Section: Radiology

Original Research Article

PREVALENCE AND RISK FACTOR ASSOCIATION OF NON- ALCOHOLIC FATTY LIVER DISEASE USING B-MODE ULTRASONOGRAPHY IN A TERTIARY CARE HOSPITAL

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ABSTRACT

Background: Non-alcoholic fatty liver disease (NAFLD) is an increasingly common global health issue, closely associated with obesity and metabolic syndrome. Early recognition of risk factors is essential to prevent progression. The objective is to assess the distribution of fatty liver grades in a study population and explore their associations with demographic and metabolic risk factors using B-Mode ultrasonography.
Materials and Methods: A cross-sectional study was conducted on 245 subjects aged 18–80 years. Demographic data, body mass index (BMI), comorbidities, and ultrasonographic fatty liver grades were recorded. Four risk factors—hypertension, type II diabetes mellitus, hyperlipidemia, and metabolic syndrome—were evaluated.
Results: The cohort showed female predominance (55.9%) with a mean age of 47.15 ± 15.6 years; 28.6% were ≤35 years. Obesity was common (81.2%, mean BMI 27.66 ± 3.0 kg/m²). Grade 1 fatty liver was most prevalent (48.2%), followed by grade 2 (41.2%) and grade 3 (10.6%). Hypertension (15.1%), diabetes (4.08%), hyperlipidemia (6.1%), and metabolic syndrome (58%) were major risk factors. Grade 3 was strongly associated with metabolic syndrome (100%) and ≥3 risk factors (92.3%).
Conclusion: NAFLD is highly prevalent among obese individuals, with disease severity strongly linked to clustering of metabolic risk factors.
Keywords: Non-alcoholic fatty liver disease (NAFLD), Ultrasonography, Obesity, Metabolic syndrome, Liver stiffness.

INTRODUCTION

Non-alcoholic fatty liver disease (NAFLD) has emerged as one of the most common chronic liver disorders worldwide, affecting nearly one-quarter of the global population.[1,2] It encompasses a wide spectrum of conditions, ranging from simple steatosis to non-alcoholic steatohepatitis (NASH), progressive fibrosis, and cirrhosis. The growing burden of NAFLD parallels the global rise in obesity, type 2 diabetes, and metabolic syndrome.[3,4]
The estimated global prevalence of NAFLD is 25–30%,[2] while in India it ranges from 9–32% in the general population, with markedly higher rates among individuals with obesity and diabetes.[5-7] This trend underscores the urgent need for early detection and the identification of modifiable risk factors to prevent disease progression.
Conventional ultrasonography remains the most widely used modality for detecting and grading fatty liver due to its availability, cost-effectiveness, and non-invasive nature. However, from a public health perspective, NAFLD presents a dual challenge: its asymptomatic course often delays diagnosis until advanced stages, while its strong association with metabolic syndrome substantially increases cardiovascular risk and overall healthcare burden.
In this context, early and non-invasive risk stratification using B-mode ultrasonography is essential for timely intervention, population-based

screening, and prevention of long-term complications. The present study was therefore undertaken to evaluate the prevalence and distribution of fatty liver grades in a hospital-based population and to examine their association with age, sex, body mass index (BMI), and metabolic risk factors.

MATERIALS AND METHODS

Study Design and Setting: A cross-sectional observational study was conducted on 245 subjects attending the radiology department of a tertiary care hospital.

Inclusion Criteria

Adults aged 18–80 years undergoing abdominal ultrasonography were included.

Exclusion Criteria

Individuals with a history of alcohol intake, viral hepatitis, or chronic liver disease were excluded.

Data Collection:

Demographics: Age and sex

Anthropometrics: Body mass index (BMI, kg/m²)

Metabolic risk factors: Hypertension, type II diabetes mellitus, hyperlipidemia, and metabolic syndrome (defined according to Asian-modified NCEP ATP III criteria).

Body Mass Index Classification:

BMI was calculated as:

BMI = weight (in kg)/ height (in m)^2

For Asian and South Asian populations, the following cut-offs were used:

Overweight: 23.0–24.9 kg/m²

Obesity: ≥25.0 kg/m²

To be diagnosed with metabolic syndrome, an individual must meet three or more of the following criteria, as per updated Asian NCEP ATP III guidelines:

Criteria	
Central Obesity : The midpoint between the lowest rib and the iliac crest will be taken as waist circumference using a non-elastic measuring tape. Two measurements will be taken and their mean will be taken final.	Waist Circumference ≥ 90 cm (40.16 inches) in men and ≥ 80 cm (34.65 inches) in women
Hypertriglyceridemia	TGs≥ 150 mg/dL or drug treatment for elevated triglycerides
Low HDL Cholesterol	HDL ≤ 40 mg/dL in men and ≤ 50 mg/dL in women or drug treatment for low HDL cholesterol
Hypertension : Blood pressure will be measured in sitting position in the right arm using mercury sphygmomanometer. The reading having a lower value of the two will be taken as blood pressure.	Systolic BP ≥ 130 mmHg or Diastolic BP ≥ 85 mmHg or drug treatment for elevated blood pressure
Fasting Glucose	Fasting plasma glucose ≥ 100 mg/dL; or prior diagnosis of type 2 diabetes mellitus or drug treatment for elevated glucose levels.

Imaging: Abdominal ultrasonography was performed in all participants to detect and grade fatty liver. All examinations were conducted using an Esaote MyLab Eight eXP ultrasound system equipped with a curvilinear transducer (frequency range: 1–8 MHz).

Fatty liver was graded on grey-scale sonography according to hepatic echogenicity, clarity of intrahepatic vessels, and diaphragm visualization, as follows:

- **Grade 1 (Mild):** Minimal diffuse increase in hepatic echogenicity with normal visualization of the diaphragm and intrahepatic vessel borders.
- **Grade 2 (Moderate):** Moderate diffuse increase in hepatic echogenicity with slightly impaired visualization of intrahepatic vessels and diaphragm.
- **Grade 3 (Severe):** Marked increase in hepatic echogenicity with poor penetration of the posterior segment of the right lobe and poor or absent visualization of hepatic vessels and diaphragm.

Statistical Analysis: All data were compiled using Microsoft Excel 2010 and analyzed with SPSS version 25.0 (IBM Corp., Armonk, NY, USA). Descriptive statistics were used to summarize the data.

- Categorical variables were expressed as frequencies and percentages.
- Continuous variables were presented as mean ± standard deviation (SD).

RESULTS

A total of 245 subjects (137 females, 108 males) aged between 18–80 years were analyzed between April 2021 and March 2022. All participants underwent B-mode ultrasonography.

Of the study population, 55.9% were females (n=137) and 44.1% were males (n=108), indicating a female predominance. The mean age was 47.15 ± 15.6 years. The age distribution is summarized in Table 2. The largest subgroup was ≤35 years (28.6%), followed by >60 years (25.3%).

BMI values ranged from 19.8–36.9 kg/m², with a mean of 27.66 ± 3.0 kg/m². The majorities were obese (≥25 kg/m², 81.2%). Only 2% had normal BMI. Since 97.9% were overweight or obese, BMI >23 kg/m² was not considered an independent predictor in risk factor analysis.

Table 1: Baseline characteristics of the study population (n=245)

Variable	Frequency (n)	Percentage (%)
Age (years)		
≤ 35	70	28.6
36–45	56	22.9
46–60	57	23.3
> 60	62	25.3
Sex		
Female	137	55.9
Male	108	44.1
BMI (kg/m²)		
Normal (<23)	5	2.0
Overweight (23–24.9)	41	16.7
Obese (≥25)	199	81.2
Mean BMI ± SD	–	27.66 ± 3.0

Table 2: Distribution of fatty liver grades and their association with sex

Fatty liver grade	Female n (%)	Male n (%)	Total n (%)
Grade 1	69 (58.5)	49 (41.5)	118 (48.2)
Grade 2	56 (55.4)	45 (44.6)	101 (41.2)
Grade 3	12 (46.2)	14 (53.8)	26 (10.6)
Total	137 (55.9)	108 (44.1)	245 (100)

On ultrasonography, Grade 1 fatty liver was most common (48.2%), followed by Grade 2 (41.2%) and Grade 3 (10.6%).

Risk Factors and Association with Fatty Liver Grades: Five potential risk factors for fatty liver were initially considered: BMI >23 kg/m², hypertension, type II diabetes mellitus, hyperlipidemia, and metabolic syndrome. Since the majority of participants (97.9%) were overweight or obese, BMI was not analyzed as an independent predictor. The mean BMI of the cohort was 27.66 ± 3.0 kg/m².

Hypertension: Of the 245 subjects, 37 (15.1%) had hypertension as the only identifiable risk factor. Most of these patients were classified as Grade 1 fatty liver, and none had Grade 3, suggesting that isolated hypertension was not strongly associated with advanced disease.

Type II Diabetes Mellitus: Ten subjects (4.1%) were exclusively diabetic, with male predominance (n=7). Nine had BMI >23 (two overweight, seven obese), while one had normal BMI. The majority (80%) were classified as Grade 2 fatty liver, while none were Grade 3, indicating a stronger association of diabetes with moderate disease.

Hyperlipidemia: Fifteen subjects (6.1%) were exclusively hyperlipidemic, all with BMI >23 (three overweight, 12 obese). Most of them (86.7%) were classified as Grade 1 fatty liver, and none as Grade 3, suggesting hyperlipidemia alone was linked primarily with early disease.

Metabolic Syndrome and Cumulative Risk Burden: The most significant risk factor was metabolic syndrome, present in 103 subjects (58%). Its prevalence rose sharply with disease severity, being observed in 62.4% of Grade 2 and 100% of Grade 3 cases. Importantly, analysis of cumulative burden revealed that 92.3% of Grade 3 patients presented with three or more concurrent risk factors, compared to only 7.6% in Grade 1. This underscores the additive effect of multiple metabolic abnormalities in driving disease progression.

Table 3: Percentage distribution of individual risk factors in patient enrolled for study

Risk factor	Frequency (n)	Percentage (%)
Hypertension	37	15.1
Diabetes mellitus	10	4.1
Hyperlipidemia	15	6.1
Metabolic syndrome	103	58.0

Table 4: Number of risk factors present during patient enrollment in various grades of fatty liver shown below

No. of risk factors	Grade 1 n (%)	Grade 2 n (%)	Grade 3 n (%)
1	99 (83.9)	32 (31.7)	0 (0.0)
2	10 (8.5)	24 (23.8)	2 (7.7)
≥ 3	9 (7.6)	45 (44.6)	24 (92.3)
Total	118 (100)	101 (100)	26 (100)

DISCUSSION

This study highlights the high prevalence of fatty liver disease among obese individuals, with a slight female predominance. The majority of participants presented with Grade 1 (48.2%) and Grade 2 (41.2%) fatty liver, whereas Grade 3 (10.6%) was strongly associated with clustering of risk factors, particularly metabolic syndrome.

Comparison with Global Data: The distribution of fatty liver grades in this study aligns with international evidence, where NAFLD is reported to present predominantly in mild to moderate stages.[2,5]

Western cohorts demonstrate similar grade distributions, but often with a higher prevalence of advanced disease (Grade 3), attributed to increased rates of diabetes, obesity, and metabolic syndrome in those populations.[6] This suggests that while NAFLD is globally prevalent, its progression pattern is shaped by regional differences in lifestyle and metabolic health.

Risk Factor Associations: Our analysis showed that isolated hypertension and hyperlipidemia were most commonly associated with early-stage fatty liver (Grade 1). Type II diabetes mellitus was more strongly linked with moderate disease (Grade 2), consistent with its role as a key metabolic driver. In contrast, metabolic syndrome emerged as the most significant determinant of advanced fatty liver, being present in 100% of Grade 3 cases. Moreover, the finding that 92.3% of Grade 3 patients had ≥3 concurrent risk factors underscores the synergistic effect of multiple metabolic abnormalities in accelerating disease progression.

Clinical Implications: These findings reinforce the importance of screening for NAFLD in individuals with metabolic syndrome, even in the absence of overt liver dysfunction. Early detection in patients with clustering risk factors can enable timely interventions such as lifestyle modification, targeted metabolic control, and close follow-up, potentially preventing progression to cirrhosis or cardiovascular complications.

Limitations: This study has certain limitations. First, its cross-sectional design precludes follow-up or assessment of disease progression over time. Second, being a single-center study, the findings may not be fully generalizable to the broader population. Finally, the exclusion of individuals with alcohol intake may have underestimated the prevalence of overlap syndromes between alcoholic and non-alcoholic fatty liver disease.

CONCLUSION

Fatty liver disease is highly prevalent among overweight and obese individuals, with severity strongly linked to the clustering of metabolic risk factors. Among these, metabolic syndrome emerged as the most significant predictor of advanced fatty liver.

While most cases were detected at mild to moderate stages, the presence of multiple concurrent risk factors was closely associated with progression to advanced grades. These findings emphasize the need for early identification and aggressive management of obesity, diabetes, and metabolic syndrome to reduce the risk of progression to advanced fibrosis and cirrhosis.

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