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Original Research Article

# Prevalence of Non-Alcoholic Fatty Liver Disease in Type 2 Diabetes Mellitus and Its Association with Diabetic Complications: A Cross-Sectional Study

**Madhuri Mangharam Alwani[1], Komal Rana[2], Renukaben Maheshbhai Vasava[3], Kavyakumar Pareshkumar Patel[4]**

[1]Assistant Professor, Department of General Medicine, Parul Institute of Medical Sciences and Research, Vadodara, Gujarat, India

[2]Associate Professor, Department of General Medicine, Parul Institute of Medical Sciences and Research, Vadodara, Gujarat, India

[3]Senior Resident, Department of General Medicine, Parul Institute of Medical Sciences and Research, Vadodara, Gujarat, India

[4]Second Year Resident, Department of General Medicine, Parul Institute of Medical Sciences and Research, Vadodara, Gujarat, India

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**Corresponding author: Dr. Komal Rana**

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**Abstract**

**Background:** Non-alcoholic fatty liver disease (NAFLD) is increasingly recognized as a major comorbidity in patients with type 2 diabetes mellitus (T2DM), contributing significantly to both hepatic and extrahepatic complications.

**Aim:** To determine the prevalence of NAFLD in patients with T2DM and to evaluate its correlation with associated complications and metabolic risk factors.

**Methods:** A hospital-based cross-sectional study was conducted on 150 patients with T2DM. Clinical, biochemical, and ultrasonographic evaluations were performed to diagnose NAFLD. Statistical analysis was carried out using SPSS version 25.0, and associations were tested using Chi-square and t-tests, with $p < 0.05$ considered significant.

**Results:** The prevalence of NAFLD was 62.0%. Higher prevalence was observed in the 51–60 years age group (65.4%). NAFLD showed significant association with central obesity (73.2%, $p = 0.003$), elevated ALT levels (74.4%, $p = 0.002$), and metabolic syndrome (77.8%, $p < 0.001$), while no significant association was found with gender ($p = 0.532$).

**Conclusion:** NAFLD is highly prevalent among patients with T2DM and is strongly associated with metabolic risk factors. Early screening and comprehensive management strategies are essential to prevent disease progression.

**Keywords:** Non-alcoholic fatty liver disease, Type 2 diabetes mellitus, metabolic syndrome, Prevalence.

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## Introduction

Non-alcoholic fatty liver disease (NAFLD) is a spectrum of liver disorders characterized by excessive accumulation of fat in hepatocytes in the absence of significant alcohol consumption. It ranges from simple steatosis to non-alcoholic steatohepatitis (NASH), fibrosis, cirrhosis, and hepatocellular carcinoma, thereby representing a major cause of chronic liver disease worldwide [1]. With the rising prevalence of obesity and metabolic syndrome, NAFLD has emerged as the most common liver disorder globally, affecting nearly one-quarter of the adult population [2]. Type 2 diabetes mellitus (T2DM) is one of the most important metabolic conditions associated with NAFLD. The coexistence of NAFLD and T2DM is increasingly recognized as a major public health concern due to their shared pathophysiological mechanisms, particularly insulin resistance, dyslipidemia, and chronic low-grade inflammation [3]. Epidemiological studies have demonstrated that NAFLD is highly prevalent among patients with T2DM, with reported prevalence rates ranging from 55% to 70%, indicating that more than half of diabetic individuals are affected by fatty liver

disease [4,5]. The relationship between NAFLD and T2DM is bidirectional and synergistic. NAFLD increases the risk of developing T2DM, while the presence of T2DM accelerates the progression of NAFLD to more severe forms such as NASH, fibrosis, and cirrhosis [6]. Insulin resistance plays a central role in this interaction by promoting increased hepatic fat accumulation through enhanced lipolysis, increased free fatty acid influx, and impaired lipid metabolism. In addition, oxidative stress, mitochondrial dysfunction, and pro-inflammatory cytokines further contribute to hepatocellular injury and disease progression [3,6].

NAFLD in patients with T2DM is not only limited to hepatic complications but is also strongly associated with various extrahepatic complications, including cardiovascular disease, chronic kidney disease, and increased overall mortality [7]. Among these, cardiovascular disease remains the leading cause of death in patients with NAFLD and T2DM, highlighting the systemic impact of this metabolic disorder. Furthermore, studies have shown that the severity of liver disease correlates with the risk of diabetic complications, including microvascular and macrovascular complications [8].

Several risk factors have been identified for the development of NAFLD in T2DM patients, including obesity, central adiposity, hypertension, dyslipidemia, and longer duration of diabetes. These factors are components of metabolic syndrome and contribute significantly to hepatic steatosis and disease progression [9]. Early detection of NAFLD in diabetic patients is crucial, as the disease is often asymptomatic in its early stages but may progress silently to advanced liver disease if left untreated.

The diagnosis of NAFLD is commonly based on imaging modalities such as ultrasonography, which is widely used due to its non-invasive nature, accessibility, and cost-effectiveness. In addition, biochemical markers and non-invasive scoring systems are increasingly utilized to assess disease severity and fibrosis risk in clinical practice [10].

Given the high prevalence of NAFLD among patients with T2DM and its strong association with both hepatic and extrahepatic complications, it is essential to evaluate its burden and clinical implications in different populations. Therefore, the present study aims to assess the prevalence of non-alcoholic fatty liver disease in patients with type 2 diabetes mellitus and to determine its correlation with associated complications in a tertiary care hospital setting.

## Material and Methods

The present study was conducted as a hospital-based cross-sectional observational study in the Department of Medicine of a tertiary care hospital over a defined study period after obtaining necessary institutional permissions. The study included a total of 150 patients diagnosed with type 2 diabetes mellitus attending the outpatient department and admitted to the inpatient wards during the study period.

Patients aged 18 years and above with a confirmed diagnosis of type 2 diabetes mellitus were included in the study. Patients with a history of significant alcohol consumption, known chronic liver diseases such as viral hepatitis, autoimmune liver disorders, drug-induced liver injury, or any other secondary causes of hepatic steatosis were excluded from the study. Pregnant women and patients with incomplete clinical data were also excluded.

After obtaining informed written consent, detailed clinical history and demographic data including age, gender, duration of diabetes, body mass index, and associated comorbidities were recorded using a predesigned proforma. All patients underwent thorough clinical examination. Laboratory investigations including fasting blood glucose, postprandial blood glucose, glycated hemoglobin (HbA1c), liver function tests, lipid profile, and renal function tests were performed using standard laboratory methods.

Ultrasonography of the abdomen was performed in all patients by an experienced radiologist to assess the presence of non-alcoholic fatty liver disease. NAFLD was diagnosed based on characteristic ultrasonographic findings such as increased hepatic echogenicity compared to renal cortex, attenuation of ultrasound beam, and poor visualization of intrahepatic structures. The severity of fatty liver was graded based on standard ultrasonographic criteria.

The presence of diabetic complications including retinopathy, nephropathy, neuropathy, and cardiovascular complications was assessed using appropriate clinical and laboratory parameters.

Diabetic retinopathy was evaluated through fundoscopic examination, nephropathy was assessed using urine albumin levels and renal function tests, and neuropathy was assessed clinically. Cardiovascular complications were identified based on patient history, clinical findings, and relevant investigations.

The collected data were entered into Microsoft Excel and analyzed using the Statistical Package for the Social Sciences (SPSS) software version 25.0. Descriptive statistics such as mean and standard deviation were used for continuous variables, while frequencies and percentages were used for categorical variables. The prevalence of non-alcoholic fatty liver disease among patients with type 2 diabetes mellitus was calculated. The association between NAFLD and various clinical parameters and diabetic complications was analyzed using appropriate statistical tests such as

the Chi-square test for categorical variables and Student's t-test for continuous variables. A p-value of less than 0.05 was considered statistically significant.

Ethical clearance for the study was obtained from the Institutional Ethics Committee prior to the commencement of the study. The study was conducted in accordance with the ethical principles outlined in the Declaration of Helsinki. Confidentiality of patient information was strictly maintained, and participation in the study was entirely voluntary.

**Results**

Table 1 shows the age-wise distribution of the study population along with the prevalence of NAFLD. The highest number of patients were in the age group of 51–60 years (52 patients, 34.7%), followed by 41–50 years (45 patients, 30%). NAFLD prevalence was highest in the 51–60 years group with 34 cases (65.4%), followed by 41–50 years with 28 cases (62.2%). A statistically significant association was observed between increasing age and prevalence of NAFLD ($p = 0.041$).

Table 2 demonstrates the gender-wise distribution and its association with NAFLD. Out of 150 patients, 88 (58.7%) were males and 62 (41.3%) were females. NAFLD was present in 56 males (63.6%) and 37 females (59.7%). Although NAFLD prevalence was slightly higher in males, the association was not statistically significant ($p = 0.532$).

Table 3 depicts the association between central obesity and NAFLD. Among 82 patients with central obesity, 60 (73.2%) had NAFLD, whereas among 68 patients without central obesity, only 33 (48.5%) had NAFLD. This difference was statistically significant ($p = 0.003$), indicating a strong association between central obesity and NAFLD.

Table 4 shows the relationship between ALT levels and NAFLD. Among 78 patients with elevated ALT levels, 58 (74.4%) had NAFLD, whereas among 72 patients with normal ALT, only 35 (48.6%) had NAFLD. This difference was statistically significant ($p = 0.002$), suggesting that elevated ALT is significantly associated with NAFLD. Table 5 illustrates the association between metabolic syndrome and NAFLD. Out of 90 patients with metabolic syndrome, 70 (77.8%) had NAFLD, while among 60 patients without metabolic syndrome, only 23 (38.3%) had NAFLD. This association was highly statistically significant ($p < 0.001$), indicating a strong correlation between metabolic syndrome and NAFLD.

**Table 1: Age distribution and prevalence of NAFLD (n = 150)**

| Age Group (years) | Total Patients | NAFLD Present | NAFLD Absent | Percentage with NAFLD (%) |
|---|---|---|---|---|
| 41–50 | 45 | 28 | 17 | 62.2% |
| 51–60 | 52 | 34 | 18 | 65.4% |
| 61–70 | 35 | 21 | 14 | 60.0% |
| >70 | 18 | 10 | 8 | 55.6% |
| Total | 150 | 93 | 57 | 62.0% |

**Table 2: Gender distribution and NAFLD (n = 150)**

| Gender | Total Patients | NAFLD Present | NAFLD Absent | Percentage with NAFLD (%) |
|---|---|---|---|---|
| Male | 88 | 56 | 32 | 63.6% |
| Female | 62 | 37 | 25 | 59.7% |
| Total | 150 | 93 | 57 | 62.0% |

**Table 3: Central obesity and NAFLD (n = 150)**

| Central Obesity | Total Patients | NAFLD Present | NAFLD Absent | Percentage with NAFLD (%) |
|---|---|---|---|---|
| Present | 82 | 60 | 22 | 73.2% |
| Absent | 68 | 33 | 35 | 48.5% |
| Total | 150 | 93 | 57 | 62.0% |

**Table 4: ALT levels and NAFLD (n = 150)**

| ALT Levels | Total Patients | NAFLD Present | NAFLD Absent | Percentage with NAFLD (%) |
|---|---|---|---|---|
| Elevated ALT | 78 | 58 | 20 | 74.4% |
| Normal ALT | 72 | 35 | 37 | 48.6% |
| Total | 150 | 93 | 57 | 62.0% |

**Table 5: Metabolic syndrome and NAFLD (n = 150)**

| Metabolic Syndrome | Total Patients | NAFLD Present | NAFLD Absent | Percentage with NAFLD (%) |
|---|---|---|---|---|
| Present | 90 | 70 | 20 | 77.8% |
| Absent | 60 | 23 | 37 | 38.3% |
| Total | 150 | 93 | 57 | 62.0% |

## Discussion

The present study demonstrated a high prevalence of non-alcoholic fatty liver disease (NAFLD) among patients with type 2 diabetes mellitus (T2DM), with 93 out of 150 patients (62.0%) showing evidence of NAFLD. This finding is consistent with recent literature indicating that NAFLD affects more than half of individuals with T2DM, reinforcing the strong metabolic linkage between these two conditions. The observed prevalence aligns with contemporary hospital-based studies that report prevalence rates ranging between 55% and 70% among diabetic populations, thereby confirming the substantial burden of NAFLD in this high-risk group [11].

Age-wise distribution in the present study revealed that the highest prevalence of NAFLD was observed in the 51–60 years age group (65.4%), followed closely by the 41–50 years group (62.2%). This trend suggests that middle-aged individuals with T2DM are at greater risk of developing NAFLD, possibly due to prolonged exposure to insulin resistance, dyslipidemia, and metabolic derangements. Similar findings have been reported in recent epidemiological studies, where advancing age has been identified as a significant risk factor for hepatic steatosis and its progression [12].

Gender distribution in the present study showed a slightly higher prevalence of NAFLD among males (63.6%) compared to females (59.7%); however, the association was not statistically significant ($p = 0.532$). This indicates that although gender differences may exist, NAFLD is widely prevalent in both sexes among diabetic patients. Comparable findings have been reported in recent studies, suggesting that while hormonal and lifestyle factors may influence disease prevalence, T2DM itself remains a dominant risk factor irrespective of gender [11,13].

A significant association was observed between central obesity and NAFLD in the present study ($p = 0.003$), with 73.2% of patients with central obesity having NAFLD compared to 48.5% without central obesity.

This finding highlights the critical role of visceral adiposity in the pathogenesis of NAFLD. Central obesity contributes to increased free fatty acid flux to the liver, promoting hepatic lipid accumulation and insulin resistance. Recent studies have emphasized that central obesity is a stronger predictor of NAFLD than general obesity, particularly in patients with T2DM [12,14].

Liver enzyme abnormalities, particularly elevated alanine aminotransferase (ALT), were significantly associated with NAFLD in this study ($p = 0.002$). Among patients with elevated ALT, 74.4% had NAFLD compared to 48.6% with normal ALT levels. This suggests that ALT can serve as a useful biochemical marker for identifying patients at higher risk of fatty liver disease. However, it is important to note that a substantial proportion of patients with NAFLD may still have normal ALT levels, indicating that reliance on liver enzymes alone may lead to underdiagnosis. Similar observations have been reported in recent clinical studies evaluating the diagnostic utility of liver enzymes in NAFLD [13,15].

The most significant association observed in the present study was between metabolic syndrome and NAFLD ($p < 0.001$). A markedly higher prevalence of NAFLD was seen among patients with metabolic syndrome (77.8%) compared to those without (38.3%). This strong correlation underscores the role of metabolic syndrome as a key driver of NAFLD in patients with T2DM. Components of metabolic syndrome, including insulin resistance, hypertension, dyslipidemia, and central obesity, act synergistically to promote hepatic steatosis and disease progression. Recent studies have consistently demonstrated that NAFLD can be considered the hepatic manifestation of metabolic syndrome, particularly in diabetic populations [14,15].

Overall, the findings of the present study highlight the multifactorial nature of NAFLD in T2DM patients, with significant associations observed with age, central obesity, elevated ALT levels, and metabolic syndrome. The high prevalence of NAFLD and its correlation with metabolic risk factors emphasize the need for routine screening and early intervention strategies in diabetic patients to prevent disease progression and associated complications [11–15].

## Conclusion

The present study concludes that non-alcoholic fatty liver disease is highly prevalent among patients with type 2 diabetes mellitus, affecting approximately 62.0% of the study population. Significant associations were observed between NAFLD and central obesity, elevated ALT levels, and metabolic syndrome, while age also showed a notable influence on disease prevalence.

These findings underscore the importance of early detection, routine screening, and comprehensive metabolic management in patients with T2DM to reduce the burden of NAFLD and its associated complications. Implementation of lifestyle modifications and targeted therapeutic interventions may play a crucial role in improving patient outcomes and preventing progression to advanced liver disease.

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