ORIGINAL ARTICLE

Frequency of Nonalcoholic Fatty Liver Disease in Type 2 Diabetes Mellitus Patients

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Abstract

Background: Global prevalence of Non-Alcoholic fatty liver disease (NAFLD) is 25.24%. It is the most prevalent disease in the Middle East and South America. The study conducted in Pakistan showed that the overall prevalence of NAFLD in patients with type 2 diabetes is 54.6%.

Objective: The study aims to determine the frequency of NAFLD in type 2 diabetes mellitus.

Methods: The study was cross-sectional descriptive, conducted at the Department of General Medicine at Peoples University of Medical and Health Sciences, NawabShah. The study was conducted from December 2024 to February 2025. The sample calculated was n=195~ 200. Non-probability consecutive sampling technique was used. In data analysis, all categorical data including the Number of NAFLD cases, BMI, gender, frequency of comorbidity and presence of symptoms were taken in frequencies and percentages. The relative frequency of variables with NAFLD was taken using the Chi-square test with a p-value <0.05. Further association of NAFLD with gender, age, and BMI was seen using bivariate analysis. Multivariate logistic regression analysis was carried out to investigate variables independently associated with the presence of NAFLD.

Results: NAFLD is associated with older age (mean age as 55.6 ± 3.1 years, p = 0.036) and higher weight (76.56 ± 3.1 kg, p = 0.001). Prevalence of NAFLD was observed in 48.5% (n=97) in type 2 diabetic patients. Higher BMI correlates with NAFLD, affecting 30.9% of overweight/obese individuals (p < 0.001).

Conclusion: Study findings provide comprehension of the prevalence of NAFLD in type 2 diabetic patients and the risk associated with the development of NAFLD in Sindh. In NAFLD patients, weight and age were found to be significantly associated with the disease.

Keywords: *Fatty liver, diabetes mellitus, type 2 diabetes mellitus, nonalcoholic fatty liver.*

INTRODUCTION

Diabetes Mellitus is considered a major health problem among metabolic diseases and it is affecting the overall well-being of the individuals in Pakistan [1]. There is a strong connection between inflammation and Type 2 diabetes, as inflammation in fat tissues contributes to insulin resistance, which further leads to hyperglycemia and, as a result, long-term complications occur in diabetic patients [2]. Currently, 240 million people around the world have been diagnosed with diabetes. By the end of 2025, it is expected that the number of new cases will increase to 380 million worldwide. Among these new cases, 80% of diabetes will occur in low- and middle-income countries [3]. Pakistan is ranked 7th among countries which are included in the list of having severe cases of diabetes. There are currently 6.9 million cases of diabetes in Pakistan, and this number is expected to rise to 11.5 million which is almost double in 2025. The prevalence of diabetes in Pakistan varies from 7.6% to 11%, which is considered high prevalence in the region compared with the other countries [4].

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The most common liver disease is Non-Alcoholic Fatty Liver Disease (NAFLD) [5]. Fatty liver that occurs due to other causes than alcohol consumption or any other secondary condition that can cause steatosis in liver cells is now considered a major public health concern [6]. NAFLD can cause many liver diseases, which may include simple steatosis in the liver, Non-Alcoholic steatohepatitis, liver fibrosis, and liver cirrhosis which may eventually lead to liver cancer [7]. The global prevalence of NAFLD is 25.24%. It is the most prevalent disease in the Middle East and South America [8]. In comparison with people from Western countries where prevalence varies from 15-40%, the prevalence of NAFLD is 9-40% in Asian region countries [9]. In Asia, the current prevalence of NAFLD is estimated to be 29.6%. This is considered to be higher in comparison with the people belonging to the Western world [10].

The study conducted in Pakistan showed that the overall prevalence of NAFLD in patients with type 2 diabetes is 54.6% [11]. Another study conducted by Kanwal *et al.* reported that the rate of new cases of NAFLD in patients with type 2 diabetes mellitus is 61.5% [12]. There is an increased risk of complications in cases with type 2 diabetes and NAFLD. This includes the complications related to micro and macrovascular

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conditions, which further increases the additional risk of severity in NAFLD. These types of complications are major concerns in diabetes and can worsen NAFLD by promoting systemic inflammation, impaired circulation, and organ damage. [13]. This may lead to cirrhotic liver, liver carcinoma and eventually death [14]. Literature in Pakistan lacks longitudinal studies showing the increased risk of progression with type 2 diabetes, which may advance into fibrosis and cirrhotic liver [15]. The Gold standard for diagnosis of NAFLD is liver biopsy, but due to the resource-limited setups and lack of health spending in Pakistan most of the cases are only diagnosed based on ultrasound [16]. In Pakistan's clinical practice, NAFLD is often overlooked, although it has high risk and morbidity.

The study aims to determine the frequency of NAFLD in patients with type 2 diabetes mellitus visiting the Peoples Medical College Hospital, Nawabshah, Sindh. In Pakistan, most of the focus is given the treatment of patients rather than quantifying the burden of the disease and its risk factors.

MATERIALS AND METHODS

The study was a cross-sectional descriptive study. It was conducted in the Department of General Medicine at Peoples University of Medical and Health Sciences, NawabShah. The study was conducted from December 2024 to February 2025. Ethical approval was taken before the start of the data collection process with Ref No. CPSP/REU/MED-2021-226-18452.

200 patients with type 2 diabetes were enrolled for the study. Initial assessment included all 200 patients aged between 20-60 years both male and female diagnosed with type 2 diabetes from which 54 were initially reported as NAFLD -ve. Other 146 were further sent for U/S as they were having signs of hepatomegaly or symptoms of metabolic syndrome. All the known cases of Chronic liver disease and a history of autoimmune hepatitis were excluded from the study. The sample size was calculated using the WHO sample size calculator using the prevalence of NAFLD as 54.6% [11], with a margin of error (d)=5% and Confidence interval =95%. The total sample calculated was n=195~ 200 as a non-probability consecutive sampling technique was used to select the participants.

Diagnostic Criteria

Diagnosis of NAFLD was based on (I) Clinical Examination: A physical exam to look for signs and symptoms associated with metabolic syndrome and hepatomegaly, which suggested the presence of NAFLD those having no signs or symptoms were considered non-NAFLD. (II) Ultrasound: Those with signs of hepatomegaly or symptoms of metabolic syndrome were referred for an ultrasound to assess liver structure and identify fatty infiltration.

A structured questionnaire was used to collect data from all the patients who fulfilled the inclusion criteria and gave consent to participate in the study. The questionnaire was categorised into two sections I) Demographic information of the patient (including age, sex and residence) and II) Clinical data (weight, height, BMI according to the WHO guidelines [17], presence of Non-Alcoholic fatty liver based on U/S report and any additional co-morbidity).

Data collected was analysed using the SPSS (Statistical Package for Social Sciences) version 28. All the categorial data including the Number of NAFLD cases, BMI, gender, frequency of comorbidity and presence of symptoms were taken in frequencies and percentages. Continuous variables including weight, height, age and Random blood sugar (RBS) were taken as means and standard deviations. The relative frequency of the variable with NAFLD was taken using the Chi-square test with a p-value of less than 0.05. Further, the association of NAFLD with gender, age, and BMI was seen using the bivariate analysis. Multivariate logistic regression analysis was carried out to further investigate the clinical variables independently associated with the presence of NAFLD.

RESULTS

A total of 200 participants were included in this study. Gender distribution shows females are 42.5% (n=85) while 57.5% (n=115) are males. According to the BMI classifications [17], 28.5% were underweight, 46.5% had a normal BMI, 21.5% were overweight, and 3.5% were obese. Residency data indicates that rural residents were 49% (n=98), whereas 51% (n=102) resided in urban areas. Table **1** presents the basic characteristics of participants.

The prevalence of non-alcoholic fatty liver disease (NAFLD) was observed in 48.5% (n=97), while 51.5% (n=103) did not have the disease. Among 97 patients diagnosed with NAFLD in type 2 diabetes, 55.6% had the disease alone, whereas 44.3% had NAFLD along with co-morbidities. In patients with NAFLD along with co-morbidities, the commonest reported comorbidity was chronic obstructive pulmonary disease (COPD) 9% followed by hypertension (7%), ischemic heart disease (IHD) (6.5%) and asthma (2%). Regarding symptoms, 73% of participants reported experiencing at least one symptom, while 27% were asymptomatic. Among the

Table 1: Participants characteristics.

Study Variables	Total Participants n=200	Frequency (%)
Gender	Female	85(42.5)
	Male	115(57.5)
BMI	Underweight	57(28.5)
	Normal	93(46.5)
	Overweight	43(21.5)
	Obese	7(3.5)
Residency	Rural	98(49)
	Urban	102(51)
Non-Alcoholic Fatty Liver Disease	YES	97(48.5)
	NO	103(51.5)
Disease Alone or With Comorbidity	ALONE	54(27)
	COMORBIDITY	43(21.5)
	NOT APPLICABLE	103(51.5)
Comorbidity	ASTHMA	4(2)
	HTN	14(7)
	COPD	18(9)
	IHD	13(6.5)
Symptoms Present	YES	146(73)
	NO	54(27)
Common Symptoms	EPIGASTRIC PAIN	75(52.5)
	CONSTIPATION	45(30.8)
	INDIGESTION	26(17.8)

146 symptomatic patients, the commonest symptom reported was Epigastric pain (52.5%) followed by Indigestion (30.8%), and constipation (17.8%)

Table 2: Frequency of non-alcoholic fatty liver disease with participant's characteristics.

Study Variables	NAFLD -ve		NAFLD +ve	p-value <0.05
Mean Age (Mean ±SD)	49.9 ± 1.9		55.6 ± 3.1	0.036
Mean Weight (Mean ±SD)	63.2 ± 2.1		76.56 ± 3.1	0.001
Mean Height (Mean ±SD)	1.72 ± 0.02		1.62 ± 0.05	0.049
Residency[a]	Urban	63 (61.2)	39 (40.2)	0.003
	Rural	40 (38.8)	58 (59.2)	
Gender[a]	Male	60 (58.3)	55 (56.6)	0.469
	Female	43 (41.7)	42 (43.3)	
BMI[a]	Underweight	43 (41.7)	14 (14.4)	<0.001
	Normal Weight	46 (44.7)	47 (48.5)	
	Overweight	13 (12.6)	30 (30.9)	
	Obese	1 (1)	6 (6.2)	

a: Data is expressed as n(%).

The mean age in patients with NALFD was 55.6 +/- 3.1 years indicating older patients are more likely to have NAFLD (p=0.036) as shown in Table **2**. Patients with a mean weight of 63.2 ± 2.1 kg did not have NAFLD, while patients with an increased mean weight of 76.56 ± 3.1 kg had NAFLD, with a p-value of 0.001. Higher BMI is significantly associated with NAFLD as reported 30.9% NAFLD in overweight and obese individuals with a p-value of <0.001.

Table 3: Association of non-alcoholic fatty liver disease with clinical parameters.

Covariates	OR	CI (95%) (Lower-upper)	p-Value	AOR	CI (95%) (Lower-Upper)	p-value <0.05
Age	1.048	(1.021-1.077)	<0.001***	0.928	(0.873-0.986)	<0.001***
Weight	1.089	(1.060-1.119)	<0.001***	0.847	(0.763-0.940)	<0.001***
Height	—	—	—	3.732	(2.989-5.987)	0.733
Gender						
Female	Reference Category					
Male	0.983	(0.536-1.645)	0.824	2.024	(0.792-0.907)	0.09
BMI						
Obese	Reference Category					
Underweight	0.054	(0.006-0.490)	0.099***	0.033	(0.001-1.090)	0.056
Normal	0.170	(0.020-1.470)	0.170	0.092	(0.005-1.777)	0.114
Overweight	0.385	(0.042-3.524)	0.398	0.479	(0.034-6.833)	0.587
Residency						
Urban	Reference Category					
Rural	0.427	(0.242-0.753)	0.003***	2.955	(1.388-6.291)	0.005***
Presence Of Symptoms						
Symptoms Present	Reference Category					
Symptoms Not Present	0.552	(0.293-1.039)	0.066	0.761	(0.318-1.821)	0.540

*OR= Odds Ratio, AOR=Adjusted Odds Ratio, ***p-value = Highly significant*

In binary logistic regression analysis, increasing age is significantly associated with NAFLD with OR: 1.048 (95% CI: 1.021-1.077, p <0.001 as shown in Table **3**. Higher weight also shows a significant association with increased risk of NAFLD with OR 1.089 (95% CI: 1.060-1.119, p <0.001). Height, gender and BMI do not show a significant association with NAFLD. In Multi-logistic regression analysis, after the adjustments age remains significantly associated with development of NAFLD with an AOR 0.928 (95% CI:0.873-0.986, p=0.016) as shown in Table **3**. Weight after adjustment shows significance in the reverse direction with an AOR of 0.847 (95% CI: 0.763-0.940, p=0.002). Height, gender and BMI were found insignificant in the adjusted odds ratio suggesting lifestyle and environmental factors influence NAFLD risk beyond the simple anthropometric measurements.

DISCUSSION

This descriptive cross-sectional study has main findings that include the prevalence of Non-Alcoholic fatty liver disease (NAFLD) in type 2 diabetes patients and its associated risk factors that include anthropometric measures like age, weight, height and BMI. In our study findings, the prevalence of NAFLD was found to be 48.5% among the participants. Our finding is lower than the study conducted at Lahore Postgraduate Medical Institute showing the frequency of NAFLD in type 2 diabetic patients as 54.6% [11]. A study conducted by Ajmera *et al.* found a high prevalence of NAFLD at 65% in type 2 diabetic patients [14]. In our study males (57.5%) were found to have a higher prevalence of NAFLD than in females (42.5%). The gender was not statistically significant in our study. A study conducted on the Japanese population showed males (26%) have a double rate of prevalence than females (13%) [18]. The study results differ from the findings of Succurro *et al.* as they have shown that pre-diabetic and diabetic women are likely to have a higher prevalence of NAFLD than men [19].

In our study, we have found that age and weight are significantly associated with the presence of NAFLD in type 2 diabetic patients. The higher mean age (55.6 years) of participants was statistically significant in NAFLD cases as compared to the patients without NAFLD with a mean age (of 49.9 years). The results of our study were found to be consistent with the study conducted at Ogaki Municipal Hospital. Age was reported to be above 50 years was significantly associated with the progression of NAFLD [20, 21]. The prevalence of NAFLD increases as the age increases due to the decreased capacity of the liver to regenerate. An increase in age decreases the management of fat deposition which ultimately develops NAFLD in type 2 diabetic patients. The findings were further supported while conducting the binary logistic regression, which shows increased age of the patients is significantly associated with the development of NAFLD (OR: 1.048, 95% CI: 1.021-1.077, p<0.001). The results were inconsistent with the study conducted by Yamane *et al.* According to the study results young age was significantly associated with the development of NAFLD in type 2 diabetes. This is due to the age taken as young as 64.7 years and a comparative age was taken as 77.1 years [21].

An increase in weight is also significantly related to the development of NAFLD in type 2 diabetic patients. Patients who are averagely heavier (76.56kg) as compared to the patients having an average weight of 63.2kg (p<0.001) are more likely to have NAFLD. Adding to this, the prevalence of NAFLD was also found to be associated with 30.9% of overweight and obese patients when comparing their BMIs with the Normal and underweight patients. Obesity has a role in the establishment of NAFLD in type 2 diabetic patients according to the findings of our study. Insulin resistance and weight gain cause adiposity, which is a known contributor to the accumulation of fat in liver cells [22]. The regression analysis conducted in our study supports these findings as weight remained a strongly associated risk factor for the development of NAFLD (OR: 1.089, 95% CI: 1.060-1.119, p<0.001). The results were inverse after adjusting other factors such as gender and age (AOR: 0.847, 95% CI:0.763-0.940, p<0.001). This explains that weight alone is not the predictor of NAFLD but when combined with other factors can enhance the process of disease. Body weight, as a crude measure, does not fully capture fat distribution or metabolic health status. For instance, two individuals with the same weight may have markedly different visceral fat levels, insulin sensitivity, or lipid profiles.

Co-morbidities reported commonly in type 2 diabetic patients with NAFLD include COPD (9%), Ischemic heart disease (IHD) (6.5%), hypertension (7%) and asthma (2%). There is an increased risk of metabolic syndrome and the development of cardiovascular diseases (CVD) in patients with NAFLD. Although the prevalence of comorbidities was found to be low in patients with NAFLD in our study. The asymptomatic nature of the disease supports the importance of early screening in populations at risk especially those with hypertension and obesity.

The study has a few limitations. Firstly, this is a cross-sectional study and is weak to develop a causal association of NAFLD in type 2 diabetic patients with related risk factors such as weight, age and gender. In addition to this, recall bias can be introduced in self-reporting of the co-morbidities and symptomology. Lastly, the data was collected from a single geographic region. This eventually causes the limitation to generalising the findings to larger populations in Pakistan.

CONCLUSION

The study findings provide the comprehension of the prevalence of NAFLD in type 2 diabetic patients and the risk associated with the development of NAFLD in Sindh. In NAFLD patients, weight and age were found to be significantly associated with the disease. The findings from this study highlight the importance of early screening and appropriate intervention for the population at risk, specifically those with age advancement and increasing obesity. It is further recommended to investigate the genetic, lifestyle and environmental factors and their role in the development of NAFLD. This will support the development of public health strategies to combat this rising health concern.

ETHICAL APPROVAL

Ethical approval was obtained from the Institutional Review Committee of Peoples University of Medical and Health Science, NawabShah (REF letter No. CPSP/REU/MED-2021-226-18452). All procedures performed in studies involving human participants were by the ethical standards of the institutional and/ or national research committee and the Helsinki Declaration.

CONSENT FOR PUBLICATION

Written informed consent was taken from the participants.

AVAILABILITY OF DATA

The data set may be acquired from the corresponding author upon a reasonable request.

FUNDING

None.

CONFLICT OF INTEREST

The authors declare no conflict of interest.

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AUTHORS' CONTRIBUTION

TQ and AAJ developed the main concept, questionnaire and data analysis. HKT: writing the manuscript, its revisions and correspondence. HQ Initial writing. IM data collection and corrections. HZ and FM did data collection and proofreading.

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