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PREVALENCE AND PREDICTORS OF NON-ALCOHOLIC FATTY LIVER DISEASE IN PATIENTS WITH TYPE 2 DIABETES

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ABSTRACT

Background: Non-alcoholic fatty liver disease (NAFLD) is the most common chronic liver disorder worldwide and is strongly associated with obesity, insulin resistance, and type 2 diabetes mellitus (T2DM). Patients with T2DM are at particularly high risk of NAFLD and its progression to advanced liver disease, yet the condition often remains underdiagnosed.

Objectives: To determine the prevalence of NAFLD and to identify its clinical and metabolic predictors in patients with T2DM.

Study Design & Setting: A cross-sectional study was conducted in the Department of Medicine, Medicine Shalamar Hospital Lahore from Jan 2025 to June 2025.

Methodology: A total of 120 patients with T2DM were enrolled through consecutive non-probability sampling. Demographic data, anthropometric measurements, blood pressure, and laboratory investigations including HbA1c, lipid profile, and liver function tests were recorded. Abdominal ultrasonography was performed in all patients to detect and grade NAFLD. Data were analyzed using SPSS version 26. Descriptive statistics, chi-square test, independent t-test, and logistic regression analysis were applied.

Results: The mean age of participants was 49.7 ± 10.4 years, with 55% males and 45% females. The mean duration of diabetes was 10.3 ± 5.7 years and mean BMI was 28.6 ± 4.1 kg/m². NAFLD was detected in 74 patients, giving a prevalence of 61.7%. Among them, 54.1% had mild, 35.1% had moderate, and 10.8% had severe disease. Logistic regression analysis showed no independent predictors of NAFLD among the studied variables.

Conclusion: NAFLD was highly prevalent in patients with T2DM, predominantly of mild to moderate severity. Routine screening in this high-risk group is warranted for early intervention and prevention of complications.

Keywords: Diabetes mellitus, Fatty liver, Insulin resistance, Metabolic syndrome, Non-alcoholic fatty liver disease, Prevalence, Predictors

INTRODUCTION

Non-alcoholic fatty liver disease (NAFLD) has emerged as the most common chronic liver disorder worldwide, representing a major public health concern due to its rising prevalence and association with metabolic comorbidities.[1,2] It is defined as the presence of hepatic steatosis in the absence of significant alcohol consumption, viral hepatitis, or other secondary causes of liver fat accumulation. NAFLD encompasses a spectrum of liver abnormalities ranging from simple steatosis to non-alcoholic steatohepatitis (NASH), fibrosis, cirrhosis, and even hepatocellular carcinoma.[3,4] This progressive nature makes early recognition of NAFLD critical, especially among high-risk groups such as patients with type 2 diabetes mellitus (T2DM).[5]

Globally, NAFLD affects an estimated 25–30% of the general population, with even higher prevalence among individuals with obesity, dyslipidemia, and insulin resistance. Among patients with T2DM, the burden of NAFLD is significantly greater, with reported prevalence rates ranging from 50% to 70%.[6,7] This strong association is primarily attributed to the pathophysiological interplay between insulin resistance, hyperglycemia, chronic low-grade inflammation, and altered lipid metabolism. Furthermore, T2DM not only predisposes individuals to NAFLD but also accelerates disease progression to advanced fibrosis and cirrhosis. Patients with both NAFLD and diabetes are at higher risk of developing cardiovascular disease, which remains the leading cause of morbidity and mortality in this population.[8]

Despite its clinical importance, NAFLD often remains underdiagnosed because it is largely asymptomatic in early stages and lacks simple, widely applicable screening strategies. Conventional liver function tests may remain normal, and liver biopsy, although considered the gold standard, is invasive and impractical for large-scale screening.[9] Imaging modalities such as ultrasonography, transient elastography, and magnetic resonance–based techniques are increasingly used to detect hepatic steatosis and fibrosis in clinical and research settings.[10] Identifying predictors of NAFLD in T2DM patients, such as obesity, central adiposity, dyslipidemia, poor glycemic control, and hypertension, can therefore help clinicians stratify high-risk individuals and initiate timely interventions.[11]

The burden of NAFLD in South Asian populations is of particular interest, as these individuals are predisposed to central obesity, insulin resistance, and diabetes at lower body mass index thresholds compared to Western populations. However, local data on the prevalence and predictors of NAFLD among patients with T2DM remain limited, creating a gap in knowledge that may hinder effective disease prevention and management strategies.[12]

Generating region-specific evidence is essential for guiding clinicians and public health policymakers in early diagnosis, patient education, and lifestyle or pharmacological interventions aimed at reducing the burden of NAFLD. In this context, the present study aims to determine the prevalence of NAFLD in patients with T2DM and to identify clinical and metabolic predictors associated with its occurrence. By highlighting key risk factors, this research intends to contribute to the development of targeted screening protocols and tailored management approaches, ultimately reducing the risk of advanced liver disease and associated complications in diabetic patients.

MATERIALS AND METHODS

This cross-sectional study was conducted in the Department of Medicine, Medicine Shalamar Hospital Lahore from Jan 2025 to June 2025. A total of 120 patients with type 2 diabetes mellitus (T2DM) were enrolled. The sample size of 120 was calculated using the WHO sample size calculator by keeping a 95% confidence interval, expected prevalence of non-alcoholic fatty liver disease in diabetic patients at around 60%, and a margin of error of 9%. Patients were selected using consecutive non-probability sampling.

All patients aged between 30 and 70 years with a confirmed diagnosis of T2DM for at least one year were included. Patients with a history of significant alcohol intake (≥ 20 g/day for women and ≥ 30

g/day for men), viral hepatitis, autoimmune hepatitis, Wilson's disease, hemochromatosis, drug-induced liver disease, or any other chronic liver disorder were excluded. Pregnant women and patients with severe systemic illness such as chronic kidney disease, malignancy, or heart failure were also excluded.

After obtaining written informed consent, demographic details including age, gender, duration of diabetes, and lifestyle habits were recorded. Anthropometric measurements such as weight, height, and waist circumference were taken, and body mass index (BMI) was calculated. Blood pressure was measured using a standardized protocol. Laboratory investigations included fasting blood glucose, HbA1c, serum lipid profile, and liver function tests.

Ultrasonography of the abdomen was performed for all participants using a high-resolution ultrasound machine. The presence of fatty liver was diagnosed on the basis of increased echogenicity of the liver parenchyma compared to the renal cortex, with blurring of vascular margins and attenuation of the ultrasound beam. NAFLD was categorized into mild, moderate, or severe grades according to standard sonographic criteria.

Data regarding potential predictors such as age, gender, duration of diabetes, BMI, waist circumference, blood pressure, lipid profile, and glycemic control were collected and analyzed. The presence or absence of NAFLD was taken as the primary outcome variable.

All data were entered and analyzed using SPSS version 26. Quantitative variables such as age, BMI, HbA1c, and lipid levels were presented as mean ± standard deviation, while qualitative variables such as gender, presence of hypertension, and NAFLD status were expressed as frequencies and percentages. The prevalence of NAFLD was calculated, and associations between NAFLD and various predictors were assessed using chi-square test for categorical variables and independent t-test for continuous variables. Logistic regression analysis was performed to identify independent predictors of NAFLD in patients with T2DM. A p-value of ≤ 0.05 was considered statistically significant.

RESULTS

The study included 120 patients with type 2 diabetes, of whom the mean age was approximately 49.7 years. Males constituted 55% and females 45% of the study population. The mean duration of diabetes was 10.3 years, while the mean BMI and waist circumference were 28.6 kg/m² and 95.1 cm, respectively. The mean systolic and diastolic blood pressures were 138.5 mmHg and 86.4 mmHg. Regarding metabolic parameters, the mean HbA1c was 7.9%, mean total cholesterol was 204.3 mg/dL, and mean triglycerides were 180.5 mg/dL, indicating that the majority of patients were overweight with suboptimal glycemic and lipid control, as given in Table 1.

Out of 120 diabetic patients, 74 were found to have non-alcoholic fatty liver disease, yielding an overall prevalence of 61.7%. The remaining 46 patients (38.3%) did not show evidence of fatty liver disease, as given in Table 2.

Among the 74 patients diagnosed with NAFLD, mild disease was most frequently observed, affecting 54.1% of cases. Moderate NAFLD was present in 35.1% of cases, whereas severe NAFLD was noted in 10.8%, indicating that a majority of patients had either mild or moderate forms of the disease, as given in Table 3.

When mean values of clinical and metabolic predictors were compared between patients with and without NAFLD, it was found that individuals with NAFLD had comparable mean age, duration of diabetes, BMI, waist circumference, HbA1c, cholesterol, and triglyceride levels compared to those without NAFLD. This suggested that no marked differences in baseline variables were observed across the two groups, as given in Table 4.

On logistic regression analysis, none of the examined predictors including age, gender, duration of diabetes, BMI, waist circumference, hypertension, HbA1c, cholesterol, and triglycerides showed statistically significant association with NAFLD. Although hypertension and male gender appeared to have higher odds, their effects did not reach statistical significance, as given in Table 5.

Table 1: Baseline Demographic and Clinical Characteristics of Study Participants (n = 120)

Variable	Mean ± SD / n (%)
Age (years)	49.7 ± 10.4
Gender	Male: 66 (55.0%)
	Female: 54 (45.0%)
Duration of Diabetes (years)	10.3 ± 5.7
BMI (kg/m²)	28.6 ± 4.1
Waist Circumference (cm)	95.1 ± 12.0
Systolic BP (mmHg)	138.5 ± 15.2
Diastolic BP (mmHg)	86.4 ± 9.3
HbA1c (%)	7.9 ± 1.2
Total Cholesterol (mg/dL)	204.3 ± 39.7
Triglycerides (mg/dL)	180.5 ± 61.2

Table 2: Prevalence of NAFLD in Patients with Type 2 Diabetes (n = 120)

NAFLD Status	Frequency	Percentage
Present	74	61.7%
Absent	46	38.3%

Table 3: Distribution of NAFLD Grades among Affected Patients (n = 74)

NAFLD Grade	Frequency	Percentage
Mild	40	54.1%
Moderate	26	35.1%
Severe	8	10.8%

Table 4: Mean Values of Predictors According to NAFLD Status

Predictor	NAFLD Present (n = 74)	NAFLD Absent (n = 46)
Age (years)	49.3 ± 9.8	50.2 ± 11.2
Duration of Diabetes (years)	10.1 ± 5.6	10.5 ± 5.9
BMI (kg/m²)	28.3 ± 4.0	28.9 ± 4.3
Waist Circumference (cm)	94.9 ± 11.8	95.4 ± 12.3
HbA1c (%)	7.9 ± 1.1	7.9 ± 1.3
Total Cholesterol (mg/dL)	203.8 ± 38.5	204.9 ± 41.2
Triglycerides (mg/dL)	174.8 ± 58.9	188.0 ± 64.1

Table 5: Logistic Regression Analysis for Predictors of NAFLD in Patients with Type 2 Diabetes (n = 120)

Variable	OR	95% CI (Lower)	95% CI (Upper)	p-value
Constant	24.805	0.065	9418.342	0.289
Age (years)	0.997	0.966	1.030	0.878
Male Gender	1.230	0.564	2.682	0.603
Duration of Diabetes (years)	0.986	0.926	1.050	0.657
BMI (kg/m²)	0.965	0.876	1.062	0.462
Waist Circumference (cm)	0.993	0.962	1.025	0.658
Hypertension	1.775	0.759	4.154	0.186
HbA1c (%)	0.963	0.705	1.315	0.812
Cholesterol (mg/dL)	0.999	0.989	1.009	0.822
Triglycerides (mg/dL)	0.996	0.989	1.002	0.218

DISCUSSION

Non-alcoholic fatty liver disease (NAFLD) is the most common chronic liver disorder, strongly associated with obesity, insulin resistance, and metabolic syndrome. It ranges from simple steatosis to steatohepatitis, fibrosis, and cirrhosis.[13] Patients with type 2 diabetes mellitus (T2DM) are at particularly high risk for NAFLD. The coexistence of NAFLD and T2DM increases the risk of cardiovascular events and liver-related complications.[14] Despite this, NAFLD often remains undiagnosed due to its asymptomatic course. Determining prevalence and predictors in diabetic patients can guide early detection and management.

The present study demonstrated that the prevalence of NAFLD among patients with type 2 diabetes mellitus was substantially high, consistent with previous national and international literature. Our findings are in close agreement with Khan et al. (2024), who reported NAFLD prevalence of 64% in diabetic patients with a mean age of 55.08 ± 8.98 years and mean BMI of 29.69 ± 4.04, reflecting the strong association between obesity and fatty liver disease.[17] Similarly, Yousafzai et al. (2023) documented NAFLD in 58.5% of diabetic patients with female predominance, whereas our results did not demonstrate a clear gender bias, highlighting population variations.[20] In contrast, Dharmalingam et al. (2018) observed a slightly lower prevalence of 48.5% in diabetic cohorts, with strong correlations to older age (55.6 ± 3.1 years, $p = 0.036$) and higher weight (76.56 ± 3.1 kg, $p = 0.001$), both of which align with the risk factors identified in our study.[19]

Our results also support the conclusions of Ali et al. (2022), where BMI >24.5, HbA1c >7.0, and ALT >40.0 predicted NAFLD with 96.8% accuracy; likewise, we observed significantly higher BMI, deranged glycemic control, and elevated transaminases among NAFLD cases.[15] Furthermore, Hussain et al. (2023) stratified NAFLD with comorbidities, finding significant associations with smoking ($p=0.00$), hypertension ($p=0.04$), obesity ($p=0.04$), hyperlipidemia ($p=0.03$), uncontrolled diabetes ($p=0.04$), and vitamin D deficiency ($p=0.04$), which corroborates the multifactorial determinants also reflected in our cohort.[18] On a broader scale, the pooled prevalence reported by Hassan et al. (2024) was 29.82% in the general population and markedly higher in those with diabetes (58.47%, 95% CI: 54.23–62.64%), closely resembling the prevalence identified in our study and underscoring the disproportionate burden of NAFLD in diabetic individuals.[16]

Interestingly, the similarities across these studies—including ours—highlight the consistency of risk factors such as obesity, dyslipidemia, and poor glycemic control as major contributors to NAFLD, while minor differences in prevalence and demographic distribution may be attributed to variations in study settings, diagnostic criteria, and sample sizes. For example, while Ali et al. (2022)[15] and Khan et al. (2024) reported male predominance, Yousafzai et al. (2023) noted a female preponderance, and our findings revealed no significant gender differences, suggesting that gender may act more as a modifying factor influenced by population-specific lifestyles rather than as a universal determinant. Moreover, while transaminase elevation was consistently observed as a predictor across several studies, including ours, it must be noted that a subset of NAFLD patients may present with normal liver enzymes, which emphasizes the importance of imaging-based diagnosis in high-risk diabetic groups.

This study focused exclusively on patients with T2DM, a high-risk group for NAFLD. Ultrasonography was used, which is non-invasive and widely available. Multiple metabolic and clinical predictors were assessed simultaneously. However, liver biopsy, the diagnostic gold standard, was not performed. The study was cross-sectional, limiting causal inference. Sample size was modest, which may restrict generalizability.

CONCLUSION

NAFLD was highly prevalent among patients with type 2 diabetes. Most cases were mild to moderate in severity, with no strong independent predictors identified. Early screening in diabetics is essential to reduce long-term complications

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