Research Square

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Diagnostic Utility of Fibroscan in Detecting Subclinical Metabolic Dysfunction Associated Steatotic Liver Disease (MASLD) in Recently Diagnosed Type 2 Diabetes Mellitus in Eastern India

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Research Article

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Abstract

Introduction:

Metabolic dysfunction-associated steatotic liver disease (MASLD) is highly prevalent among patients with type 2 Diabetes Mellitus (T2DM) and may remain clinically silent despite progressive hepatic fibrosis. Early identification of subclinical liver involvement is therefore important in recently diagnosed T2DM patients. FibroScan provides a non-invasive assessment of hepatic steatosis and fibrosis.

Aim

To evaluate the diagnostic utility of FibroScan for detecting subclinical MASLD and significant hepatic fibrosis among recently diagnosed patients with T2DM.

Materials and methods

A prospective observational diagnostic study was conducted among 120 adults with recently diagnosed T2DM at a tertiary care government hospital in eastern India. Participants underwent clinical, anthropometric and biochemical assessment followed by FibroScan examination. Controlled attenuation parameter (CAP) was used to assess hepatic steatosis, while liver stiffness measurement (LSM) was used to evaluate hepatic fibrosis. Associations between MASLD and metabolic parameters were assessed, and diagnostic performance was evaluated using sensitivity, specificity and receiver operating characteristic (ROC) analysis.

Result

MASLD was detected in 86 (71.7%) participants, including mild, moderate and severe steatosis in 35.0%, 24.2% and 12.5%, respectively. Significant fibrosis was identified in 29 (24.2%) participants. MASLD was significantly associated with higher BMI ($p < 0.001$), HbA1c ($p = 0.011$), triglycerides ($p < 0.001$) and ALT ($p = 0.001$). FibroScan demonstrated 82.8% sensitivity, 85.7% specificity and 85.0% diagnostic accuracy for significant fibrosis, with an AUC of 0.88. CAP showed excellent discrimination for MASLD (AUC 0.91, $p < 0.001$).

Conclusion

FibroScan appears to be a useful non-invasive tool for early detection and risk stratification of MASLD and hepatic fibrosis in recently diagnosed T2DM patients.

Introduction

Metabolic dysfunction-associated steatotic liver disease (MASLD), previously termed non-alcoholic fatty liver disease (NAFLD), is one of the most common chronic liver diseases worldwide and represents a major consequence of metabolic dysfunction. The recently proposed nomenclature recognizes MASLD as hepatic steatosis occurring in the presence of at least one cardiometabolic risk factor, replacing the previous exclusion-based terminology of NAFLD [1]. The increasing prevalence of obesity, insulin resistance, and type 2 diabetes mellitus (T2DM) has contributed substantially to the growing global burden of MASLD. Importantly, MASLD and T2DM are closely interconnected, with insulin resistance playing a central role in the development and progression of hepatic steatosis, inflammation, and fibrosis [2]. Patients with T2DM have a particularly high prevalence of fatty liver disease and are at increased risk of developing progressive steatohepatitis and advanced liver fibrosis [3].

MASLD encompasses a broad clinical spectrum ranging from simple hepatic steatosis to metabolic dysfunction-associated steatohepatitis (MASH), progressive fibrosis, cirrhosis, and hepatocellular carcinoma. Although elevated aminotransferase levels may raise suspicion of liver disease, normal alanine aminotransferase and aspartate aminotransferase levels do not exclude clinically significant steatosis, steatohepatitis, or fibrosis [4]. Consequently, reliance on liver enzymes alone may lead to underdiagnosis, particularly in individuals with metabolic risk factors such as T2DM and obesity. Among the different histological features of MASLD, the stage of liver fibrosis is particularly important because it is strongly associated with long-term liver-related and disease-specific mortality [5].

The clinical importance of MASLD extends beyond liver-related complications. Cardiovascular disease is a major cause of morbidity and mortality among individuals with MASLD, and the coexistence of diabetes appears to further amplify cardiovascular risk [6]. Therefore, early identification of patients at increased risk of progressive liver disease and cardiovascular complications is essential for appropriate clinical management. However, liver biopsy, although historically considered the reference standard for assessing steatosis, inflammation, and fibrosis, is invasive, costly, and associated with sampling variability. These limitations have stimulated increasing interest in reliable non-invasive methods for the detection and staging of MASLD [7].

Transient elastography has emerged as an important non-invasive technique for assessing liver stiffness and estimating the degree of hepatic fibrosis. Evidence from systematic reviews indicates that transient elastography has useful diagnostic accuracy for identifying clinically significant and advanced fibrosis in patients with NAFLD/MASLD [8]. In addition, the controlled attenuation parameter (CAP), commonly incorporated into transient elastography examinations, provides a non-invasive estimate of hepatic steatosis and can assist in identifying and grading fatty infiltration [9]. The combination of liver stiffness measurement and CAP therefore offers a practical approach for evaluating both fibrosis and steatosis without requiring liver biopsy.

Current clinical practice increasingly emphasizes a stepwise, risk-based approach to MASLD assessment, beginning with identification of individuals with metabolic risk factors and progressing to non-invasive fibrosis assessment when appropriate. The 2024 EASL-EASD-EASO clinical practice

guidelines highlight the importance of cardiometabolic risk assessment, lifestyle modification, and non-invasive tests for identifying individuals at risk of advanced liver disease [10].

The study aims to assess the diagnostic utility of FibroScan, including CAP and liver stiffness measurement, for detecting subclinical MASLD and early hepatic fibrosis among recently diagnosed patients with type 2 diabetes mellitus.

Material and Methods

Study design

a prospective observational study

Place of study

The study was conducted in the Department of General Medicine, of a tertiary care hospital in eastern India.

Period of study

18 months

Study Population

The study population comprised of adult patients with recently diagnosed Type 2 Diabetes Mellitus (T2DM) attending the department of General Medicine, who fulfilled the predefined eligibility criteria. Participants underwent clinical, anthropometric, biochemical and FibroScan (CAP and liver stiffness measurement) assessment to detect subclinical metabolic dysfunction-associated steatotic liver disease (MASLD) and assessment of presence of hepatic fibrosis.

Sample size

120 patients

Inclusion Criteria

- Adults aged ≥ 18 years.
- Patients with recently diagnosed T2DM (within 6 months).
- Patients willing to undergo FibroScan and required investigations.
- Patients providing written informed consent.

Exclusion Criteria

- Patients with known chronic liver disease or cirrhosis.
- Patients with significant alcohol consumption.
- Patients with hepatitis B/C or other chronic liver diseases.
- Patients with acute liver disease or severe systemic illness.
- Pregnant women.
- Patients unwilling to provide informed consent.

Statistical Analysis

For statistical analysis, data were initially entered into a Microsoft Excel spreadsheet and then analyzed using SPSS (version 27.0; SPSS Inc., Chicago, IL, USA) and GraphPad Prism (version 5). Numerical variables were summarized using means and standard deviations, while Data were entered into Excel and analyzed using SPSS and GraphPad Prism. Numerical variables were summarized using means and standard deviations, while categorical variables were described with counts and percentages. Two-sample t-tests were used to compare independent groups, while paired t-tests accounted for correlations in paired data. Chi-square tests (including Fisher's exact test for small sample sizes) were used for categorical data comparisons. P-values ≤ 0.05 were considered statistically significant.

Results

Table 1
Baseline characteristics of study participants (N = 120)

Variable	n (%) / Mean ± SD
Age (years)	48.7 ± 10.2
Male	72 (60.0)
Female	48 (40.0)
BMI (kg/m²)	27.1 ± 3.8
Hypertension	51 (42.5)
Dyslipidaemia	47 (39.2)
Diabetes duration (months)	3.4 ± 1.7

Table 2
Biochemical profile of participants

Parameter	Mean ± SD
Fasting glucose (mg/dL)	154.8 ± 38.6
HbA1c (%)	7.8 ± 1.2
Triglycerides (mg/dL)	168.5 ± 72.3
HDL-C (mg/dL)	42.8 ± 8.7
ALT (U/L)	34.9 ± 18.6
AST (U/L)	28.7 ± 10.4
FIB-4 score	1.02 ± 0.48

Table 3
FibroScan findings

Finding	n (%)
MASLD absent	34 (28.3)
MASLD present	86 (71.7)
Mild steatosis (S1)	42 (35.0)
Moderate steatosis (S2)	29 (24.2)
Severe steatosis (S3)	15 (12.5)
Significant fibrosis	29 (24.2)
Mean CAP (dB/m)	287.4 ± 48.6
Mean LSM (kPa)	7.1 ± 3.2

Table 4
Factors associated with MASLD

Variable	MASLD Absent (n = 34)	MASLD Present (n = 86)	p-value
Age (years)	45.2 ± 9.8	50.1 ± 10.0	0.015
BMI (kg/m²)	24.8 ± 2.9	28.0 ± 3.6	< 0.001
HbA1c (%)	7.4 ± 0.9	8.0 ± 1.3	0.011
Triglycerides (mg/dL)	132.8 ± 45.7	182.6 ± 76.2	< 0.001
ALT (U/L)	27.1 ± 11.2	38.0 ± 20.0	0.001

Table 5
Diagnostic performance of FibroScan for significant fibrosis

Parameter	% Value
Sensitivity	82.80%
Specificity	85.70%
PPV	62.20%
NPV	94.90%
Diagnostic accuracy	85.00%
AUC	0.88

Table 6
Receiver Operating Characteristic (ROC) analysis for detection of MASLD

Parameter	AUC	p-value
BMI	0.74	< 0.001
HbA1c	0.63	0.009
Triglycerides	0.76	< 0.001
ALT	0.72	< 0.001
FIB-4	0.69	< 0.001
CAP	0.91	< 0.001
LSM	0.88	< 0.001

Table 1 presents the baseline demographic and clinical characteristics of the 120 study participants. The mean age of the participants was 48.7 ± 10.2 years, with males constituting 60.0% (72) and females 40.0% (48) of the study population. The mean BMI was 27.1 ± 3.8 kg/m², indicating that overweight status was common among the participants. Hypertension was present in 51 (42.5%) participants, while 47 (39.2%) had dyslipidaemia. The mean duration of diabetes was 3.4 ± 1.7 months, confirming that the study population consisted predominantly of recently diagnosed T2DM patients.

Table 2 shows the biochemical characteristics of the study population. The mean fasting blood glucose level was 154.8 ± 38.6 mg/dL, while the mean HbA1c was 7.8 ± 1.2%, indicating suboptimal glycaemic control at the time of assessment. The mean triglyceride level was 168.5 ± 72.3 mg/dL, whereas the mean HDL-C was 42.8 ± 8.7 mg/dL. The mean ALT and AST levels were 34.9 ± 18.6 U/L and 28.7 ± 10.4 U/L, respectively. The mean FIB-4 score was 1.02 ± 0.48, suggesting that most participants did not have a markedly elevated non-invasive fibrosis score.

Table 3 demonstrates the FibroScan findings among the 120 participants. MASLD was detected in 86 (71.7%) participants, whereas 34 (28.3%) had no evidence of MASLD. Among those with steatosis, 42 (35.0%) had mild steatosis (S1), 29 (24.2%) had moderate steatosis (S2), and 15 (12.5%) had severe steatosis (S3). Significant fibrosis was identified in 29 (24.2%) participants. The mean CAP value was 287.4 ± 48.6 dB/m, while the mean LSM was 7.1 ± 3.2 kPa. These findings indicate a substantial burden of subclinical hepatic steatosis among recently diagnosed T2DM patients.

Table 4 & Fig. 2 compares selected clinical and biochemical variables between participants with and without MASLD. Participants with MASLD had a significantly higher mean age (50.1 ± 10.0 vs. 45.2 ± 9.8 years; $p = 0.015$) and BMI (28.0 ± 3.6 vs. 24.8 ± 2.9 kg/m²; $p < 0.001$). Mean HbA1c was also significantly higher in the MASLD group (8.0 ± 1.3 vs. 7.4 ± 0.9%; $p = 0.011$). Similarly, triglyceride levels were significantly higher among participants with MASLD (182.6 ± 76.2 vs. 132.8 ± 45.7 mg/dL; $p < 0.001$). ALT levels were also significantly elevated in the MASLD group (38.0 ± 20.0 vs. 27.1 ± 11.2 U/L; $p = 0.001$). These findings suggest that greater adiposity and adverse metabolic and biochemical profiles were significantly associated with MASLD.

Table 5 and Fig. 1 demonstrates the diagnostic performance of FibroScan for identifying significant hepatic fibrosis. FibroScan showed a sensitivity of 82.8% and specificity of 85.7%, indicating good ability to discriminate participants with significant fibrosis from those without it. The positive predictive value was 62.2%, while the negative predictive value was high at 94.9%, suggesting that a negative FibroScan result was particularly useful for excluding significant fibrosis. The overall diagnostic accuracy was 85.0%. The area under the ROC curve (AUC) was 0.88, demonstrating good overall diagnostic discrimination.

Table 6 presents the ROC analysis of selected clinical and biochemical parameters for detecting MASLD. CAP demonstrated the highest diagnostic performance, with an AUC of 0.91 ($p < 0.001$), followed by LSM with an AUC of 0.88 ($p < 0.001$). Triglycerides also showed good discriminatory ability (AUC = 0.76; $p < 0.001$), while BMI had an AUC of 0.74 ($p < 0.001$). ALT demonstrated moderate diagnostic performance (AUC = 0.72; $p < 0.001$), whereas FIB-4 showed an AUC of 0.69 ($p < 0.001$). HbA1c had comparatively lower discriminatory ability (AUC = 0.63; $p = 0.009$).

Discussion

The present study demonstrated a high prevalence of metabolic dysfunction-associated steatotic liver disease (MASLD) among recently diagnosed patients with type 2 diabetes mellitus (T2DM), with 71.7% of participants showing evidence of hepatic steatosis on FibroScan. This high prevalence highlights the close relationship between diabetes and metabolic liver disease. Insulin resistance, increased hepatic fatty acid delivery, enhanced de novo lipogenesis, impaired lipid oxidation, and adipose tissue dysfunction contribute to hepatic fat accumulation in individuals with T2DM. In addition, metabolic abnormalities associated with diabetes may accelerate progression from simple steatosis to steatohepatitis and fibrosis [11].

The significantly higher BMI observed among participants with MASLD compared with those without MASLD (28.0 ± 3.6 vs. 24.8 ± 2.9 kg/m²; $p < 0.001$) is consistent with the established association between excess adiposity and hepatic steatosis. Obesity, particularly visceral adiposity, promotes insulin resistance and increases the flux of free fatty acids to the liver. Adipose tissue inflammation and altered adipokine secretion may further contribute to hepatic inflammation and fibrosis. Studies in patients with T2DM have shown that increasing BMI and central obesity are important determinants of MASLD and advanced liver disease [12]. The present findings therefore suggest that assessment of adiposity should form an important component of liver disease risk stratification in patients with newly diagnosed diabetes.

Age was also significantly higher in the MASLD group. The mean age of participants with MASLD was 50.1 ± 10.0 years compared with 45.2 ± 9.8 years among those without MASLD ($p = 0.015$). Increasing age is associated with cumulative exposure to metabolic risk factors and may also be related to greater duration or severity of insulin resistance. Furthermore, age has been incorporated into several non-invasive fibrosis prediction models because the probability of advanced fibrosis generally increases with advancing age [13]. However, age should be interpreted together with metabolic characteristics and liver-specific measurements rather than being considered an independent determinant of MASLD.

The metabolic profile observed in this study further supports the association between dysglycaemia, dyslipidaemia and hepatic steatosis. Participants with MASLD had significantly higher HbA1c values than those without MASLD (8.0 ± 1.3% vs. 7.4 ± 0.9%; $p = 0.011$). Similarly, triglyceride concentrations were substantially higher in the MASLD group (182.6 ± 76.2 vs. 132.8 ± 45.7 mg/dL; $p < 0.001$). Hypertriglyceridaemia is closely linked to hepatic insulin resistance and increased hepatic lipid synthesis. Previous studies have demonstrated that dyslipidaemia, particularly elevated triglycerides and reduced HDL-C, is frequently associated with hepatic steatosis and progression of metabolic liver disease [14]. These observations reinforce the importance of comprehensive metabolic risk-factor management in patients with T2DM and MASLD.

ALT was also significantly higher among participants with MASLD. However, the mean ALT level in the MASLD group was only modestly elevated. This finding is clinically relevant because normal or near-normal aminotransferase concentrations do not exclude significant hepatic steatosis or fibrosis. Consequently, liver enzymes should not be used in isolation to rule out MASLD or advanced liver disease [15]. The present study therefore supports the use of non-invasive liver assessment in metabolically high-risk patients even when conventional liver biochemical tests are not markedly abnormal.

FibroScan identified steatosis in 86 participants, including 42 with S1, 29 with S2 and 15 with S3 steatosis. Thus, moderate-to-severe steatosis was present in a considerable proportion of the study population. The mean CAP value of 287.4 ± 48.6 dB/m further indicates a substantial burden of hepatic fat accumulation. CAP provides a rapid and reproducible method of estimating liver steatosis and has demonstrated useful diagnostic performance in patients with metabolic liver disease [16]. The high

prevalence of abnormal CAP measurements in this study suggests that clinically silent hepatic steatosis may be common even at an early stage of T2DM.

More importantly, significant fibrosis was detected in 24.2% of participants. This finding is particularly concerning because fibrosis represents the major determinant of long-term hepatic outcomes in MASLD. Progressive fibrosis can eventually lead to cirrhosis, portal hypertension, hepatic decompensation and hepatocellular carcinoma. Recent evidence indicates that individuals with T2DM and MASLD are at increased risk of advanced fibrosis compared with patients without diabetes [17]. Therefore, the identification of approximately one-quarter of participants with significant fibrosis demonstrates that newly diagnosed diabetes should not be regarded as an early stage at which liver disease can be safely ignored.

The mean FIB-4 score in the study population was 1.02 ± 0.48, suggesting relatively low overall fibrosis risk according to commonly used thresholds. Nevertheless, FibroScan identified significant fibrosis in 29 participants. This observation emphasizes that serum-based scores and liver stiffness measurements provide complementary information. FIB-4 is particularly useful as an inexpensive first-line assessment tool, but its performance may be influenced by age and other clinical variables. In patients with diabetes, sequential assessment using a simple fibrosis score followed by liver stiffness measurement can improve identification of individuals requiring further evaluation [18].

The diagnostic performance of FibroScan for significant fibrosis was encouraging. The sensitivity of 82.8% and specificity of 85.7%, together with an AUC of 0.88, indicate good discriminatory ability. The negative predictive value of 94.9% is particularly important because a highly negative predictive test can help identify individuals who are unlikely to have significant fibrosis and therefore may not require immediate invasive investigation. The findings are consistent with the growing evidence supporting vibration-controlled transient elastography as an effective non-invasive method for fibrosis risk assessment in MASLD [19].

The ROC analysis showed that CAP had the highest discriminatory performance for identifying MASLD, with an AUC of 0.91. This finding indicates excellent diagnostic discrimination and supports the value of quantitative assessment of hepatic fat using FibroScan. LSM also showed good discriminatory performance, with an AUC of 0.88. In contrast, triglycerides, BMI and ALT demonstrated moderate discriminatory ability, while HbA1c showed comparatively limited discrimination. These results suggest that although metabolic and biochemical parameters are associated with MASLD, they cannot reliably substitute for direct non-invasive assessment of the liver.

The relatively low AUC for HbA1c (0.63) is also noteworthy. Although poorer glycaemic control was associated with MASLD in the present study, HbA1c alone had limited ability to discriminate between patients with and without hepatic steatosis. This may be explained by the multifactorial nature of MASLD, in which obesity, insulin resistance, dyslipidaemia, age, hypertension and genetic susceptibility interact with glycaemic abnormalities. Consequently, liver disease risk assessment should not depend solely on the degree of hyperglycaemia.

From a clinical perspective, the findings emphasize the importance of incorporating liver assessment into the routine evaluation of patients with T2DM. A substantial proportion of patients may have clinically silent MASLD despite relatively modest abnormalities in liver enzymes. Identification of hepatic steatosis should be followed by appropriate fibrosis risk assessment, because fibrosis stage has greater prognostic significance than steatosis alone. Recent studies have also demonstrated that the coexistence of diabetes and MASLD is associated with increased cardiovascular morbidity, reinforcing the need for integrated cardiometabolic management [20].

Limitations:

This study has some limitations. The study was conducted at a single centre and included a relatively small number of participants, which may limit the generalizability of the findings. Liver biopsy was not performed, as it is invasive and was not justified in this study population; therefore, FibroScan findings could not be compared with histopathological findings. Since only recently diagnosed patients with T2DM were included, the results may not be applicable to patients with longer-duration diabetes. Factors such as diet, physical activity, alcohol intake and medication use may also have influenced the findings and were not fully accounted for. In addition, the observational nature of the study limits the ability to establish a causal relationship between metabolic factors and MASLD or hepatic fibrosis. Larger multicentre studies with longer follow-up would help to confirm these findings

Conclusion

The present study indicates that subclinical metabolic dysfunction-associated steatotic liver disease (MASLD) is highly prevalent among individuals with recently diagnosed type 2 diabetes mellitus. FibroScan, using controlled attenuation parameter (CAP) and liver stiffness measurement (LSM), offers a simple, non-invasive and clinically valuable approach for detecting hepatic steatosis and identifying individuals at risk of significant hepatic fibrosis. The significant associations between MASLD and increased BMI, HbA1c, triglyceride and ALT levels highlight the importance of comprehensive metabolic risk assessment in newly diagnosed diabetic patients. The favourable diagnostic performance of FibroScan, including its high negative predictive value and strong ROC-AUC, supports its usefulness for early liver disease risk stratification. Integrating FibroScan into the clinical evaluation of patients with type 2 diabetes may enable earlier lifestyle intervention, improved metabolic control and appropriate liver-related follow-up, thereby helping to prevent progression to advanced liver disease.

Declarations

Conflict of interest-

(d) Nil

Author Contribution

1. A.C. & U.P. was involved in the study protocol, conceptualisation and writing the main manuscript2. A.C. & M.K. was involved in statistical analysis, referencing, proof reading All authors finally reviewed the manuscript.

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Figures

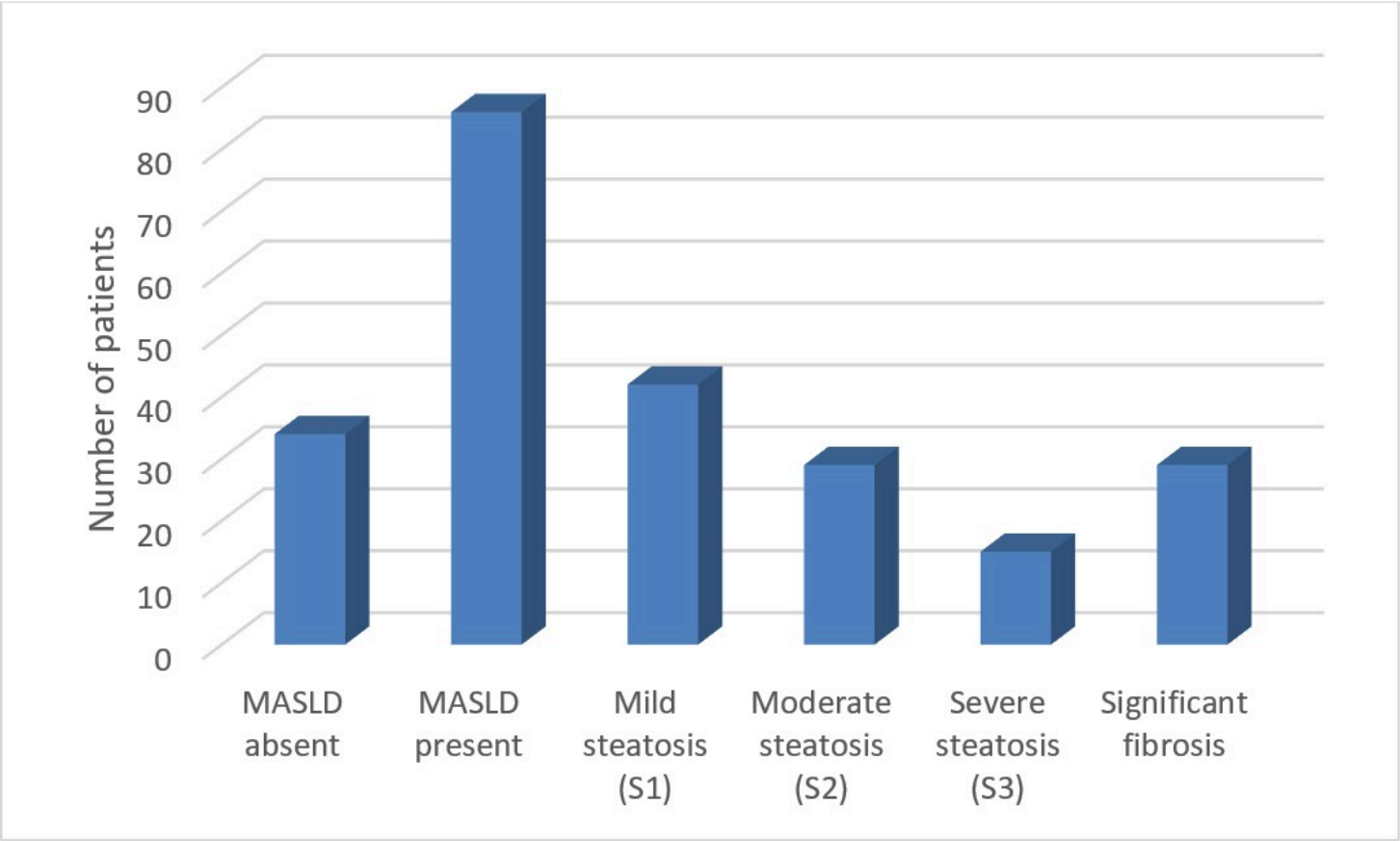


Figure 1

Distribution of Hepatic Steatosis and Significant Fibrosis According to FibroScan Findings Among Study Participants (N=120)

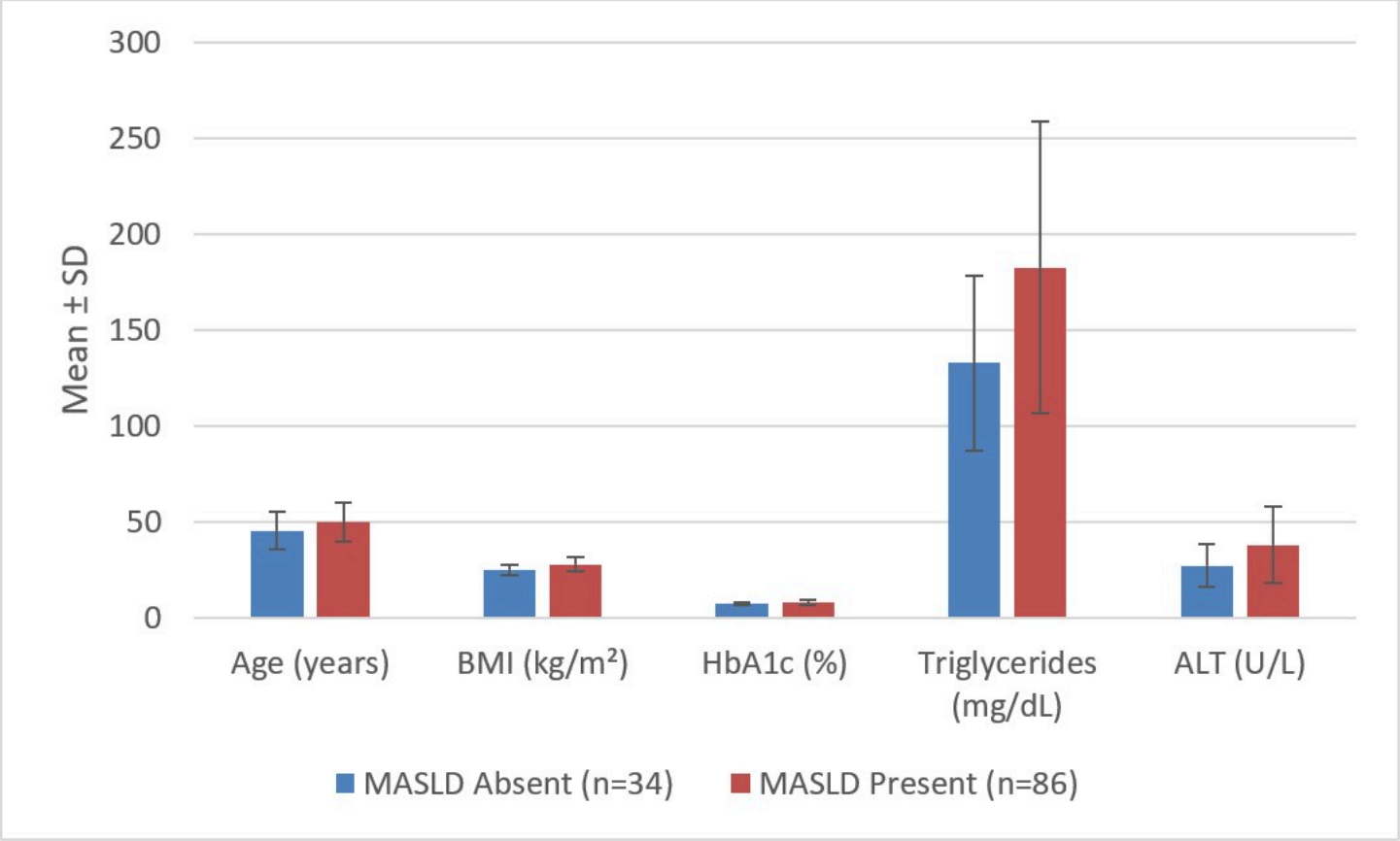


Figure 2

Factors associated with MASLD