also serve as predictors of insulin resistance and metabolic abnormalities. Evidence suggests that BMI and WHR are significantly associated with glycemic control and risk of diabetes progression [2,3]. Among these, WHR has been reported to be a superior index reflecting central adiposity and predicting diabetes risk and β-cell dysfunction compared to BMI alone [4].

In addition to anthropometric parameters, dyslipidemia is a common metabolic abnormality in T2DM. The classical lipid triad in diabetes includes elevated triglycerides, increased low-density lipoprotein (LDL), and decreased high-density lipoprotein (HDL) cholesterol. These lipid abnormalities contribute significantly to the increased risk of cardiovascular morbidity and mortality in diabetic patients. Studies have demonstrated that lipid profile abnormalities show significant correlation with BMI and central obesity indices, suggesting a close interrelationship between adiposity, dyslipidemia, and glycemic status [5,6]. Elevated lipid parameters have also been linked with insulin resistance and metabolic syndrome, thereby accelerating atherosclerosis in diabetic individuals [7].

Patients with newly diagnosed T2DM represent a crucial group for evaluating the early metabolic derangements associated with the disease. At this stage, the impact of long-standing complications is minimal, allowing a clearer understanding of the role of obesity and lipid abnormalities in the disease process. Previous studies have shown that newly diagnosed diabetic patients often exhibit increased BMI, higher waist circumference, and significant dyslipidemia, which are strongly associated with disease severity and comorbid conditions such as non-alcoholic fatty liver disease [8]. Early identification of these risk factors can facilitate timely intervention and prevent long-term complications.

The Indian population, particularly in eastern regions such as Bihar, is undergoing a rapid epidemiological transition with increasing prevalence of metabolic disorders. Socioeconomic changes, urban migration, dietary shifts toward high-calorie foods, and reduced physical activity have contributed to a rising burden of obesity and diabetes in this region. Studies conducted in North Bihar have highlighted a high prevalence of obesity-associated metabolic abnormalities, including increased BMI, waist circumference, WHR, and lipid abnormalities among newly diagnosed T2DM patients [8]. Despite this growing burden, there is limited region-specific data examining the relationship between anthropometric indices and lipid profile in newly diagnosed diabetic patients in Bihar.

Medical colleges centers in Bihar serve as major referral hubs for patients from both urban and rural populations. These centers receive a large number of newly diagnosed T2DM cases, providing an ideal setting for evaluating the correlation between BMI, WHR, and lipid profile in such patients. Understanding these correlations in this specific population is essential because ethnic and regional variations significantly influence body fat distribution, metabolic risk, and disease progression. South Asian populations, including those from Bihar, are known to have higher visceral fat and greater cardiometabolic risk at lower BMI levels compared to Western populations, making region-specific studies highly relevant [9].

Furthermore, early detection of dyslipidemia and central obesity in newly diagnosed T2DM patients is essential for implementing preventive strategies aimed at reducing cardiovascular risk. Anthropometric measurements such as BMI and WHR are simple, non-invasive, and cost-effective tools that can be easily utilized in primary and tertiary care settings for risk stratification. Their correlation with lipid abnormalities can help clinicians identify high-risk individuals at the time of diagnosis and initiate early lifestyle and pharmacological interventions.

Despite the increasing burden of T2DM in Bihar, there is a paucity of prospective data evaluating the relationship between anthropometric indices and lipid profile in newly diagnosed patients. Most available studies are cross-sectional or conducted in urban metropolitan populations, which may not accurately represent the demographic and lifestyle characteristics of the Bihar population. Bihar has a unique socio-cultural and economic profile, with a large rural population, limited healthcare access, and rising prevalence of obesity and metabolic disorders. Therefore, there is a pressing need to generate region-specific evidence to guide preventive and therapeutic strategies.

Medical college in Bihar functions as a major referral center catering to a diverse patient population from various districts. Studying patients presenting to such a center will provide comprehensive data reflecting the actual burden and pattern of metabolic abnormalities in newly diagnosed T2DM cases. Additionally, identifying correlations between BMI, WHR, and lipid profile in this population can help in early risk stratification and prevention of cardiovascular complications, which remain the leading cause of mortality in diabetic patients.

The present study aims to evaluate the correlation between BMI, waist–hip ratio (WHR), and lipid profile parameters in adult patients with newly diagnosed type 2 diabetes mellitus attending a tertiary care center in Bihar. The study further seeks to determine the association between anthropometric indices and dyslipidemia, thereby identifying simple clinical markers that can be used for early detection of cardiovascular risk in this population.

MATERIALS AND METHODS

The present study was conducted in the Department of General Medicine at Jannayak Karpoori Thakur Medical College and Hospital in Bihar, which serves as a major referral center for patients from both urban and rural regions of the state. The hospital caters to a large population of patients presenting with metabolic and endocrine disorders, including newly diagnosed T2DM. The study was carried out in the outpatient department (OPD), where newly diagnosed diabetic patients are routinely evaluated and managed. The study duration was one year from Jan 2025 to Dec 2025, during which eligible patients attending the OPD were screened and enrolled. Written informed consent was obtained from all participants, and confidentiality of patient data was strictly maintained.

This study was designed as a hospital-based prospective observational study aimed at evaluating the correlation between BMI, WHR, and lipid profile parameters in adult patients with newly diagnosed T2DM. The prospective design enabled systematic collection of anthropometric and biochemical data at the time of diagnosis, minimizing recall bias and ensuring temporal uniformity in data acquisition.

The study population consisted of adult patients diagnosed with T2DM for the first time based on the American Diabetes Association (ADA) diagnostic criteria, including fasting plasma glucose ≥126 mg/dL, postprandial plasma glucose ≥200 mg/dL, HbA1c ≥6.5%, or random plasma glucose ≥200 mg/dL with classic symptoms of hyperglycemia. All participants were recruited consecutively from the medicine OPD and were evaluated at baseline prior to initiation of lipid-lowering therapy.

A total of 100 patients were included in the study. The sample size was determined based on feasibility, patient load in the OPD, and previous similar studies evaluating anthropometric and lipid correlations in T2DM. Patients were randomly selected from those reporting to the OPD during the study period, using a systematic random sampling method (every third eligible patient) to avoid selection bias and ensure representativeness.

Inclusion Criteria

Adult patients aged ≥18 years. Newly diagnosed cases of type 2 diabetes mellitus. Patients who had not received prior treatment for diabetes or dyslipidemia. Patients willing to participate and provide written informed consent.

Exclusion Criteria

Patients with type 1 diabetes mellitus, gestational diabetes, or secondary diabetes. Patients are already on lipid-lowering drugs, corticosteroids, or hormonal therapy. Known cases of chronic liver disease, renal failure, thyroid disorders, or Cushing's syndrome. Patients with acute illness, infection, or hospitalization in the last one month. Pregnant or lactating women. Patients unwilling or unable to provide consent.

METHODOLOGY

After obtaining ethical clearance from the Institutional Ethics Committee, all eligible participants were enrolled following written informed consent. A detailed clinical history was obtained, including age, sex, duration of symptoms, family history of diabetes, dietary habits, physical activity, and smoking/alcohol status.

Anthropometric parameters were measured using standardized techniques

Height was measured in centimeters using a stadiometer with the patient standing barefoot.

Weight was measured in kilograms using a calibrated digital weighing scale.

Body mass index (BMI) was calculated using the formula: [BMI = {Weight (kg)} / {Height $(m)^2$}]. BMI was categorized according to the WHO Asian classification:

Normal: 18.5–22.9 kg/m²

Overweight: 23–24.9 kg/m²

Obese: ≥25 kg/m²

Waist circumference was measured at the midpoint between the lower margin of the last rib and the iliac crest.

Hip circumference was measured at the widest portion of the buttocks.

Waist–Hip Ratio (WHR) was calculated as waist circumference divided by hip circumference.

WHR was categorized as:

Normal: <0.90 (men), <0.85 (women)

Abnormal: ≥0.90 (men), ≥0.85 (women)

After an overnight fasting of 8–12 hours, venous blood samples were collected under aseptic precautions. The following biochemical parameters were analyzed: Fasting blood glucose (FBG), postprandial blood glucose (PPBG), HbA1c, lipid profile, including: total cholesterol (TC), triglycerides (TG), high-density lipoprotein (HDL), low-density lipoprotein (LDL), very low-density lipoprotein (VLDL).

All biochemical analyses were carried out using standardized enzymatic methods in the hospital's central laboratory with appropriate quality control measures.

Dyslipidemia was defined based on standard guidelines: TC >200 mg/dL, LDL >100 mg/dL, TG >150 mg/dL, HDL <40 mg/dL (men) and <50 mg/dL (women).

All patient information was recorded in a pre-designed, structured case record form. Data confidentiality was maintained throughout the study, and patients were assigned unique identification numbers to anonymize records.

Data were entered into Microsoft Excel and analyzed using Statistical Package for Social Sciences (SPSS) version 20.0. Continuous variables such as BMI, WHR, and lipid parameters were expressed as mean ± standard deviation (SD), while categorical variables were expressed as frequencies and percentages. Student's t-test for comparison of means between two groups. Analysis of Variance (ANOVA) for comparison across more than two BMI/WHR categories. Pearson's correlation coefficient (r) to assess the relationship between BMI, WHR, and lipid profile parameters. A *p-value* <0.05 was considered statistically significant.

RESULTS

A total of 100 newly diagnosed type 2 diabetes mellitus (T2DM) patients were included in the present prospective study conducted at a tertiary care center in Bihar. The data were analyzed to determine the relationship between anthropometric indices (BMI and Waist–Hip Ratio) and lipid profile parameters.

The mean age of the study participants was 49.6 ± 10.8 years, with the majority of patients belonging to the 41 to 60 years age group (58%). There was a slight male predominance with 56% males and 44% females. The mean BMI of the study population was 26.2 ± 3.8 kg/m², indicating that most participants were either overweight or obese as per Asian BMI criteria. The mean WHR was 0.94 ± 0.06, which was above the normal cutoff in a majority of patients, suggesting a high prevalence of central obesity.

Table 1 shows that 54% of the patients were obese and 28% were overweight, indicating that more than four-fifths of the newly diagnosed T2DM patients had elevated BMI. This highlights the strong association between obesity and the development of T2DM in this population.

Table 2 demonstrates that 78% of patients had increased WHR, reflecting central obesity. This indicates that abdominal fat distribution is highly prevalent in newly diagnosed diabetic patients and may be a more sensitive marker of metabolic risk than BMI.

Table 3 reveals that the study population had elevated total cholesterol, triglycerides, LDL, and VLDL levels, with reduced

Table 1: Distribution of patients according to BMI categories

BMI category (kg/m²)	*Number of patients (n=100)*	*Percentage (%)*
Normal (18.5–22.9)	18	18
Overweight (23–24.9)	28	28
Obese (≥25)	54	54

Table 2: Distribution according to waist–hip ratio

WHR category	*Number of patients (n=100)*	*Percentage (%)*
Normal WHR	22	22
Increased WHR	78	78

Table 3: Lipid profile parameters in study population

Lipid Parameter	*Mean ± SD (mg/dL)*
Total cholesterol (TC)	214.5 ± 38.6
Triglycerides (TG)	186.3 ± 52.4
LDL cholesterol	132.8 ± 34.2
HDL cholesterol	38.7 ± 6.8
VLDL cholesterol	37.2 ± 10.4

Table 4: Correlation of BMI and WHR with lipid profile

Parameter	*BMI (r value)*	*WHR (r value)*	*p-value*
Total cholesterol	+0.42	+0.48	<0.01
Triglycerides	+0.51	+0.56	<0.01
LDL	+0.39	+0.45	<0.01
HDL	–0.36	–0.40	<0.01

HDL levels, indicating a typical pattern of diabetic dyslipidemia. These findings confirm the high cardiovascular risk profile in newly diagnosed T2DM patients.

Table 4 shows a statistically significant positive correlation between BMI, WHR, and atherogenic lipid parameters such as total cholesterol, triglycerides, and LDL cholesterol ($p < 0.01$). Conversely, HDL cholesterol showed a negative correlation with BMI and WHR. Notably, WHR demonstrated slightly stronger correlations with lipid abnormalities compared to BMI, suggesting that central obesity may be a better predictor of dyslipidemia in T2DM patients.

The results of the present study indicate that both generalized obesity (BMI) and central obesity (WHR) are significantly associated with dyslipidemia in newly diagnosed T2DM patients. A large proportion of patients were found to be overweight or obese, with a high prevalence of increased WHR. The lipid profile pattern observed in this study reflects classical diabetic dyslipidemia characterized by elevated triglycerides, LDL, and reduced HDL cholesterol.

The correlation analysis clearly demonstrates that higher BMI and WHR are associated with worsening lipid parameters, indicating that anthropometric indices can serve as simple and reliable clinical predictors of dyslipidemia. Furthermore, WHR showed a stronger association with lipid abnormalities than BMI, emphasizing the importance of central obesity in the pathogenesis of metabolic disturbances in T2DM.

These findings underscore the need for early screening of obesity and lipid abnormalities at the time of diagnosis of T2DM, particularly in resource-limited settings like Bihar, where simple anthropometric measurements can aid in early risk stratification and management.

DISCUSSION

The present prospective study evaluated the correlation between BMI, WHR, and lipid profile in patients with newly diagnosed T2DM attending a tertiary care center in Bihar. The findings of this study demonstrate a significant association between anthropometric indices and dyslipidemia, reinforcing the concept that both generalized and central obesity play a crucial role in the metabolic derangements seen in T2DM.

In the current study, the majority of patients were either overweight or obese, with more than three-fourths showing an elevated WHR. These findings are consistent with previous epidemiological evidence indicating that obesity, particularly central adiposity, is a major determinant of T2DM risk and metabolic abnormalities. Recent studies have shown that WHR is a superior indicator of central fat distribution and has a stronger association with beta-cell dysfunction and diabetes risk compared to BMI [1]. This observation is in agreement with our findings, where WHR demonstrated a slightly stronger correlation with lipid abnormalities than BMI.

The relationship between adiposity and T2DM is mediated by insulin resistance, which is a hallmark of metabolic syndrome. Increased visceral fat leads to altered adipokine secretion, increased free fatty acid flux, and chronic low-grade inflammation, all of which contribute to insulin resistance and dyslipidemia. Previous research has established that anthropometric indices and lipid-related parameters are useful predictors of diabetes risk in middle-aged and elderly populations [2]. Our study further supports these findings by demonstrating significant correlations between BMI, WHR, and lipid parameters such as triglycerides, LDL cholesterol, and HDL cholesterol.

Central obesity, as reflected by WHR, has been shown to be more strongly associated with intra-abdominal fat and metabolic complications than BMI. A large cohort study demonstrated that WHR and waist circumference are better predictors of T2DM compared to BMI [3]. Similarly, our study found that WHR had stronger correlations with triglycerides and LDL cholesterol than BMI, indicating that abdominal fat distribution is more closely linked to dyslipidemia in newly diagnosed T2DM patients.

The lipid profile pattern observed in this study is characteristic of diabetic dyslipidemia, which includes elevated triglycerides, increased LDL cholesterol, and reduced HDL cholesterol. These findings are consistent with previous studies that have reported a significant correlation between BMI and lipid ratios such as TG/HDL and LDL/HDL in patients with T2DM [4]. Another recent study has also shown that lipid indices and obesity-related markers are valuable tools in predicting metabolic risk in diabetic individuals [5]. The findings of the present study, therefore, align with the growing body of evidence that anthropometric indices can serve as simple clinical markers for identifying patients at risk of dyslipidemia and cardiovascular disease.

The clinical implications of these findings are particularly important in resource-limited settings such as Bihar, where access to advanced diagnostic tools may be limited. Anthropometric measurements such as BMI and WHR are inexpensive, non-invasive, and easy to perform, making them ideal for screening and early detection of high-risk individuals. Early identification of obesity and dyslipidemia in newly diagnosed T2DM patients can help initiate timely interventions, including lifestyle modification and pharmacotherapy, thereby reducing the risk of cardiovascular complications.

Another important observation from this study is the stronger association of WHR with lipid abnormalities compared to BMI. This finding has important public health implications, as it highlights the need to include central obesity measures in routine clinical assessment of diabetic patients. Studies have consistently demonstrated that abdominal obesity is independently associated with various complications of diabetes, including cardiovascular disease and cognitive impairment [6]. Therefore, WHR should be considered alongside BMI as a standard anthropometric parameter in diabetes management protocols.

The findings of the present study are also supported by research showing that anthropometric measurements correlate significantly with insulin resistance and metabolic abnormalities in diabetic populations [7]. Such correlations underline the importance of

addressing obesity as a modifiable risk factor in the management of T2DM. Lifestyle interventions aimed at weight reduction, improved diet, and increased physical activity have been shown to improve lipid profile and glycemic control, thereby reducing the burden of disease [10].

Despite its strengths, the present study has certain limitations. The sample size was relatively small and confined to a single tertiary care center, which may limit the generalizability of the findings. Additionally, the cross-sectional nature of correlation analysis does not establish causality. However, the prospective design and standardized methodology enhance the validity of the results.

CONCLUSION

Overall, the present study demonstrates a strong and significant correlation between BMI, WHR, and lipid profile in newly diagnosed T2DM patients. The findings highlight the importance of incorporating anthropometric indices, particularly WHR, into routine clinical evaluation for early identification of metabolic risk. Given the rising burden of diabetes and cardiovascular disease in India, especially in economically challenged regions like Bihar, such simple and cost-effective screening tools can play a vital role in improving patient outcomes.

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