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Diagnostic efficacy of FIB-4 scores, NAFLD-Fibrosis score and BARD score in the assessment of liver fibrosis in NAFLD

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Abstract
Background*: There is a growing need for a dependable and cost-effective non-invasive marker to evaluate hepatic fibrosis in individuals with non-alcoholic fatty liver disease (NAFLD). This study aimed to assess and compare the diagnostic accuracy of the FIB-4 score, NAFLD fibrosis score (NAFLD-FS), and BARD score in determining liver fibrosis in NAFLD patients.* ***Methods:*** *The Fibrosis-4 (FIB-4) score, Non-Alcoholic Fatty Liver Disease Fibrosis Score (NAFLD-FS), and BARD score were assessed in a cohort of 100 NAFLD patients at a tertiary care center in Dehradun, India. Liver shear wave elastography was used as the reference standard. Sensitivity and specificity for each non-invasive test were evaluated using receiver operating characteristic (ROC) curve analysis. Diagnostic performance was measured by calculating the area under the ROC curve (AUROC), and comparisons were made among the AUROCs of the different non-invasive tests.* ***Results:*** *The C-statistics for diagnostic efficacies of the FIB-4 score, NAFLD-FS, and BARD score in assessing liver fibrosis were statistically significant. The difference between the concordance (C-) statistics of the FIB-4 score and NAFLD-FS regarding their diagnostic efficacy in assessing liver fibrosis was statistically not significant ($p = 0.953$). FIB-4 score was superior to the BARD score in diagnosing liver fibrosis ($p = 0.009$). NAFLD-FS was better than the BARD score in diagnosing liver fibrosis ($p = 0.017$).* ***Conclusions:*** *The FIB-4 score, NAFLD-FS, and BARD score showed very good performance in assessing liver fibrosis in patients with NAFLD. The FIB-4 score and NAFLD-FS showed comparable diagnostic accuracy but both were superior to the BARD score in assessing liver fibrosis in patients with NAFLD.*

Keywords*: Non-invasive markers; Hepatic fibrosis; Hepatic steatosis; Non-alcoholic fatty liver; Non-alcoholic steatohepatitis.*

Introduction

Non-Alcoholic Fatty Liver Disease (NAFLD) refers to a spectrum of liver conditions resulting from an accumulation of excess fat in the liver. It is characterized by hepatic steatosis. Under this condition, excess fat gets built up and there are no other reasons which yield secondary hepatic accumulation of fat. The two types of NAFLD are non-alcoholic fatty liver (NAFL) and non-alcoholic steatohepatitis (NASH) [1].

NAFLD is a leading cause of liver disease and can progress to fibrosis and cirrhosis. It has become the most common cause of chronic liver disease [2,3]. Worldwide occurrence of NAFLD accounts for 25% of liver related-diseases, with a rapid increase in cases in Western countries [4]. Additionally, NAFLD is associated

with approximately 4-22% of cases of hepatocellular carcinoma in the Western world [5]. In India, the statistics of the occurrence of liver-related diseases among the general population ranges from 9% to 53% [6]. NAFLD, particularly in developed countries, is now a regular and familiar reason for the occurrence of chronic forms of liver-related diseases. This hints at the fact that NAFLD is a matter of serious concern and might become the primary reason for liver transplantation in the coming decade [7].

NAFLD is linked to metabolic syndrome (MS), obesity, type 2 diabetes mellitus, dyslipidemia, cardiovascular disease, and stroke [8,9,10]. Insulin resistance is a key pathogenic factor in both NAFLD and MS [11]. Additionally, smoking is an autonomous factor related to NAFLD development [12,13].

It is common for a majority of patients to have little or negligible symptoms. Yet, some patients also complain of discomfort in the right upper quadrant of the abdomen. Thus, NAFLD may be detected in a patient who incidentally undergoes imaging to diagnose an unconnected condition [14].

Liver biopsy is considered the gold standard for diagnosing Non-Alcoholic Fatty Liver Disease (NAFLD), as it can reveal inflammation and fibrosis, as well as their causes. However, due to its invasive nature, associated discomfort, and potential risks, including rare but serious complications, there is a need for simpler, non-invasive methods for assessing liver fibrosis. [15].

Thus, the increased occurrence of NAFLD implies that it is a prerequisite to have consistent non-invasive indicators and tests. These indicators and tests must be consistent in such a way that even in the absence of a liver biopsy, they must be able to inform the existence of any advanced disease precisely. The occurrence and degree of fibrosis are the utmost significant aspects in the identification of NAFLD [16]. The progression to advanced fibrosis (stages F3–F4) in NAFLD patients is clinically significant, as it is linked to a more than threefold increase in mortality risk [17].

Non-invasive methods for evaluating liver fibrosis include the NAFLD Fibrosis Score (NAFLD-FS), Fibrosis-4 (FIB-4) score, Body Mass Index (BMI), AST/ALT ratio (Aspartate Aminotransferase/Alanine Aminotransferase), and the BARD score. Parameters like the AST to Platelet Ratio Index (APRI) and the AST/ALT ratio are easily accessible to patients. While these scoring systems have demonstrated improved accuracy in predicting hepatic fibrosis, there is ongoing discussion about the need for additional data to enhance their reliability. [18].

Since NAFLD is a very common entity with an established risk of progression to liver fibrosis, the study and application of these predictive models can help in the early identification of individuals who are more susceptible to the development of liver fibrosis, thus enabling the implementation of necessary measures like pharmacological intervention and lifestyle modifications in such individuals.

This study aims to evaluate and compare the diagnostic validity and accuracy of non-invasive fibrosis scores in identifying liver fibrosis among adult patients with NAFLD or NASH.

Materials and Methods

This cross-sectional observational study was conducted at a tertiary care hospital in Uttarakhand, India, from July 2021 to December 2022. The study included patients diagnosed with Non-Alcoholic Fatty Liver Disease (NAFLD), following informed written consent and approval from the institutional ethics committee. The procedures adhered to the Helsinki Declaration of 1964 and its subsequent amendments. The sample size was calculated to be 96, based on an assumed prevalence of fatty liver of 50% and a relative precision of 20% at a 0.05 significance level, with an adjustment to 100 to account for potential dropouts. The study enrolled 100 patients aged 18 and older with a diagnosis of NAFLD confirmed by ultrasonographic findings and clinical history. Exclusion criteria included individuals with alcoholic fatty liver disease, autoimmune hepatitis, or pregnancy.

Study protocol

All patients attending the General Medicine Outpatient Department (OPD) and Inpatient Department (IPD) who met the inclusion criteria were included in the study. Each patient underwent a thorough history and clinical examination. The physiological variables recorded included age, sex, heart rate, blood pressure, temperature, weight, height, and body mass index (BMI). Diagnosis of NAFLD was made based on ultrasound grading.

Ultrasound abdomen was done for all patients. Diagnostic criteria for fatty liver on ultrasound: fibrosis was graded (0-3) based on visual analysis of liver echogenicity and its intensity, provided that the gain setting was optimum. A mild increase in liver echogenicity was classified as grade I; when the echogenicity of the liver obscured the echogenic walls of the portal vein branches, it was labeled as grade II; and when the echogenicity obscured the diaphragmatic outline, it was categorized as grade III fatty infiltration. [19]. Biochemical tests included complete hemogram, liver function tests, lipid profile, fasting blood sugar (FBS), thyroid profile (serum TSH [Thyroid stimulating hormone], free T3, free T4), viral serology for hepatitis C (HCV antibody), hepatitis B (HbsAg), other tests if necessary, like – glycated hemoglobin (HbA1c) and antinuclear antibody (ANA). By using the results of the above-mentioned investigations, the following scores were calculated

BMI, AST/ALT Ratio, and Diabetes Score (BARD Score) used the weighted sum of three variables to obtain a composite score for identification and prediction of the presence of advanced fibrosis [16].

Non-alcoholic Fatty Liver Disease Fibrosis Score (NAFLD-FS): The Non-Alcoholic Fatty Liver Disease Fibrosis Score (NAFLD-FS) incorporates factors such as age, body mass index (BMI), platelet count, hyperglycemia, albumin level, and the aspartate aminotransferase to alanine aminotransferase (AST/ALT) ratio. The score uses two cut-off values: a score below –1.455 indicates a low likelihood of advanced fibrosis, while a score above 0.675 suggests the presence of advanced fibrosis. [18].

Fibrosis-4 (FIB-4) score: Platelet count, ALT and AST levels and age, were parameters used in the FIB-4 score [19].

Liver Elastography: Shear Wave Elastography (S.W elastography) was considered the gold standard and performed by Philips (EPIQ5G) machine using a probe 1-5 MHz to assess the liver stiffness. The liver stiffness measurements were scored according to Metavir by using the following cutoffs [20].

Normal	- Metavir F0	: 3-6.5 kPa
Mild fibrosis	- Metavir F2	: 7-11 kPa
Moderate fibrosis	- Metavir F3	: 11-21 kPa
Severe fibrosis	- Metavir F4	: 22^{+} kPa

Statistical Analysis:

Data analysis was performed using the Statistical Package for Social Sciences (SPSS) software, version 23. Qualitative variables were presented as frequencies and percentages, while quantitative variables were reported as mean ± standard deviation (SD). The Chi-square or Fisher's exact test was used to assess the association between categorical variables. For normally distributed data involving more than two groups, analysis of variance (ANOVA) was conducted using a general linear model. The diagnostic effectiveness of each model was evaluated by calculating the concordance (C-) statistic, equivalent to the area under the receiver operating characteristic curve (AUC). DeLong's test was used to compare the C-statistics of various non-invasive scores. A p-value of less than 0.05 was considered statistically significant.

Results

The demographic and clinical profiles of patients with NAFLD are shown in Table 1. Male dominance was seen (male: female ratio 1.63: 1). Seventy-one patients had a BMI between 25-29.9 kg/m^2 with a mean BMI of 27.3 ± 2.6 kg/m^2. The most common symptoms were early fatigability (43%), loss of appetite (36%), pain in the abdomen (32%), nausea (31%), dyspepsia (27%), and vomiting (16%). Hepatomegaly (32%), and icterus (6%) were the prominent signs.

Table 1: Demographic and clinical profile of the patients with NAFLD

Characteristics		Number of patients (n=100)
Age (years)	≤40	28
	40-60	64
	≥60	8
Sex	Male	62

	Female	38
Body mass index (kg/m^2)	Normal (<25 kg/m^2)	14
	Overweight (25- 29.9kg/m^2)	71
	Obese (≥30 kg/m^2)	15
Dietary habits	Vegetarian	33
	Mixed diet eaters	67
Smoker		36
Hypertension		31
Diabetes mellitus		35
Clinical symptoms		
Abdominal pain		32
Nausea		31
Vomiting		16
Dyspepsia		27
Loss of appetite		36
Early fatigability		43
Jaundice		3
Clinical signs		
Pallor		5
Icterus		6
Hepatomegaly		32

The investigation profile and non-invasive scores of patients with NAFLD are shown in Table 2. Nineteen patients had thrombocytopenia and nine patients had hemoglobin less than 10 gm/dl. Forty-six patients had AST/ALT ≥ 1, and 27 patients had serum triglyceride levels of more than 200 mg/dl. The mean FIB-4 score was 2.00 ± 1.40 (range 0.669 to 6.33), the mean NAFLD-FS score was -1.16 ± 1.42 (range -5.4 to 2.28) and the mean BARD score was 2.06 ± 1.11 (range 0 to 4).

able 2: Investigation profile and non-invasive scores of patients with NAFLD

Investigation	**Mean** ± SD	**Reference range**
Hemoglobin (g/dl)	13.09 ± 1.86	12.0 - 16.0 g/dl (females) 13.5 - 17.5 g/dl (males)
WBC count (thousand/cumm)	6.70 ± 1.9	4.0 - 11.0 thousand/cumm
Platelet count (thousand/cumm)	211.73 ± 78.23	150 - 450 thousand/cumm
Serum total cholesterol (mg/dl)	184.17 ± 37.01	< 200 mg/dl
Serum triglyceride (mg/dl)	157.92 ± 69.55	< 150 mg/dl
Serum high density lipoprotein (mg/dl)	41.69 ± 7.98	> 40 mg/dl (males) > 50 mg/dl (females)
Serum low density lipoprotein (mg/dl)	103.21 ± 29.95	< 100 mg/dl (optimal)
Serum very low density lipoprotein (mg/dl)	31.45 ± 14.64	2 - 30 mg/dl
Serum total bilirubin (mg/dl)	0.96 ± 0.60	0.1 - 1.2 mg/dl
Serum direct bilirubin (mg/dl)	0.28 ± 0.34	0.0 - 0.4 mg/dl
Serum indirect bilirubin (mg/dl)	0.68 ± 0.40	0.2 - 0.8 mg/dl
Serum ALT (IU/L)	64.63 ± 62.27	7 - 56 IU/L
Serum AST (IU/L)	62.49 ± 60.69	5 - 40 IU/L
Serum AST/ALT	1.08 ± 0.50	0.8 - 1.2

Serum ALP (IU/L)	111.35 ± 89.20	44 - 147 IU/L
Serum albumin (g/dl)	3.90 ± 0.60	3.5 - 5.0 g/dl
Serum total protein (g/dl)	7.15 ± 0.68	6.4 - 8.3 g/dl
Serum globulin (g/dl)	3.23 ± 0.62	2.0 - 3.5 g/dl
Serum free T3 (pg/ml)	3.08 ± 0.58	2.3 - 4.2 pg/ml
Serum free T4 (ng/dl)	0.99 ± 0.24	0.8 - 2.0 ng/dl
Serum TSH (µIU/ml)	2.73 ± 1.21	0.4 - 4.0 µIU/ml
Fasting blood sugar (mg/dl)	119.94 ± 46.54	70 - 100 mg/dl
HbA1c (%)	6.17 ± 1.36	< 5.7% (normal) 5.7 - 6.4% (prediabetes)
Non-invasive score		
FIB-4 score	2.00 ±1.40	< 1.3 (low risk) > 2.67 (high risk)
NAFLD-FS	-1.16 ± 1.42	< -1.455 (low risk) > 0.676 (high risk)
BARD score	2.16 ±1.11	0-1 (low risk) 2-4 (high risk)

Data are presented as mean ± standard deviation. WBC, white blood cell; ALP, alkaline phosphatase; ALT, alanine aminotransferase; AST, aspartate aminotransferase; TSH, thyroid stimulating hormone; HbA1c, glycated hemoglobin; FIB-4 score, fibrosis-4 score; NAFLD-FS, non-alcoholic fatty liver disease-fibrosis score; BARD score, body mass index, AST/ALT ratio, and diabetes score.

Among patients with mild fibrosis, the grade of NAFLD was grade 1 in 18.6%, grade 2 in 55.8% and grade 3 in 25.6% of patients. Among patients with moderate fibrosis, the grade of NAFLD was grade 1 in 26.7%, grade 2 in 26.7% and grade 3 in 46.7% of patients. Among patients with no fibrosis, the grade of NAFLD was grade 1 in 31%, grade 2 in 50% and grade 3 in 14.3% of patients (Table 3). No significant association was seen between the USG grade of NAFLD and the severity of fibrosis as per liver elastography (p = 0.090).

Table 3: Ultrasound findings of patients with NAFLD and Shear wave elastography findings

NAFLD, non-alcoholic fatty liver disease; S.W. elastography, shear wave elastography.

Ultrasound grade of NAFLD	**S.W. elastography**			**Total patients (%)**
	Number of patients (%)			
	Mild fibrosis (n=43)	**Moderate fibrosis (n=15)**	**No fibrosis (n=42)**	
Grade 1	8 (18.6)	4 (26.7)	13 (31)	25 (25.0)
Grade 2	24 (55.8)	4 (26.7)	21 (50.0)	49 (49.0)
Grade 3	11 (25.6)	7 (46.7)	6 (14.3)	24 (24.0)
Hepatomegaly	0 (0.0)	0 (0.0)	2 (4.8)	2 (2.0)

There was a statistically significant difference concerning FIB-4 score, NAFLD-FS and BARD score among patients with various grades of liver fibrosis (Table 4).

Table 4: FIB-4 score, NAFLD-FS and BARD score as per severity of liver fibrosis in patients with NAFLD

CI, confidence interval; FIB-4 score, fibrosis-4 score; NAFLD-FS, non-alcoholic fatty liver disease-fibrosis score; BARD score, body mass index, AST/ALT ratio, and diabetes score.

Non-invasive score		Mean	SD	95% CI for mean		Anova	p-value
				Lower bound	Upper bound		
FIB-4 score	Mild Fibrosis	2.10	.90	1.82	2.37	79.71	0.001
	Moderate Fibrosis	4.36	1.56	3.50	5.23		
	No Fibrosis	1.07	.34	.96	1.17		
NAFLD-FS	Mild Fibrosis	-.78	.80	-1.02	-.53	83.03	0.001
	Moderate Fibrosis	.94	.90	.44	1.44		
	No Fibrosis	-2.30	.93	-2.59	-2.01		
BARD score	Mild Fibrosis	2.37	.97	2.07	2.67	17.48	0.001
	Moderate Fibrosis	3.20	.56	2.89	3.51		
	No Fibrosis	1.57	1.06	1.24	1.90		

The C-statistic for diagnostic efficacy of the FIB-4 score in assessing liver fibrosis was statistically significant (p = 0.000) (Fig. 1a). Using an optimal FIB-4 score cut-off of 2.15, the sensitivity and specificity for the diagnostic efficacy in assessing liver fibrosis were 93.3% and 83.5% respectively. The C-statistic for the diagnostic efficacy of NAFLD-FS in assessing liver fibrosis was statistically significant (p = 0.000) (Fig. 1b). Using an optimal NAFLD-FS cut-off of -0.34, the sensitivity and specificity for diagnostic efficacy in assessing liver fibrosis were 93.7% and 82.7% respectively. The C-statistic for the diagnostic efficacy of the BARD score in assessing liver fibrosis was statistically significant (p = 0.000) (Fig. 1c). Using an optimal BARD score cut-off of 2.50, the sensitivity and specificity for diagnostic efficacy in assessing liver fibrosis were 92.2% and 68.2% respectively.

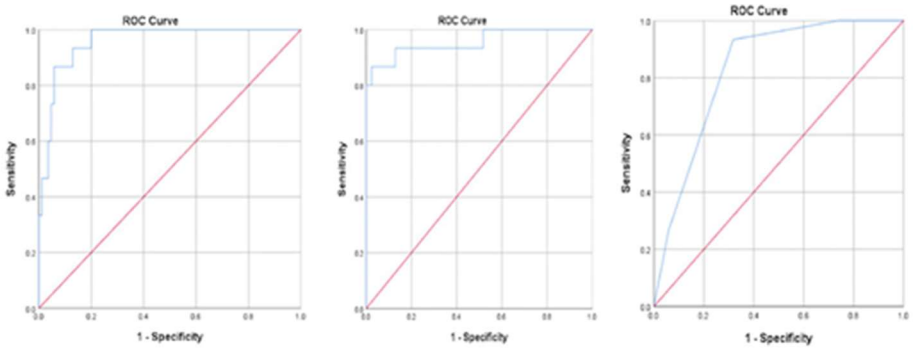

Fig 1a Fig 1b Fig 1c

Non-invasive fibrosis score	FIB-4
AUROC	0.958
Cut-off point	2.15
Sensitivity	93.3%
Specificity	83.5%
p- value	0.000

Non-invasive fibrosis score	NAFLD-FS
AUROC	0.955
Cut-off point	-0.34
Sensitivity	93.7%
Specificity	82.7%
p- value	0.000

Non-invasive fibrosis score	BARD
AUROC	0.831
Cut-off point	2.50
Sensitivity	92.2%
Specificity	68.2%
p- value	0.000

Fig. 1 ROC curves for the diagnostic efficacies of the (a) Fibrosis-4 (FIB-4) score, (b) NAFLD-FS, and (c) BARD score in assessing liver fibrosis

The difference between the C-statistics of the Fibrosis-4 (FIB-4) score and NAFLD-FS regarding their diagnostic efficacies in assessing liver fibrosis was statistically not significant (p=0.953) (Fig. 2a). The Fibrosis-4 (FIB-4) score was superior to the BARD score in assessing liver fibrosis (p=0.009) (Fig. 2b). The NAFLD-FS was superior to the BARD score in assessing liver fibrosis (p=0.017) (Fig. 2c).

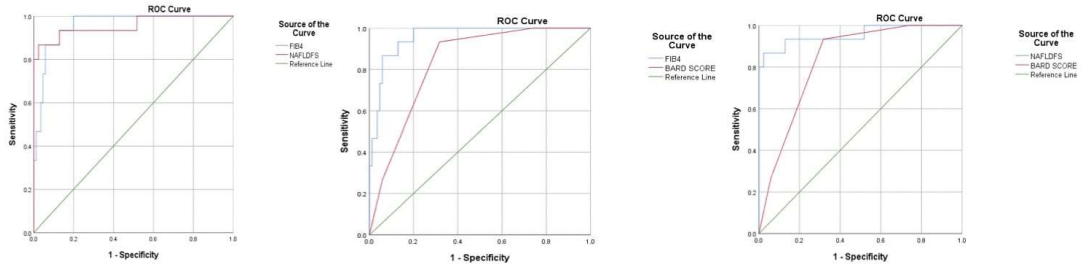

Fig 2a Fig 2b Fig 2c

Fig. 2 Comparison of the ROC curves for the diagnostic efficacies of (a) Fibrosis-4 (FIB-4) score and NAFLD-FS, (b) Fibrosis-4 (FIB-4) score and BARD score, and (c) NAFLD-FS and BARD score in assessing liver fibrosis

Discussion

It is important to have an ideal test for the identification of hepatic fibrosis that would have qualities like high specificity and sensitivity including low cost for the patient. It should also have the characteristics to be used for the identification of all chronic liver-related diseases. Regarding NAFLD, this kind of test must have the capability to differentiate between a fatty liver and steatohepatitis. Despite decades of research on this, right now no test can fulfill these criteria and hence the quest for such a test is still going on [15].

As there is no such ideal test, it is vital to consider both the clinical questions and the performance variables of the test for good utilization of the existing test. Usually, there are no other markers related to common liver disease in NAFLD such as abnormal hepatic imaging with or without abnormal liver enzymes, hepatitis C, constant presence of hepatomegaly without any apparent reason. Based on clinical presentation, no current non-invasive panel has assessed the performance in the particular NAFLD subsets. It is common knowledge that most of the subjects having NAFLD with the condition of advanced fibrosis are found with normal liver enzymes. Therefore, it is correct to say that the tests which are based on liver enzymes are not suitable for such a condition [24].

In patients having NAFLD, we concluded that the simple non-invasive tests are valid to diagnose hepatic fibrosis by taking shear elastography as the gold standard test. We recorded a substantial difference concerning specificity, sensitivity and AUROCs among the various non-invasive scores (FIB-4 score, NAFLD fibrosis score, and BARD score) that are applied in our group.

We observed that most of the NAFLD cases were of 41 to 50 years [42%] age which was similar to that of the research by Shah et al., where the average age was 48.0 ± 12.0 years [15]. There were more males (62%) in our study than females (38%) compared to a study by Subasi et al., in which 52.8 % were males and 47.2% were females [25]. A study done by Pouwels et al., documented the signs and symptomatology of NAFLD as fatigue, right upper quadrant discomfort, hepatomegaly, acanthosis nigricans, and lipomatosis briefly [26]. Sakitani et al (2017) reported the most common presentation to be asymptomatic, although fatigue and right upper quadrant pain were also observed [27]. In our study, early fatigability [43%] was the major symptom followed by loss of appetite [36%], while 32% of cases had hepatomegaly as a major sign followed by icterus [6%].

In our study, 71% of cases were overweight with a average BMI of 27.3 ± 2.6 kg/m^2 as compared with the study done by Subasi et al, with a average BMI of 30.9 ± 5.5 kg/m2 [25]. Loomis et al in 2016 observed similar findings that the risk of developing NAFLD was about 5 – 10 fold higher in patients with high BMI as compared to the normal population [28]. When we examined the non-invasive scores (FIB4, NAFLD-FS and BARD score) in our patients, the mean value of FIB4 score was 2.00 ± 1.40, NAFLD-FS -1.16 ± 1.42 and BARD score 2.06 ± 1.11. Our results are supported by the observation by Shah et al., in their research that the average value of the FIB-4 score was 0.74 ± 1.67, NAFLD-FS -2.37 ± 0.29 and BARD score 1.98 ± 0.70 [15].

We analyzed the Receiver Operating Characteristic (ROC) curves for three non-invasive scores—NAFLD Fibrosis Score (NAFLD-FS), Fibrosis-4 (FIB-4) score, and Body mass index, AST/ALT ratio, and Diabetes (BARD) score—for detecting liver fibrosis, using shear wave elastography as the reference standard. For the FIB-4 score, the Area Under the ROC Curve (AUROC) was 0.958, with a sensitivity of 93.3% and a specificity of 83.5% at a cut-off value of 2.15. The NAFLD-FS had an AUROC of 0.955, and at a cut-off value of -0.34, it showed a sensitivity of 93.7% and a specificity of 82.7%. The BARD score had an AUROC of 0.831, with a sensitivity of 92.2% and a specificity of 68.2% at a cut-off value of 2.50. All three scores demonstrated satisfactory diagnostic performance.

A study by Demir et al. reported similar findings for different non-invasive scores, with the Area Under the ROC Curve (AUROC) being 0.95 for the Fibrosis-4 (FIB-4) score (95% CI, 0.91-1.00), 0.82 for the Body mass index, AST/ALT ratio, and Diabetes (BARD) score (95% CI, 0.71-0.92), and 0.96 for the Non-Alcoholic Fatty Liver Disease Fibrosis Score (NAFLD-FS) (95% CI, 0.92-0.99). Both the NAFLD-FS and FIB-4 scores were found to be superior to the BARD score in terms of diagnostic efficacy, specificity, Positive Predictive Value (PPV), and Negative Predictive Value (NPV). Similarly, Subasi et al. conducted a study comparing the APRI, BARD, FIB-4, NAFLD-FS, and Fibro-Meter scores, finding sensitivities of 70.0%, 73.3%, 70.0%, 66.7%, and 66.7%, and specificities of 74.5%, 66.4%, 71.8%, 71.8%, and 74.5%, respectively. They concluded that there were no significant differences in sensitivity and specificity among these tests. [25].

A systematic review by Sun et al. evaluated the diagnostic effectiveness of the Fibrosis-4 (FIB-4) score, Non-Alcoholic Fatty Liver Disease Fibrosis Score (NAFLD-FS), and Body mass index, AST/ALT ratio, and Diabetes (BARD) score for assessing liver fibrosis associated with NAFLD. The Area Under the ROC Curve (AUROC) values were 0.849 and 0.844 for the FIB-4 score at cut-offs of 1.30 and 3.25, 0.835 and 0.647 for the NAFLD-FS at cut-offs of -1.455 and 0.676, and 0.762 for the BARD score. A diagnostic test is considered good with an AUROC above 80%, excellent with an AUROC above 90%, and perfect with an AUROC of 100%. The FIB-4 score at cut-offs of 1.30 and 3.25 and the NAFLD-FS at a -1.455 cut-off yield good diagnostic results, with the FIB-4 score at a 1.30 cut-off being relatively more effective for predicting NAFLD-related liver fibrosis. [22].

We also compared the C-statistics of the Fibrosis-4 (FIB-4) score and the Non-Alcoholic Fatty Liver Disease Fibrosis Score (NAFLD-FS) in evaluating their diagnostic accuracy for liver fibrosis. The difference between them was not statistically significant (p=0.953). Our results are consistent with those of Shah et al., who also found no significant difference between the C-statistics of the FIB-4 score and NAFLD-FS for diagnosing liver fibrosis. However, a systematic review by Sun et al. indicated that the FIB-4 score had superior diagnostic accuracy compared to the NAFLD-FS [22]. The Fibrosis-4 (FIB-4) score showed significantly better performance than the Body mass index, AST/ALT ratio, and Diabetes (BARD) score in evaluating liver fibrosis (p=0.009). Similarly, the Non-Alcoholic Fatty Liver Disease Fibrosis Score (NAFLD-FS) outperformed the BARD score in assessing liver fibrosis (p=0.017). These results align with the findings of Demir et al., who also reported that the C-statistics of the NAFLD-FS and FIB-4 score demonstrated superior diagnostic accuracy compared to the BARD score. [30]. Sun et al, also observed that the C-statistics of the FIB-4 score had better diagnostic accuracy than the BARD score [22].

Limitations

In this study, shear wave elastography was employed as the diagnostic method for detecting liver fibrosis in patients with Non-Alcoholic Fatty Liver Disease (NAFLD). Although liver biopsy remains the gold standard for diagnosing liver fibrosis, it was not utilized due to its high cost and potential complications.

Conclusion

The Fibrosis-4 (FIB-4) score, Non-Alcoholic Fatty Liver Disease (NAFLD) fibrosis score, and Body mass index, AST/ALT ratio, and Diabetes (BARD) score are prominent non-invasive tools used to assess liver fibrosis in patients with NAFLD. Each score provides valuable insights, though their diagnostic accuracies differ. The FIB-4 score has been found to offer greater accuracy compared to the BARD score for evaluating liver fibrosis in individuals with NAFLD. Likewise, the NAFLD fibrosis score outperforms the BARD score in terms of diagnostic effectiveness. When comparing the FIB-4 score and the NAFLD fibrosis score, both demonstrated comparable diagnostic accuracy in assessing liver fibrosis, indicating that they are both reliable for this purpose. These scores are instrumental in evaluating advanced liver fibrosis in patients with NAFLD, providing important information that can guide clinical decisions. Their non-invasive nature makes them advantageous over more invasive procedures, and their ability to provide accurate assessments is crucial for effective management and treatment planning in NAFLD. Despite their differences in accuracy, the FIB-4 score and NAFLD fibrosis score are both valuable tools for clinicians dealing with liver fibrosis in NAFLD patients.

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