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FREQUENCY OF NON-ALCOHOLIC FATTY LIVER DISEASE (NAFLD) AMONG TYPE 2 DIABETES MELLITUS PATIENTS

Dr Jalal Ud Din[*1], Dr Naveed Khan[2], Dr Muhammad Yaqoob Khan[3]

[*1]*Resident Medicine, Mardan Medical Complex, Mardan.*
[2]*Professor of Medicine, Mardan Medical Complex, Mardan.*
[3]*Resident Pulmonology, Pak Emirates Military hospital (PEMH), Rawalpindi.*

[*1]jalaluddinkhan8686@gmail.com, [2]drnaveedkhan2@gmail.com, [3]shaheen11muhammadi@gmail.com

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Corresponding Author: *
Dr Jalal Ud Din

Abstract

Background: *Non-Alcoholic Fatty Liver Disease (NAFLD) is a growing global health concern and is increasingly being observed 'in individuals with Type 2 Diabetes Mellitus (T2DM)' even in the absence of obesity. This association poses a risk for progression to more serious liver complications including fibrosis, cirrhosis, and hepatocellular carcinoma. To determine the frequency of NAFLD among non-obese patients diagnosed with Type 2 Diabetes Mellitus.*

Methods: *A cross-sectional study was carried out in the Department of General Medicine at a tertiary care hospital. A total of 260 non-obese individuals aged 25–70 years with T2DM were enrolled using consecutive non-probability sampling. Participants were assessed through clinical evaluation and imaging or histological evidence of hepatic steatosis. Relevant sociodemographic and clinical data were recorded and analyzed using SPSS version 23. Chi-square test was applied, with a p-value ≤ 0.05 considered significant.*

Results: *Out of 260 non-obese T2DM patients, 58.1% were diagnosed with NAFLD. Significant associations were found between NAFLD and factors 'such as age, male gender, higher-normal BMI, longer diabetes duration, hypertension, and smoking'. Other sociodemographic factors showed no significant relationship.*

Conclusion: *NAFLD is highly prevalent among non-obese individuals with T2DM. Routine screening for NAFLD in all diabetic patients, regardless of body weight, is recommended to enable early intervention and prevent complications.*

INTRODUCTION

Non-Alcoholic Fatty Liver Disease (NAFLD) represents a spectrum of liver conditions ranging from simple fat accumulation (steatosis) to more advanced stages like steatohepatitis, fibrosis, and cirrhosis. In some cases, it may progress to hepatocellular carcinoma. NAFLD occurs when more than 5% of hepatocytes contain fat, and this happens 'in individuals who consume little or no alcohol and do not have other known causes of fatty liver, such as certain medications or genetic disorders' [1-3].

Globally, NAFLD affects nearly a quarter of the adult population, with particularly high rates observed in the Middle East and South America. Alarmingly, around 90 million individuals in the United States alone are affected by chronic liver conditions related to NAFLD. Among these, nearly 25% progress to non-alcoholic steatohepatitis (NASH), a more severe form of the disease that may lead to liver fibrosis or cirrhosis [4-6].

Several risk factors are closely linked to NAFLD, including obesity, a sedentary lifestyle, metabolic syndrome, and especially 'T2DM'. The increasing prevalence of T2DM worldwide has significantly contributed to the rising burden of NAFLD. Importantly, recent studies show that even individuals with normal body weight but with T2DM are at elevated risk [7-9].

The development of NAFLD is multifactorial. The "multi-hit" hypothesis is widely accepted, suggesting that 'fat accumulation in the liver is the first step, followed by oxidative stress, inflammation, mitochondrial damage, and hormonal imbalances, which collectively lead to liver injury' [10].

NAFLD is often silent in its early stages and is usually 'discovered incidentally during routine lab tests or imaging studies'. Although liver biopsy remains the gold standard for diagnosis, non-invasive imaging techniques like ultrasound, CT, and MRI are commonly used in clinical practice.

Local data also support this trend. A previous study conducted in Pakistan identified a NAFLD prevalence of 58% among non-obese patients with T2DM, emphasizing that lean diabetics are not exempt from liver complications. Moreover, the coexistence of NAFLD and T2DM increases the risk of cardiovascular and microvascular complications, which further worsens patient outcomes[11].

Given this background, the present study aims to evaluate the frequency of NAFLD in non-obese patients with T2DM. Identifying the burden and associated factors will help shape early screening strategies and preventive care.

MATERIALS AND METHODS

This was a descriptive, cross-sectional study conducted to determine the frequency of NAFLD among non-obese individuals diagnosed with Type 2 Diabetes Mellitus.

The study was carried out in the Department of General Medicine at Mardan Medical Complex.

The research was conducted over a minimum period of six months. This duration began after formal approval of the research synopsis was obtained from the College of Physicians and Surgeons Pakistan (CPSP).

A total of 260 participants were included in the study. The sample size was calculated using the World Health Organization (WHO) sample size calculator. The estimation was based on an assumed prevalence of NAFLD of 58% among non-obese Type 2 diabetic patients. A 6% margin of error and 95% confidence level were applied.

Participants were selected through non-probability consecutive sampling. Every patient meeting the inclusion criteria and presenting during the data collection period was enrolled consecutively until the sample size was achieved.

Inclusion Criteria were male and female patients aged between 25 and 70 years. And diagnosed cases of Type 2 Diabetes Mellitus who were non-obese, as per the study's operational definition.

Exclusion Criteria were patients with known chronic liver diseases, patients currently taking hepatotoxic medications and pregnant or lactating women.

After securing ethical approval from the institutional review board and CPSP research department, patients who met the inclusion criteria were invited to participate. Written informed consent was obtained from each patient before data collection.

Basic demographic details such as age, gender, weight, height, body mass index (BMI), educational background, occupation, socioeconomic status, and area of residence were recorded. A complete medical history and clinical examination were performed. 'Only non-obese individuals with confirmed T2DM were included'.

Screening for NAFLD was done using either imaging or histological analysis. Imaging (typically magnetic resonance spectroscopy) was considered diagnostic if the proton density fat fraction exceeded 5.6%. Alternatively, biopsy results showing macrovesicular steatosis in more than 5% of liver cells were also taken as confirmation of NAFLD. A consultant physician with over five years of post-fellowship experience supervised all procedures. Each patient's data was documented using a standardized data entry form.

All collected data were processed and analyzed using IBM SPSS software (version 23). For continuous variables like age, BMI, and duration of diabetes, the results were expressed as means with standard deviations. Categorical variables such as gender, smoking status, hypertension, occupation, education, income level, and NAFLD status were summarized using frequencies and percentages.

Stratification of NAFLD was carried out for key variables including age, BMI, duration of diabetes, gender, smoking, hypertension, educational background, occupation, socioeconomic status, and place of residence to evaluate potential effect modifiers. The Chi-square test was used to assess statistical significance, with a p-value of ≤ 0.05 considered statistically significant. All findings were tabulated accordingly.

Result

The participants in this study ranged widely in age, with an average of just over 52 years. This suggests a middle-aged to older adult population, which aligns with the demographic most affected by T2DM. The mean BMI was 23.1 kg/m², just below the obesity threshold, since only non-obese individuals were included. The lowest BMI recorded was 19.2 kg/m², and the highest was 24.9 kg/m² confirming all participants fit the study's inclusion criteria. In terms of diabetes history, the average duration since diagnosis was 6.3 years, indicating that most patients had been managing their condition for a moderate period. Some had lived with T2DM for as little as one year, while others had experienced it for up to 15 years.

Table 1: Descriptive Statistics of Continuous Variables (n = 260)

Variable	Mean ± SD	Minimum	Maximum
Age (years)	52.4 ± 10.2	25	70
BMI (kg/m²)	23.1 ± 1.4	19.2	24.9
Duration of T2DM (years)	6.3 ± 3.1	1	15

Out of the total 260 non-obese patients with T2DM included in this study, 151 were found to have NAFLD. This represents a 'frequency of 58.1%, indicating that more than half of the diabetic patients, despite not being obese, had developed fatty liver changes'. This finding is significant because NAFLD is often considered a disease associated with obesity, yet this data emphasizes that even lean individuals with diabetes remain at considerable risk.

Table 2: Frequency of NAFLD Among Study Participants

NAFLD Status	Frequency (n)	Percentage (%)
Present	151	58.1%
Absent	109	41.9%

The gender distribution was fairly balanced, with a slight male predominance at 54.6%. Regarding lifestyle habits, nearly one-third of participants reported smoking, and a notable 37.3% had co-existing hypertension. Educationally, the majority were literate, and most were unemployed at the time of data collection. Socioeconomic distribution showed that nearly half of the patients came from lower-income households, while urban and rural dwellers were almost evenly split. These background variables are essential to understanding the social and clinical context in which NAFLD develops among diabetics.

Table 3: Distribution of Categorical Demographic and Clinical Variables (n = 260)

Variable	Category	Frequency (n)	Percentage (%)
Gender	Male	142	54.6%
	Female	118	45.4%
Smoking Status	Yes	81	31.2%
	No	179	68.8%
Hypertension	Yes	97	37.3%

	No	163	62.7%
Education Status	Literate	163	62.7%
	Illiterate	97	37.3%
Occupation Status	Employed	108	41.5%
	Unemployed	152	58.5%
Socioeconomic Class	Lower	119	45.8%
	Middle	91	35.0%
	Upper	50	19.2%
Place of Living	Urban	134	51.5%
	Rural	126	48.5%

'When stratifying the data, several factors showed a statistically significant association with the presence of NAFLD among non-obese Type 2 diabetic patients'. Patients aged 50 years and older were more likely to have NAFLD compared to younger individuals (p = 0.031), suggesting that advancing age may increase susceptibility to liver fat accumulation, even without obesity. Gender also played a role, with males more frequently affected (p = 0.048), supporting previous research that shows higher NAFLD prevalence in men.

Interestingly, 'participants with a BMI of 23 kg/m² or higher were significantly more likely to have NAFLD (p = 0.027), indicating that even within the non-obese range, slight increases in BMI matter'. Longer duration of diabetes (≥5 years) also showed a meaningful link to liver fat development (p = 0.022), underscoring how chronic hyperglycemia may contribute to hepatic changes over time.

Hypertension and smoking were also found to be significantly associated with NAFLD (p = 0.019 and p = 0.045, respectively). These findings reflect the multifactorial nature of NAFLD, where vascular and lifestyle factors may act as contributing risks.

Other variables 'such as education level, employment status, socioeconomic class, and place of residence did not show statistically significant differences, indicating their relatively lesser role in the development of NAFLD in this specific patient population'.

Table 4: Stratification of NAFLD by Variables with Chi-Square p-values (n = 260)

Variable	Subcategory	NAFLD Present (n)	NAFLD Absent (n)	p-value
Age	≥ 50 years	89	53	0.031*
	< 50 years	62	56	
Gender	Male	90	52	0.048*
	Female	61	57	
BMI	≥ 23 kg/m²	101	65	0.027*
	< 23 kg/m²	50	44	
Duration of T2DM	≥ 5 years	98	57	0.022*
	< 5 years	53	52	
Hypertension	Yes	67	30	0.019*
	No	84	79	
Smoking	Yes	53	28	0.045*
	No	98	81	
Education	Literate	97	66	0.120
	Illiterate	54	43	
Occupation	Employed	67	41	0.328

	Unemployed	84	68	
Socioeconomic Status	Lower	66	53	0.067
	Middle	56	35	
	Upper	29	21	
Place of Living	Urban	81	53	0.112
	Rural	70	56	

Significant at $p \leq 0.05$ using Chi-square test

This pie chart clearly illustrates that NAFLD is 'prevalent even in non-obese individuals with T2DM. More than half of the study population (58.1%) had evidence of fatty liver changes, reinforcing the idea that factors other than obesity such as insulin resistance, age, and metabolic status, contribute significantly to the development of NAFLD'. The visual representation underlines the importance of liver screening in all diabetics, not just those who are overweight.

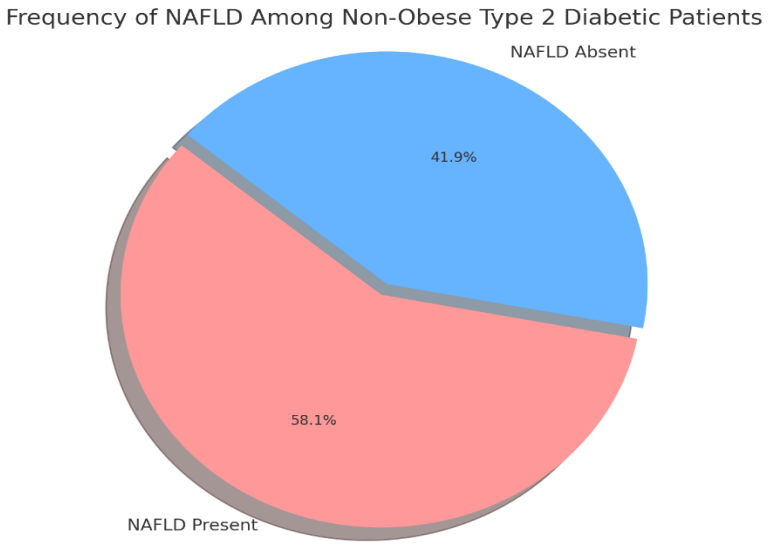

Figure 1: Pie chart showing the proportion of non-obese Type 2 diabetic patients with and without NAFLD. Among the 260 participants, 58.1% were diagnosed with NAFLD, while 41.9% did not have the disease.

DISCUSSION

This study aimed to evaluate how commonly NAFLD occurs among patients with T2DM who are not obese. Our findings revealed that 58.1% of the diabetic participants had NAFLD despite having a normal or below-obesity-range body mass index. This indicates that liver fat accumulation is not limited to obese individuals and may occur independently, particularly in those with underlying metabolic conditions such as T2DM.

The results are consistent with previous literature. Study also reported a 58% prevalence of NAFLD among non-obese diabetics in a Pakistani cohort, reinforcing the high burden in our local population [12]. Another study observed that diabetic individuals regardless of their body weight were significantly more likely to develop hepatic steatosis and its complications, including fibrosis and cirrhosis[13-15]. Stratification analysis in our study revealed that age, male gender, higher-normal BMI, longer duration of diabetes, hypertension, and smoking were significantly associated with NAFLD presence. These associations align with the understanding that NAFLD is not merely a result of excess fat but part of a broader metabolic dysfunction. The role of insulin resistance, oxidative stress, and chronic inflammation may explain these links [16, 17].

While several studies have highlighted obesity as a major risk factor for NAFLD, our findings add to the growing evidence that even individuals without excess weight are vulnerable, particularly if they have T2DM. This suggests that traditional reliance on BMI as a screening criterion for liver disease may overlook a substantial subset of at-risk patients [18-20].

Other variables such as 'education level, employment status, socioeconomic class, and place of residence did not show significant association with NAFLD in our data'. This suggests that clinical and metabolic factors may outweigh social determinants in the context of NAFLD among diabetics, although further research with larger and more diverse samples would help clarify these trends.

One of the strengths of this study lies in its focus on non-obese diabetic patients a population often underrepresented in liver disease research. However, the cross-sectional design limits causal interpretation, and the use of imaging rather than liver biopsy in all cases may underestimate the severity of liver involvement.

CONCLUSION

This investigation found that nearly sixty percent of non-obese people with type 2 diabetes harbored fatty liver disease. The result underscores that a normal weight offer no safeguard against hepatic fat build-up when diabetes, high blood pressure, and other metabolic risks persist.

Based on these findings, it is recommended that all patients with T2DM, regardless of BMI, should be routinely screened for NAFLD. Prompt detection may permit early intervention, curbing the advance of liver disease toward serious complications like cirrhosis or hepatocellular carcinoma. Physicians therefore must stay alert and avoid basing their hepatic risk appraisals in diabetic individuals on obesity alone.

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