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PREVALENCE OF NON-ALCOHOLIC FATTY LIVER DISEASE IN ADULTS EVALUATED BY UNENHANCED COMPUTED TOMOGRAPHY (CT) SCAN

Original Research

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ABSTRACT

Background: Non-alcoholic fatty liver disease (NAFLD) is an increasingly prevalent hepatic condition worldwide, closely linked to the rising burden of obesity, metabolic syndrome, and type 2 diabetes. NAFLD encompasses a spectrum from simple steatosis to non-alcoholic steatohepatitis (NASH), with potential progression to cirrhosis and hepatocellular carcinoma. In low- and middle-income countries, early detection is often limited due to resource constraints and lack of awareness. Imaging-based assessments, especially computed tomography (CT), offer a valuable non-invasive method for identifying hepatic steatosis in at-risk populations.

Objective: To determine the prevalence of non-alcoholic fatty liver disease in asymptomatic Pakistani adults using unenhanced CT scans.

Methods: A retrospective cross-sectional study was conducted on 223 asymptomatic adult patients who underwent unenhanced abdominal CT scans at Liaquat University of Medical & Health Sciences. Patients aged 40–70 years were included. Hepatic and splenic attenuation values were measured using regions of interest on a PACS workstation. Hepatic steatosis was defined by a hepatic attenuation index (HAI) ≤ 5 Hounsfield units. Data were analyzed using SPSS version 22.0. Associations with age, gender, and comorbidities including diabetes, hypertension, atherosclerosis, and ischemic heart disease were assessed using chi-square tests ($p \leq 0.05$ considered significant).

Results: The mean age was 45.03 ± 15.97 years. Mean liver attenuation was 57.37 ± 7.76 HU and mean spleen attenuation was 52.76 ± 3.09 HU. NAFLD was detected in 41.7% of patients. A significantly higher prevalence was found among males (28.3%) and those aged >40 years (27.4%) ($p = 0.021$). In patients with diabetes, hypertension, and ischemic heart disease, NAFLD prevalence was 12.1%, 10.8%, and 2.2%, respectively.

Conclusion: CT-based imaging revealed a substantial prevalence of NAFLD in asymptomatic adults, particularly among older males. Despite lower associations with cardiometabolic conditions, targeted screening remains essential for timely intervention.

Keywords: Adult Population, Fatty Liver, Heart Diseases, Liver Attenuation, Prevalence, Radiological Diagnosis, Unenhanced CT Scan.

INTRODUCTION

With the global rise in obesity, there has been a parallel surge in obesity-associated disorders, including hypertension, diabetes mellitus, cardiovascular diseases, and non-alcoholic fatty liver disease (NAFLD) (1,2). NAFLD, also referred to as hepatic steatosis, is characterized by excessive lipid accumulation in hepatocytes—exceeding 5% of liver weight—in individuals who do not consume significant amounts of alcohol and who test negative for hepatitis B and C infections. It has emerged as the most common chronic liver disease worldwide, with more than half of the obese population exhibiting signs of hepatic steatosis. Among them, 15% to 30% may progress to non-alcoholic steatohepatitis (NASH), a more advanced and potentially life-threatening form of liver inflammation (3). This trajectory is particularly concerning as hepatic steatosis can evolve into liver cirrhosis, bringing substantial morbidity and mortality in its wake (4). The sharp increase in global rates of type 2 diabetes and obesity has contributed to NAFLD's emergence as a major public health challenge (5). In Western countries, the prevalence of fatty liver disease has been estimated to affect up to 30% of the general population (6). Similarly high trends have been observed in South Asia, where urban populations—such as in Sri Lanka—demonstrate significant prevalence rates (7). In China, studies have documented a prevalence of hepatic steatosis at 20.82% (8), while in Pakistan, the figures show regional variation depending on the population under study. One hospital-based study in Pakistan found NAFLD in approximately 14% of otherwise healthy males (9), while another study reported that more than half (51%) of patients with diabetes also had fatty liver disease (10).

Despite the clinical importance of detecting NAFLD early, liver biopsy—the diagnostic gold standard—is invasive, costly, and impractical for widespread screening, especially in asymptomatic individuals. As awareness about the consequences of NAFLD grows, so does the need for safe, accessible, and accurate diagnostic tools to identify at-risk populations. Imaging modalities such as abdominal ultrasound, MRI, and CT scans have emerged as non-invasive alternatives. Ultrasound is widely used due to its availability and cost-effectiveness; however, it offers a more subjective evaluation (11). In contrast, unenhanced computed tomography (CT) and magnetic resonance imaging (MRI) provide more precise assessments of hepatic fat content and have shown stronger correlation with histological findings (12). Given this context, the present study was conducted to evaluate the prevalence of non-alcoholic fatty liver disease in an asymptomatic adult population in Pakistan using unenhanced CT imaging, aiming to fill the gap in local epidemiological data and support early, non-invasive detection in clinical practice.

METHODS

This retrospective cross-sectional study was conducted over a two-month period at the Department of Radiology and Imaging, Liaquat University of Medical & Health Sciences (LUMHS), Jamshoro and Hyderabad campuses, as well as the Advanced Diagnostic Centre, LUMHS Jamshoro, Sindh, Pakistan. The study aimed to assess the prevalence of non-alcoholic fatty liver disease (NAFLD) in an asymptomatic adult population through unenhanced computed tomography (CT) imaging. Ethical approval for the study was granted by the Liaquat University of Medical & Health Sciences Ethical Review Committee (Reference No. LUMHS/REC/-673), and all procedures were conducted in accordance with the principles of the Declaration of Helsinki. Informed consent was obtained from all participants prior to data inclusion. Participants were selected using a random sampling technique. The sample size was calculated to be 223, using a 95% confidence level, a 5% margin of error, and an expected prevalence of 50% for the primary outcome, which aligns with estimates from previous studies on NAFLD prevalence in similar populations (13). Eligible participants were aged between 40 and 70 years, and both male and female patients were considered for inclusion. Only individuals who underwent unenhanced abdominal CT scans for various clinical indications during the study period were included. Patients with known liver diseases of viral or alcoholic etiology, those with psychiatric disorders such as antisocial personality disorder, and those who declined to participate were excluded to minimize confounding variables and ensure ethical compliance (13,14).

Imaging data were reviewed retrospectively on a Picture Archiving and Communication System (PACS) workstation. Hepatic and splenic parenchymal attenuation values were quantitatively assessed by drawing regions of interest (ROI) while carefully avoiding major vessels, bile ducts, and focal lesions. The hepatic attenuation index (HAI) was calculated by subtracting the mean hepatic attenuation (in Hounsfield units) from the mean splenic attenuation. A hepatic attenuation index value of ≤5 Hounsfield units was used to classify

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the presence of hepatic steatosis, as defined in prior validated protocols. Data were entered and statistically analyzed using the Statistical Package for Social Sciences (SPSS) version 22.0. Descriptive statistics were computed for demographic and clinical variables. The chi-square test was applied to determine the association between the presence of NAFLD and categorical variables such as age, gender, and employment status. Stratification was performed to control for potential confounding by age, gender, and employment status. A p-value of ≤0.05 was considered statistically significant.

RESULTS

A total of 223 patients were included in the analysis. The majority of participants (56.5%) were above 40 years of age, while 43.5% were aged 40 years or below. Males constituted a higher proportion of the sample at 58.7%, compared to 41.3% females. Regarding comorbidities, atherosclerosis was identified in 31.8% of participants, diabetes mellitus in 25.1%, hypertension in 19.7%, and ischemic heart disease in 8.5%, indicating a moderate burden of metabolic and cardiovascular risk factors in the study population. Non-alcoholic fatty liver disease (NAFLD) was detected in 41.7% (n=93) of the study population. Statistically significant associations were observed between NAFLD and both age and gender. Participants older than 40 years demonstrated a higher prevalence of NAFLD (27.4%) compared to those aged 40 years or younger (14.3%), with a p-value of 0.021. Similarly, males had a greater proportion of NAFLD cases (28.3%) relative to females (13.5%), and this difference was also statistically significant (p = 0.021). No statistically significant associations were found between NAFLD and the presence of atherosclerosis (p = 0.447), diabetes mellitus (p = 0.254), or ischemic heart disease (p = 0.155). Hypertension showed a near-significant trend, with NAFLD present in 10.8% of hypertensive patients compared to 30.9% in normotensive individuals (p = 0.054), suggesting a potential link that may warrant further evaluation in a larger sample. Among the 223 patients included in the study, the overall prevalence of non-alcoholic fatty liver disease (NAFLD) was 41.7% (n = 93), while 58.3% (n = 130) of participants did not exhibit hepatic steatosis. This substantial burden reflects the growing impact of NAFLD in asymptomatic adult populations.

Table 1: Baseline characteristics of the patients (n=223)

Variables	Frequency (n)	Percentage (%)
Age, years		
≤40 years	97	43.5
>40 years	126	56.5
Gender of Patients		
Males	131	58.7
Females	92	41.3
Atherosclerosis		
Absent	152	68.2
Present	71	31.8
Diabetes		
Present	56	25.1
Absent	167	74.9
Hypertension		
Present	44	19.7
Absent	179	80.3
Ischemic Heart Disease		
Present	19	8.5
Absent	204	91.5

Table 2: Association of NAFLD with age, gender and co-morbid

	NAFLD		
Variables	Yes	No	p-value
	n (%)	n (%)	
Age, years			
≤40	32 (14.3)	65 (29.1)	0.021
>40	61 (27.4)	65 (29.1)	
Gender of Patients			
Male	63 (28.3)	68 (30.5)	0.021
Female	30 (13.5)	62 (27.8)	
Atherosclerosis			
Present	27 (12.1)	44 (19.7)	0.447
Absent	66 (29.6)	86 (38.6)	
Diabetes			
Present	27 (12.1)	29 (13.0)	0.254
Absent	66 (29.6)	101 (45.3)	
Hypertension			
Present	24 (10.8)	20 (9.0)	0.054
Absent	69 (30.9)	110 (49.3)	
IHD			
Present	5 (2.2)	14 (6.3)	0.155
Absent	88 (39.5)	116 (52.0)	

Chi-square test applied

NAFLD=Non-alcoholic fatty liver disease

Table 3: Prevalence of Non-Alcoholic Fatty Liver Disease (NAFLD) in Study Population (n = 223)

NAFLD Status	Frequency (n)	Percentage (%)
Positive (Yes)	93	41.7%
Negative (No)	130	58.3%
Total	223	100.0%

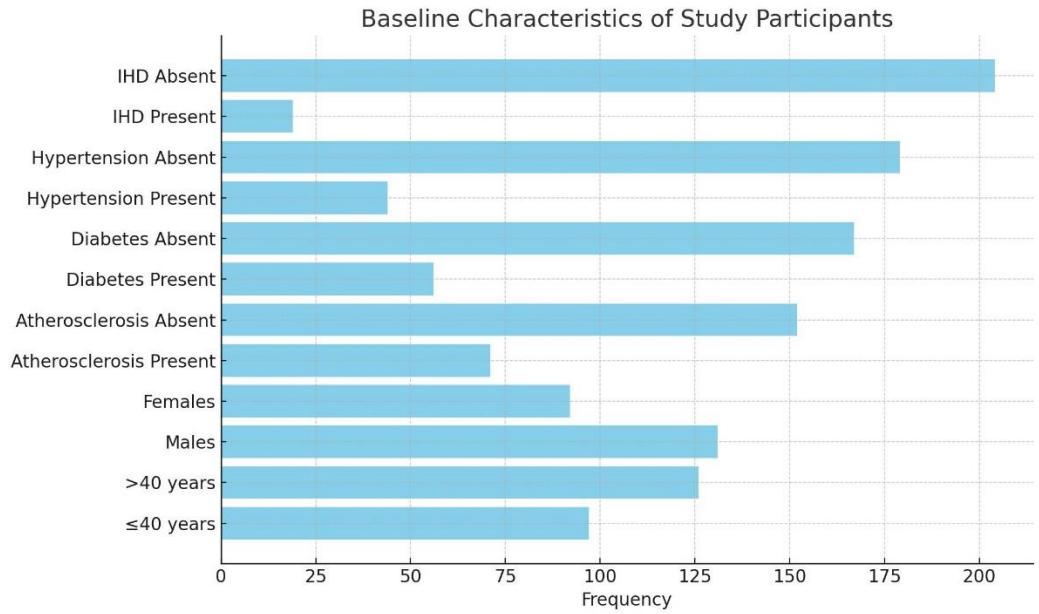

Figure 1Baseline Characteristic of Study Participants

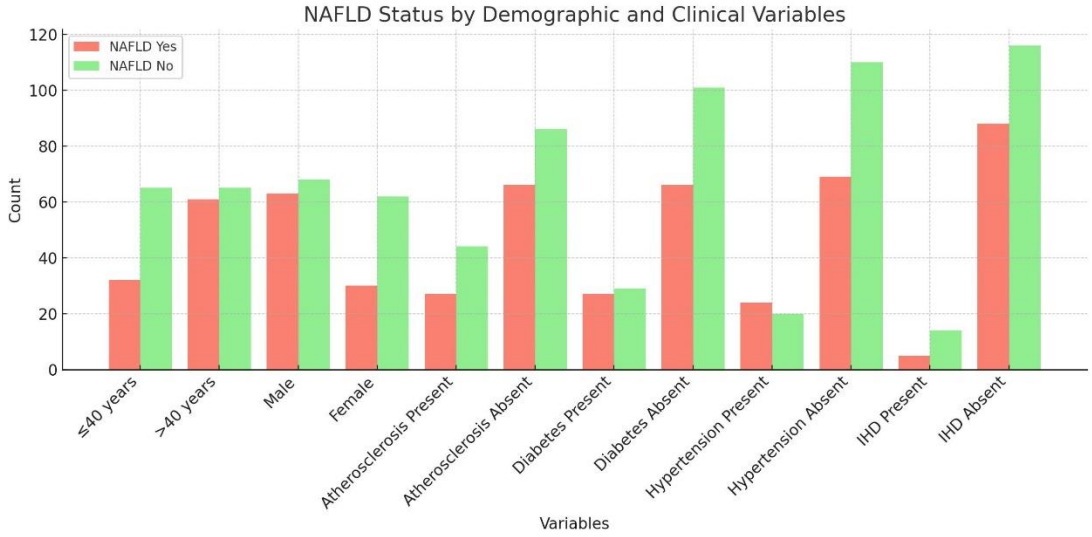

Figure 2 NAFLD Status by Demographic and Clinical Variables

DISCUSSION

Non-alcoholic fatty liver disease (NAFLD) is increasingly being recognized as a hepatic manifestation of metabolic syndrome, particularly in individuals without identifiable secondary causes such as alcohol consumption or hereditary hepatic disorders. It encompasses a spectrum of liver abnormalities ranging from simple steatosis to non-alcoholic steatohepatitis (NASH), which may ultimately progress to fibrosis, cirrhosis, and hepatocellular carcinoma. In the present study, a notably high prevalence of NAFLD was observed, exceeding previous estimates reported in the Pakistani population, which ranged from 13.5% to 17.5% when assessed using ultrasound-based imaging techniques (13,14). The elevated detection rate in this study may be attributed to the use of non-contrast

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computed tomography (CT), which offers superior diagnostic accuracy in hepatic fat quantification compared to ultrasound. CT is known to provide a sensitivity of approximately 82% and specificity of 100%, whereas ultrasound has a lower sensitivity of 64% and a specificity of 97% (15,16). This study found a significantly higher prevalence of NAFLD among males than females, aligning with several previous findings that suggest a gender-based predisposition to fatty liver disease (17). However, this contradicts earlier research that reported a female predominance, likely due to larger sample sizes and variations in methodology (18). The present study also highlighted a higher burden of NAFLD among individuals aged over 40 years, reflecting age as a contributory risk factor. Interestingly, the prevalence among younger individuals was also notable, indicating that NAFLD is no longer confined to older age groups. Factors such as obesity, sedentary behavior, poor dietary habits, and psychological stress have been implicated in the early onset of hepatic steatosis, particularly in adolescents and young adults (19). This finding corresponds with emerging evidence that metabolic derangements in younger populations are contributing to early-stage liver disease and increased risk of progression to NASH and liver-related morbidity.

Despite diabetes being a well-established risk factor for NAFLD, the prevalence of fatty liver disease among diabetic individuals in this study was lower than anticipated. Prior studies have demonstrated considerable variability, with prevalence rates ranging from 20.3% to as high as 63.6%, influenced by factors such as glycemic control, disease duration, and the diagnostic modality employed (19,20). For instance, a study in Japan demonstrated a clear gradient in NAFLD prevalence corresponding to glycemic status—25.6% in normoglycemic individuals, 56.2% in those with impaired fasting glucose, and 68% among patients with type 2 diabetes mellitus (21). The relatively lower frequency reported in the present study might reflect differences in diabetes severity, unaccounted glycemic indices, or variations in diagnostic thresholds. Atherosclerosis and ischemic heart disease (IHD), both considered vascular complications of NAFLD, showed a surprisingly low association with hepatic steatosis in this cohort. This stands in contrast to previous findings where subclinical atherosclerosis was often identified in patients with NAFLD due to arterial stiffness and endothelial dysfunction (22). Similarly, while other studies have reported NAFLD as a predictor of cardiovascular events and mortality, the association with IHD in this study was not statistically significant (19). Possible explanations include sample size limitations, diagnostic criteria variability, and the lack of specific cardiovascular imaging or biomarkers in the current methodology. Hypertension also demonstrated a lower-than-expected association with NAFLD, although a trend toward significance was observed. Other studies have reported nearly 50% prevalence of NAFLD in hypertensive patients, often linked to left ventricular hypertrophy, myocardial lipid infiltration, and arrhythmogenic alterations in cardiac tissue (18,19). Furthermore, epicardial fat, a marker of cardiac risk, was not assessed in this study but is known to be closely associated with NAFLD and metabolic syndrome.

Cerebrovascular complications, particularly ischemic stroke, have also been associated with NAFLD in previous studies, with one reporting a 42.7% prevalence in stroke patients (22). However, the current study did not investigate such neurologic outcomes, which remains a notable gap given the systemic inflammatory burden associated with fatty liver disease. This study carries several strengths, including the use of CT imaging, which is more sensitive in detecting hepatic steatosis than ultrasound, and a focus on an asymptomatic adult population, which adds epidemiological value to screening protocols. Nonetheless, the study had several limitations. It was retrospective and conducted at a single center, which may limit generalizability. Important clinical and anthropometric variables such as body mass index (BMI), lipid profiles, glycemic indices, and liver enzyme levels were not evaluated, precluding a comprehensive metabolic assessment. Furthermore, the relationship between NAFLD and epicardial adiposity, arrhythmia, diastolic dysfunction, and cerebrovascular complications was not explored, all of which are critical to understanding the systemic impact of hepatic steatosis. Additionally, no stratification of NAFLD severity based on hepatic attenuation indices was performed, which would have allowed a better understanding of disease progression risk.

In conclusion, the study underscores a high burden of NAFLD in a middle-income population using CT imaging and highlights key associations with age and gender. However, its findings diverge from prior studies in areas such as diabetes and cardiovascular comorbidities, emphasizing the need for more comprehensive, prospective research. Future studies should incorporate larger, multicenter cohorts and detailed clinical profiling, including metabolic syndrome parameters, liver fibrosis scoring, epicardial fat quantification, and long-term outcomes. These improvements are essential to refine screening strategies and therapeutic interventions for NAFLD in both high- and moderate-risk populations.

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CONCLUSION

This study highlights the considerable burden of non-alcoholic fatty liver disease among asymptomatic adults in Pakistan, particularly among males and older individuals, reinforcing the condition's strong association with demographic risk factors. The use of unenhanced CT scans proved to be a valuable diagnostic tool, offering greater accuracy compared to traditional ultrasound methods. Although metabolic and cardiovascular comorbidities did not show statistically significant associations, the findings underscore the importance of early detection and the need for proactive public health strategies in developing regions. These insights pave the way for future research to better understand the metabolic and cardiovascular implications of NAFLD and to inform evidence-based screening and management protocols.

AUTHOR CONTRIBUTION

Author	Contribution
Munawar Hussain	Substantial Contribution to study design, analysis, acquisition of Data Manuscript Writing Has given Final Approval of the version to be published
Mahreen Rasool	Substantial Contribution to study design, acquisition and interpretation of Data Critical Review and Manuscript Writing Has given Final Approval of the version to be published
Hafeez Ur Rehman	Substantial Contribution to acquisition and interpretation of Data Has given Final Approval of the version to be published
Waseem Mirza	Contributed to Data Collection and Analysis Has given Final Approval of the version to be published
Hatem Adel	Contributed to Data Collection and Analysis Has given Final Approval of the version to be published
Sadhu Ram Raika*	Substantial Contribution to study design and Data Analysis Has given Final Approval of the version to be published
Harchand Rabari	Contributed to study concept and Data collection Has given Final Approval of the version to be published

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