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PREVALENCE OF LIVER STEATOSIS: A STEP FORWARD FOR BETTER EVALUATION USING ULTRASOUND

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Abstract

Background: Non-alcoholic fatty liver disease (NAFLD) is the most prevalent chronic liver disease worldwide, defined by hepatic fat accumulation in >5% of hepatocytes without significant alcohol use. NAFLD encompasses a spectrum from benign steatosis to non-alcoholic steatohepatitis (NASH) and may progress to cirrhosis and hepatocellular carcinoma. **Methods:** A systematic literature search was

performed using PubMed and Google Scholar for studies published between January 2016 and December 2021. Keywords included "hepatic steatosis," "NAFLD," "fatty liver," and "ultrasound-detected NAFLD." English-language studies involving adult populations focusing on epidemiology, diagnosis, risk factors, or management of NAFLD were included. **Results:** Out of 700 initially identified articles, 555 eligible participants were included after exclusions. Among 577 who met all criteria, 377 had fatty liver and 200 served as controls. Fatty liver patients showed significantly higher age, abdominal girth, triglycerides, liver enzymes (AST/ALT), and male predominance compared with controls (all $p<0.05$). Ultrasound demonstrated sensitivity of 60–94% and specificity of 66–97% for detecting steatosis. **Conclusion:** Ultrasound remains a reliable, non-invasive first-line tool for hepatic steatosis detection. Lifestyle modification, weight management, and metabolic risk-factor control are the cornerstones of NAFLD management.

Keywords: NAFLD (Non Alcoholic Fatty Liver Disease), liver steatosis, conventional ultrasound, hepatic steatosis, HR (Hazard Ratio), NASH(Non-Alcoholic Steatohepatitis)

INTRODUCTION

Hepatic steatosis (NAFLD) is the most common chronic liver disease worldwide, affecting ~30% of Western populations and up to 90% of patients with obesity, insulin resistance, or hypertension. It is characterized by lipid accumulation in >5% of hepatocytes in the absence of excessive alcohol intake.

NAFLD is associated with multiple extrahepatic conditions including type 2 diabetes mellitus (T2DM), cardiovascular disease (CVD), chronic kidney disease (CKD), and polycystic ovarian syndrome (PCOS). Without adequate management, NAFLD can progress to NASH, cirrhosis, portal hypertension, and hepatocellular carcinoma.

Liver biopsy remains the historical gold standard but is invasive, costly, and carries procedural risks. Consequently, non-invasive imaging—particularly conventional ultrasound (CUS)—has emerged as the recommended first-line screening tool, offering sensitivity of 60–94% and specificity of 66–97% for hepatic steatosis detection.

This review evaluates the role of ultrasound in the assessment of hepatic steatosis and summarizes current evidence on prevalence, diagnostic techniques, risk factors, and management.

LITERATURE REVIEW

Lietialie (2018) demonstrated the growing utility of imaging in NAFLD assessment, noting conventional ultrasound as the predominant first-line method alongside emerging quantitative techniques such as elastography. NAFLD prevalence was estimated at 70% among overweight individuals and 90% among diabetic patients.

Yin et al. (2016) applied combined consistency, backscattering, and reduction structure analysis in ultrasound imaging. Hepatic steatosis affects ~1 in 3 individuals in developed nations, representing a significant public health burden. Pirmoazen et al. (2020) highlighted how quantitative ultrasound (QUS) has substantially improved hepatic steatosis quantification compared with conventional ultrasound, offering worldwide accessibility, real-time assessment, and low cost with quantitative rather than qualitative fat estimation.

Qurrat-ul-Ain et al. (2016) validated the Fatty Liver Index (FLI) in Pakistani adults, reporting NAFLD in 34% of 210 participants (AUC 0.95 for hepatic steatosis). Lin et al. (2016) found 26.5% prevalence of moderate-to-severe steatosis and identified soil heavy metals as a risk factor in men. Wu et al. (2017) analyzed 2,345 participants (⩾40 years) from Tangshan city using hepatic ultrasound, confirming ultrasound's central role in NAFLD screening. Abdul Sattar et al. (2018) reported high steatosis prevalence in Malaysians aged 53–60 years, particularly in men and those with obesity, hypercholesterolemia, and hyperglycemia. Ansari et al. (2020) found 63% of NAFLD patients to be asymptomatic on ultrasound, with enlarged liver in 19% and no signs of cirrhosis. Xia et al. (2020) and Namoos & Shabbir (2021) confirmed the strong correlation between lipid profiles, biochemical markers, and ultrasound-detected NAFLD.

METHODOLOGY

Study Design and Setting

This narrative and evidence-based literature review was conducted over four months (May–August 2021). Searches were performed using PubMed and Google Scholar databases.

Inclusion Criteria

- Publications related to liver steatosis or NAFLD diagnosed by ultrasonography
- Studies published in English involving adult populations (age ⩾30 years)

- Focus on epidemiology, diagnosis, risk factors, or NAFLD management

Exclusion Criteria

- Articles unrelated to liver steatosis or using non-ultrasound modalities as primary tool
- Incomplete examination data or inadequate methodological quality
- Case reports, editorials, and non-English publications

Study Selection and Participants

A total of 700 participants who underwent first-time fatty liver screening were identified. After excluding 22 patients aged <30 years and 123 with incomplete examinations, 555 eligible participants remained. Out of 577 who met all inclusion criteria, 377 had fatty liver and 200 were non-fatty liver controls.

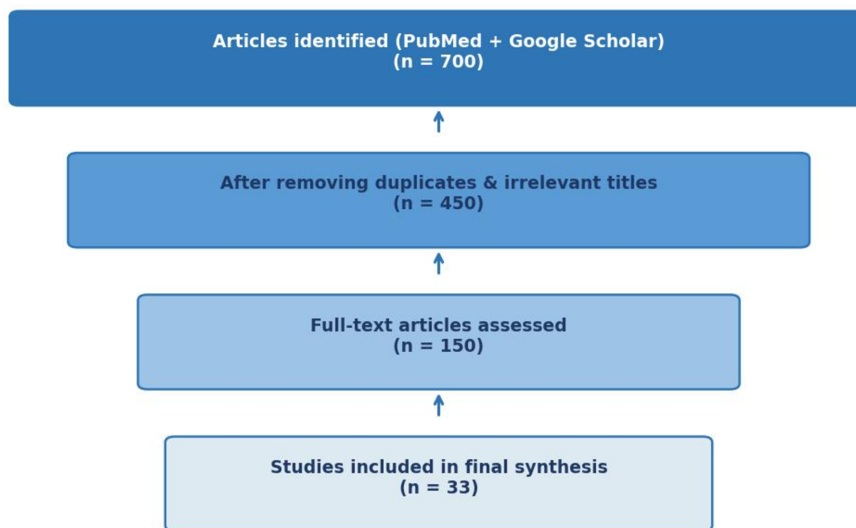

Figure D – PRISMA Flow Diagram Showing Study Selection Process

RESULTS

Among the 700 participants screened, 577 met all inclusion criteria and formed the analysis cohort. The prevalence of NAFLD and NASH underscores the need for accurate, non-invasive modalities such as ultrasound, particularly for asymptomatic patients. Williams et al. reported NASH in 12.2% and NAFLD in 46.0% of asymptomatic individuals

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screened by ultrasound with subsequent liver biopsy confirmation. Machine learning (random forest) models showed superior predictive performance (C-statistic: 0.925) compared with conventional classification models.

Participant Characteristics

Table 1 : *Clinical and Biochemical Characteristics of Study Groups*

Variable	Fatty Liver (n=377)	Non-Fatty Liver (n=200)	p-value
Age – Mean (SD), years	54.1 (12.6)	49.4 (15.2)	0.001
Male gender, n (%)	207 (54.9%)	66 (33.0%)	<0.0001
Systolic BP (mmHg)	130.2 (18.8)	119.5 (17.1)	0.203
Diastolic BP (mmHg)	80.1 (11.2)	74.7 (11.1)	0.048
Abdominal Girdle (cm)	85.8 (11.2)	73.5 (7.4)	0.001
Triglyceride (mg/dL)	146.0 (83.8)	87.9 (44.8)	<0.0001
HDL-C (mg/dL)	50.9 (13.1)	64.7 (15.4)	0.037
Total Cholesterol (mg/dL)	105.4 (28.3)	93.9 (14.4)	<0.0001
GOT-AST (U/L)	29.4 (15.2)	24.3 (11.2)	0.003
GPT-ALT (U/L)	35.7 (24.6)	20.6 (14.1)	<0.0001

Clinical Measurements

Fatty liver patients were significantly older (54.1 vs 49.4 years, p=0.001) and had considerably larger abdominal girth (85.8 vs 73.5 cm, p=0.001), consistent with central obesity as a major risk factor. Systolic blood pressure was elevated in the fatty liver group, though this did not reach significance (p=0.203).

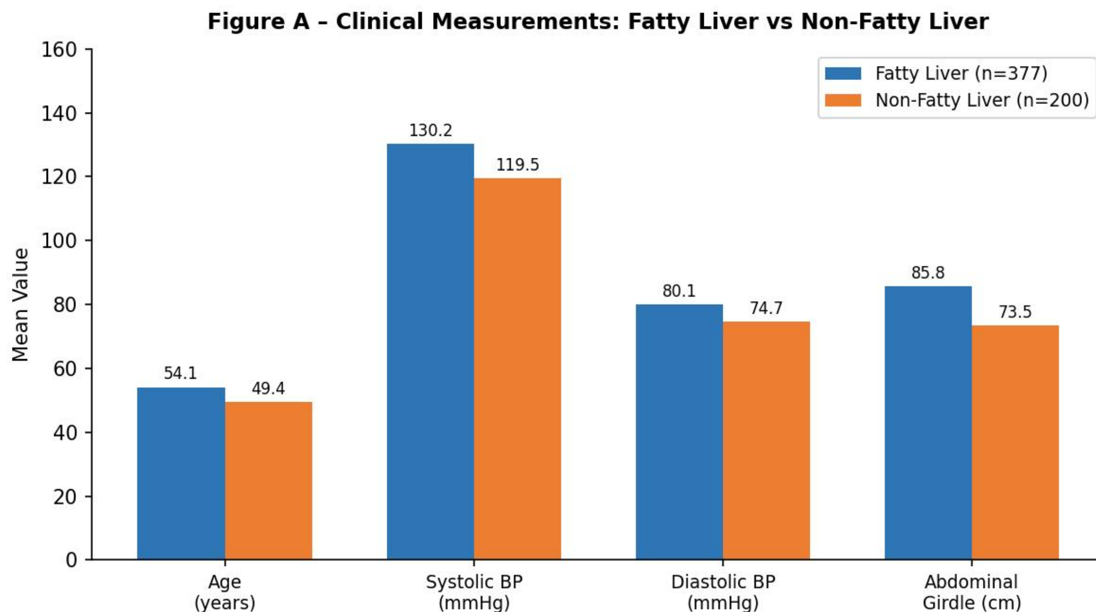

Figure A – Clinical Measurements: Mean Values Compared Between Groups

Biochemical Markers

Triglycerides were markedly elevated in the fatty liver group (146 vs 87.9 mg/dL, $p<0.0001$), while HDL-C was significantly lower (50.9 vs 64.7 mg/dL, $p=0.037$), reflecting dyslipidaemia. Liver enzymes GOT-AST and GPT-ALT were both significantly elevated, indicating hepatocellular injury. Total cholesterol was also higher in the fatty liver group (105.4 vs 93.9 mg/dL, $p<0.0001$).

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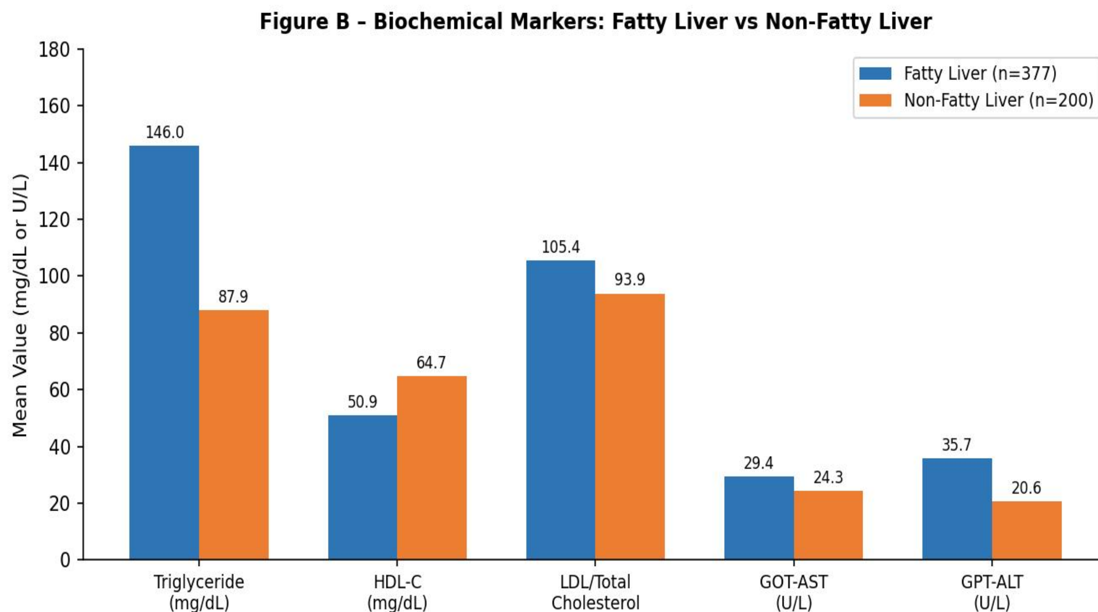

Figure B – Biochemical Markers: Mean Values Compared Between Groups

Gender Distribution

Male sex was significantly more prevalent in the fatty liver group (54.9% vs 33.0%, p<0.0001), confirming male gender as an independent risk factor for NAFLD. In the non-fatty liver cohort, females predominated (67.0% female).

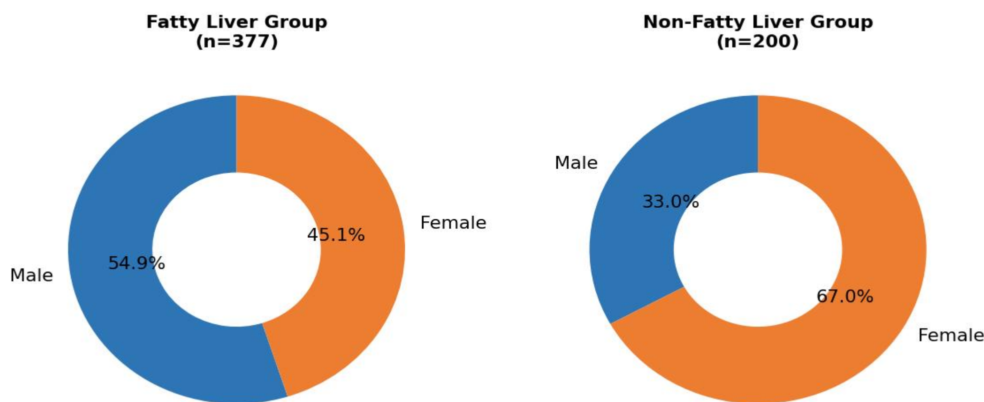

Figure C – Gender Distribution Across Study Groups

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DISCUSSION

This review demonstrates that machine learning models—particularly the random forest classifier (C-statistic 0.925 with 10-fold cross-validation)—outperform conventional statistical approaches in predicting fatty liver disease, representing a promising avenue for clinical decision support.

NAFLD affects approximately 25% of the global population and encompasses a spectrum from simple steatosis to NASH. The data confirm that metabolic risk factors—abdominal obesity, hypertriglyceridemia, low HDL-C, elevated liver enzymes, and male sex—are consistently and significantly associated with ultrasound-detected NAFLD.

Byra et al. demonstrated transfer learning using deep convolutional neural networks (CNNs) on B-mode ultrasound images for fatty liver diagnosis, achieving high accuracy. Parallel supervised learning approaches using 157 hepatic ultrasound images further validated algorithmic diagnosis.

Ultrasound remains a cost-effective, non-invasive, and widely accessible first-line tool. Combined with biochemical markers, it effectively screens for NAFLD and stratifies severity. Quantitative ultrasound methods (QUS), including controlled attenuation parameter (CAP) and transient elastography, offer improved quantification of steatosis compared with conventional qualitative B-mode assessment, with less operator dependency.

NAFLD is a leading cause of end-stage liver disease and hepatocellular carcinoma globally, with cardiovascular mortality (HR 1.55–1.85) and T2DM co-morbidity (HR 2.25) representing major clinical concerns. Early detection through population-based ultrasound screening, combined with lifestyle intervention, offers the greatest potential for disease prevention.

CONCLUSION

Ultrasound correlates reliably with hepatic steatosis and associated metabolic histological findings, confirming its role as the recommended first-line investigation. NAFLD—driven by unhealthy diet, sedentary behavior, obesity, and metabolic syndrome—is the world's most prevalent chronic liver disease (~30% in Western populations).

Liver biopsy, while historically the gold standard, is invasive and should be reserved for cases where non-invasive methods are inconclusive. Ultrasound sensitivity and specificity for steatosis exceed those for NASH and fibrosis, underscoring its specific utility in initial screening. Early identification and lifestyle-based management can significantly reverse hepatic fat accumulation and reduce long-term morbidity.

RECOMMENDATIONS

Individuals at elevated NAFLD risk include those who are overweight/obese, have T2DM or hypertension, have dyslipidemia, smoke, or are aged >50 years. Recommended preventive and management strategies include:

- Achieve and maintain healthy weight through caloric restriction and regular physical activity
- Cease smoking and limit or eliminate alcohol consumption
- Optimize management of diabetes, hypertension, and hypercholesterolemia with primary care support
- Undergo regular abdominal ultrasound surveillance for at-risk individuals
- Implement population-level NAFLD awareness campaigns utilizing mass media and primary healthcare networks

This study highlights the urgent need for physician education and public awareness programs targeting NAFLD prevention, early detection, and treatment.

AUTHORS CONTRIBUTION

Wajid Ali Shah: Conceptualization, study design, data collection, and manuscript writing.

Dr Shahid Ullah Khan: Literature review, methodology design, and critical review of the manuscript.

Sharifullah: Supervision of data collection, clinical interpretation of results, and manuscript revision.

Safi Ullah Khan: Data collection, patient recruitment, and assistance with literature review.

Aliza Shameen/Nida Islam Statistical analysis, data entry, and preparation of tables.

Faiza Iqbal: Corresponding author. Overall project coordination, final manuscript preparation, and submission. Critically revised and approved the final version of the manuscript.

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Inam Ullah: Ethical approval, questionnaire design, data verification, and review of the discussion section.

All authors read and approved the final manuscript.

REFERENCES

1. Popa SL, et al. Non-Alcoholic Fatty Liver Disease: Implementing Complete Automated Diagnosis and Staging. Diagnostics. 2021;11(6):1078.
2. Popa A, et al. Quantification of Liver Fibrosis, Steatosis, and Viscosity Using Multiparametric Ultrasound. Diagnostics. 2021;11(5):783.
3. Pirmoazen AM, et al. Quantitative ultrasound approaches for diagnosis and monitoring hepatic steatosis in NAFLD. Theranostics. 2020;10(9):4277.
4. Kumar R, et al. Non-alcoholic Fatty Liver Disease: Growing Burden, Adverse Outcomes. J Clin Transl Hepatol. 2020;8(1):76-86.
5. Capanni M, et al. Prolonged n-3 polyunsaturated fatty acid supplementation ameliorates hepatic steatosis. Aliment Pharmacol Ther. 2006;23(8):1143-51.
6. Kasper P, et al. NAFLD and cardiovascular diseases: a clinical review. Clin Res Cardiol. 2021;110(7):921-37.
7. Byra M, et al. Transfer learning with deep CNN for liver steatosis assessment in ultrasound images. Int J CARS. 2018;13(12):1895-903.
8. Han A, et al. Noninvasive diagnosis of NAFLD using radiofrequency ultrasound data with 1D-CNN. Radiology. 2020;295(2):342-50.
9. Papatheodoridi M, Cholongitas E. Diagnosis of NAFLD: current concepts. Curr Pharm Des. 2018;24(38):4574-86.
10. Stefan N, et al. NAFLD: causes, diagnosis, cardiometabolic consequences, and treatment strategies. Lancet Diabetes Endocrinol. 2019;7(4):313-24.
11. Huang T, et al. NAFLD: a review of epidemiology, risk factors, diagnosis and management. Intern Med J. 2020;50(9):1038-47.
12. Jarvis H, et al. Metabolic risk factors and incident advanced liver disease in NAFLD. PLoS Med. 2020;17(4):e1003100.
13. Jennison E, et al. Diagnosis and management of NAFLD. Postgrad Med J. 2019;95(1124):314-22.
14. Angulo P. Nonalcoholic fatty liver disease. N Engl J Med. 2002;346(16):1221-31.

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Print ISSN 3007-2379

15. Castera L, et al. Noninvasive assessment of liver disease in NAFLD. Gastroenterology. 2019;156(5):1264-81.
16. Ozturk A, et al. Quantitative hepatic fat quantification in NAFLD using ultrasound. Ultrasound Med Biol. 2018;44(12):2461-75.
17. Koizumi Y, et al. New diagnostic technique to evaluate hepatic steatosis using attenuation coefficient on US B-mode. PLoS One. 2019;14(8):e0221548.
18. Adibi A, et al. Sonographic fatty liver in overweight children. Endokrynol Pol. 2009;60(1):14-9.
19. Li Q, et al. Current status of imaging in NAFLD. World J Hepatol. 2018;10(8):530.
20. Iwasaki T, et al. Correlation between ultrasound-diagnosed NAFLD and periodontal condition. Sci Rep. 2018;8(1):1-7.
21. Liao Y-Y, et al. Multifeature analysis of an ultrasound quantitative diagnostic index for classifying NAFLD. Sci Rep. 2016;6(1):1-11.
22. Yang B-L, et al. External validation of fatty liver index in Taiwan. PLoS One. 2015;10(3):e0120443.
23. Qurrat-ul-Ain AL, et al. Validation of fatty liver index for NAFLD in Pakistani adults. Pak J Pathol. 2017;28(1):21-7.
24. Lin Y-C, et al. Association between soil heavy metals and fatty liver disease in men in Taiwan. BMJ Open. 2017;7(1):e014215.
25. Wu R, et al. NAFLD and coronary artery calcification in northern Chinese population. Sci Rep. 2017;7(1):1-9.
26. Khammas ASA, et al. Prevalence and risk factors of sonographically detected NAFLD in Malaysia. Porto Biomed J. 2019;4(2).
27. Ansari AM, et al. Risk factors for NAFLD: A cross-sectional study in Pakistani population. KJMS. 2020;13(2):287.
28. Xia Y, et al. Insoluble dietary fibre intake associated with lower prevalence of NAFLD. Nutr Metab. 2020;17(1):1-11.
29. Namoos K, Shabbir W. Role of lipid profile and biochemical markers in NAFLD patients. 2021.
30. Wu C-C, et al. Prediction of fatty liver disease using machine learning algorithms. Comput Methods Programs Biomed. 2019;170:23-9.

Pakistan Journal of Medical & Cardiological Review
https://pakjmcr.com/index.php/1/about
Online ISSN 3007-2387
Print ISSN 3007-2379

31. Khov N, et al. Bedside ultrasound in the diagnosis of NAFLD. World J Gastroenterol. 2014;20(22):6821.
32. Petta S, et al. Prevalence and severity of NAFLD by transient elastography. Liver Int. 2018;38(11):2060-8.
33. Reddy DS, et al. A novel computer-aided diagnosis framework using deep learning for fatty liver classification. IEEE Healthcom. 2018.