

Determination of Frequency of Increased Carotid Intimal Media Thickness Among Patients With Non-Alcoholic Fatty Liver Disease

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Abstract: Non-alcoholic fatty liver disease (NAFLD) has been linked to early atherosclerosis, for which carotid intima-media thickness (CIMT) is a validated surrogate. Determining how often CIMT is elevated in NAFLD and whether the severity of hepatic steatosis tracks with CIMT can guide cardiovascular risk stratification. **Objective:** The objective of this study is to determine the frequency of increased carotid intima-media thickness (CIMT) among patients with non-alcoholic fatty liver disease (NAFLD) and to assess the potential association between NAFLD severity, metabolic risk factors, and CIMT elevation. **Methods:** After ethical approval from the institutional review board, this cross-sectional study was conducted at the Department of Radiology, KRL Hospital, Islamabad, from 1st August 2024 to 31st January 2025, after obtaining informed written consent from patients. Using non-probability consecutive sampling, 100 patients aged 18-70 years diagnosed with NAFLD by ultrasonography. Patients with a prior history of some cardiovascular disease, stroke, diabetes, acute or chronic liver disease, and those on medication affecting lipid profile were excluded from the present study. **Results:** The study of 100 patients with non-alcoholic fatty liver disease (NAFLD) found a mean age of 48.7 ± 11.5 years, with 58% male and 42% female. The mean BMI was 26.7 ± 4.7 kg/m², and 56% of participants had increased carotid intima-media thickness (CIMT) (mean 1.04 ± 0.27 mm). No significant associations were found between increased CIMT and age, gender, BMI, or NAFLD severity ($p > 0.05$).

Conclusion: Metabolic syndrome should possibly have a greater influence on subclinical atherosclerosis in patients with NAFLD. However, these relations deserve further investigation in upcoming in-depth studies.

Keywords: Non-alcoholic Fatty Liver Disease, Carotid Intima-Media Thickness, Atherosclerosis, Metabolic Syndrome, Cross-Sectional Studies

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Introduction

Non-alcoholic fatty liver disease (NAFLD) is today considered the most common liver condition globally, related to metabolic syndrome and increased cardiovascular risk (1). Several recent studies have shown that patients with NAFLD exhibit a marked increase in carotid intimal-media thickness (CIMT), an indicator of early atherosclerosis (2). Hence, CIMT is predominantly used to identify early CVD in high-risk groups because it reflects the lumen caliber of the carotid artery, resulting from the build-up of plaque and inflammation, and denotes an alteration in vascular structure seen in NAFLD (3). Research has also revealed that NAFLD patients have, on average, higher CIMT values than non-liver-disordered subjects, again hinting that NAFLD has the potential to independently increase cardiovascular risk regardless of existing conventional CVD risk markers (4). For instance, a follow-up study showed an increase of CIMT among NAFLD patients to 32% from a control rate of 22% indicating the progression of NAFLD and the vascular changes therein (5). Other papers also show that NAFLD patients with higher BMI, older age, and the presence of metabolic syndrome components, including fasting glucose and cholesterol, have higher CIMT levels; these findings support the metabolic relationship between NAFLD and these abnormalities (6). As NAFLD increasingly presents in the population and has already been shown to be associated with higher CIMT, further vascular evaluations should be performed for this NAFLD population, especially if they have comorbid metabolic risk factors (7). An enhanced awareness of CIMT with these patients could help increase early CVD prevention and decrease total mortality and morbidity related to liver diseases and their cardiovascular sequelae. The objective of this study is to determine the frequency of increased carotid intima-media thickness (CIMT) among

patients with non-alcoholic fatty liver disease (NAFLD) and to assess the potential association between NAFLD severity and CIMT elevation.

Methodology

After ethical approval from the institutional review board, this cross-sectional study was conducted at the Department of Radiology, KRL Hospital, Islamabad, from 1st August 2024 to 31st January 2025. Using non-probability consecutive sampling, 100 patients aged 30 to 70 years diagnosed with NAFLD by ultrasonography were included. Patients with a prior history of some cardiovascular disease, acute or chronic liver disease, diabetes, stroke, or on medication affecting lipid profile were excluded from the present study. After obtaining informed written consent from patients, each patient underwent a complete clinical examination, and the results of anthropometric measurements were documented. NAFLD was diagnosed by abdominal ultrasonography to assess liver brightness and detect hepatic fat accumulation. Carotid intima-media thickness was evaluated by high-resolution B-mode ultrasound imaging of the common carotid artery. CIMT status was defined according to the CIMT value obtained at a point along the distal common carotid artery. This particular CIMT was considered elevated relative to baseline if it was 0.9 mm or greater, as this is a sign of asymptomatic atherosclerosis. Data analysis was performed using the Statistical Package for the Social Sciences (SPSS) version 26. Continuous variables were presented as mean and standard deviation, while categorical variables were presented as percentage and frequency. The chi-square test was used to assess the association between increased



CIMT and age, gender, BMI, and NAFLD grade. Statistically significant differences were determined if $p < 0.05$.

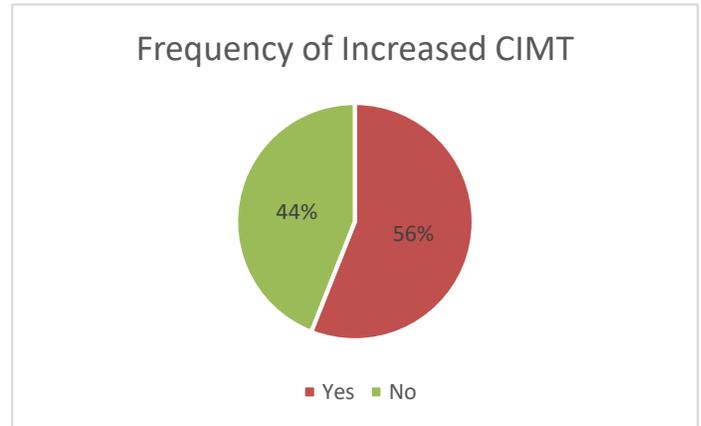
Results

The study involved 100 patients with non-alcoholic fatty liver disease (NAFLD) to investigate the frequency of increased carotid intima-media thickness (CIMT) and its association with various demographic and clinical parameters. The mean age of participants was 48.7 ± 11.5 years, with 54% (54 patients) aged ≤ 50 years and 46% (46 patients) aged > 50 years. The gender distribution was 58% male (58 patients) and 42% female (42 patients). The mean body mass index (BMI) was 26.7 ± 4.7 kg/m^2 , with 44% (44 patients) having a BMI ≤ 25 and 56% (56 patients) having a BMI > 25 . In terms of NAFLD severity, 37% (37 patients) had mild NAFLD, 42% (42 patients) had moderate NAFLD, and 21% (21 patients) had severe NAFLD. The mean CIMT among participants was 1.04 ± 0.27 mm, with 56% (56 patients) exhibiting increased CIMT (> 0.9 mm) (Table 1).

In the study, 56 patients (56%) exhibited increased carotid intima-media thickness (CIMT), defined as a CIMT greater than 0.9 mm. Conversely, 44 patients (44%) had a CIMT value within the normal range (≤ 0.9 mm) (Figure 1).

Stratification of CIMT by age, gender, BMI, and NAFLD grade revealed no significant associations. Among patients aged ≤ 50 years, 30 had increased CIMT, while 24 did not, and among those aged > 50 years, 26 had increased CIMT, while 20 did not ($p=0.542$). Gender-based

stratification revealed 29 males and 27 females had increased CIMT, with no significant difference ($p=0.112$). Similarly, BMI did not significantly affect CIMT: 25 patients with a BMI ≤ 25 and 31 with a BMI > 25 showed increased CIMT ($p=0.523$). Regarding NAFLD severity, 23 patients with mild NAFLD, 23 with moderate NAFLD, and 10 with severe NAFLD exhibited increased CIMT, but this also showed no statistically significant



difference ($p=0.55$) (Table 2).

Figure 1: Frequency of increased CIMT in the study participants.

Table 1: Demographic and Clinical parameters of the study

Parameters	Mean and Frequency (N=100)
Age (years)	48.7 ± 11.5
≤ 50 years	54 (54%)
> 50 years	46 (46%)
Gender	
Male	58 (58%)
Female	42 (42%)
BMI (kg/m^2)	26.7 ± 4.7
≤ 25	44 (44%)
> 25	56 (56%)
NAFLD Grade	
Mild	37 (37%)
Moderate	42 (42%)
Severe	21 (21%)
CIMT (mm)	1.04 ± 0.27

Table 2: Stratification increased CIMT based on age, gender, BMI, and NAFLD grade

Parameters	Increase in CIMT		P value
	Yes	No	
Age (years)			0.542
≤ 50 years	30	24	
> 50 years	26	20	
Gender			0.112
Male	29	29	
Female	27	15	
BMI (kg/m^2)			0.523
≤ 25	25	19	
> 25	31	25	
NAFLD Grade			0.55
Mild	23	14	
Moderate	23	19	
Severe	10	11	

Discussion

This study revealed that 56% of the NAFLD patients had elevated CIMT, a factor that supported the earlier studies that showed that NAFLD patients had a higher risk of subclinical atherosclerosis. Nevertheless, the

study did not reveal any association between CIMT and vital or clinical characteristics, including age, sex, BMI, or NAFLD severity. This lack of statistical significance differs from prior research on the primary causes of CIMT elevation in NAFLD patients.

One study by Bom et al. (2021) established a direct correlation between CIMT and components of metabolic syndrome, weight and age, among NAFLD patients, who had a statistically significantly higher CIMT than the control group. Similarly, they found that CIMT was elevated in 32% of NAFLD patients, similar to the current study's 56%, and observed highly significant associations between metabolic variables, particularly obesity (5). Moreover, Kumar et al. (2024) also found a strong association between CIMT and BMI in NAFLD patients, with patients with BMI >30 having higher CIMT values (8). This implies that the lack of statistical association between BMI and CIMT in the present study ($p = 0.523$) may be due to a lower sample size or other regional factors that could affect the results.

On the other hand, such works as Barton et al. (2022) established that the NAFLD severity, regardless of the mild manifestations of the disease, was not an independent determinant of CIMT values (9), and this was consistent with the results of the current study, as NAFLD grade did not affect CIMT value significantly ($p = 0.55$). This could mean that other factors, such as metabolic syndrome, might make a much larger contribution to vessel remodeling in NAFLD than inflammation and fibrosis in the liver. Besides, Mohammadzadeh et al. (2019) showed that CIMT was more strongly associated with liver histology in NAFLD, notably NASH, suggesting that liver inflammation rather than simple fat deposition may be more critical for CIMT alterations (10).

In the present study, no correlation between age and CIMT was observed ($p = 0.542$). However, some previous investigations have reported that age plays a vital role in the development of atherosclerosis in NAFLD. Taag et al. (2022) concluded that patients aged 60 or older have higher CIMT values than younger NAFLD patients, further supporting the notion that age and vascular damage in NAFLD are linked (11). Again, gender differences as a predictor of cardiovascular risk did not affect CIMT in the current study ($p=0.112$). However, both Khoshbaten et al. (2023) and Khan et al. (2022) reported that NAFLD may be associated with increased CIMT in male patients, possibly due to metabolic comorbidities (2, 13).

These findings indicate that although most previous studies have confirmed increased atherosclerotic risk in NAFLD patients, the association between CIMT and demographic or clinical characteristics remains inconclusive (14, 15). These differences may be attributed to sample size, study design, or geographic location, highlighting the need for advanced research to definitively understand the cross-sectional interactions among liver disease, metabolic features, and vascular function and morphology.

Conclusion

In conclusion, this research demonstrates a high prevalence of CIMT in patients with NAFLD, at 56% in this study. However, the difference was not statistically significant when comparing CIMT with age, gender, BMI, or NAFLD severity. In concordance with some of the literature, these results propose that metabolic syndrome should possibly have a greater influence on subclinical atherosclerosis in patients with NAFLD. However, these relations deserve further investigation in upcoming in-depth studies.

Declarations

Data Availability statement

All data generated or analysed during the study are included in the manuscript.

Ethics approval and consent to participate

Approved by the department concerned. (IRBEC-24)

Consent for publication

Approved

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Conflict of interest

The authors declared no conflicts of interest.

Author Contribution

SEZ (Post Graduate Resident)

Manuscript drafting, Study Design,

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Review of Literature, Data entry, Data analysis, and drafting an article.

MWA (Associate Professor)

Conception of Study, Development of Research Methodology Design,

BI (Post Graduate Resident)

Study Design, manuscript review, and critical input.

NNU (Consultant Radiologist)

Review of Literature, Data entry, Data analysis, and drafting an article.

FTZ (FCPS Peads)

Manuscript drafting, Study Design

All authors reviewed the results and approved the final version of the manuscript. They are also accountable for the integrity of the study.

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