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ORIGINAL RESEARCH

Performance of APRI and FIB-4 Scores Compared to FibroScan: A Cross-Sectional Study in a Black Sub-Saharan African Population

Jean-Bonny Nsumbu[1,2], Jean-Robert Makulo[3], Trésor Mutombo Tshiswaka[4], Christian Kisoka Lusunsi[4], Charles Nlombi Mbendi[1]

[1]Unit of Hepato-Gastroenterology, Department of Internal Medicine, University Hospital of Kinshasa, Kinshasa, Congo; [2]Unit of Hepato-Gastroenterology, Hôpital Médecins de Nuit SARL, Kinshasa, Congo; [3]Unit of Nephrology, Department of Internal Medicine, University Hospital of Kinshasa, Kinshasa, Congo; [4]Unit of Cardiology, Department of Internal Medicine, University Hospital of Kinshasa, Kinshasa, Congo

Correspondence: Jean-Bonny Nsumbu, Email bonnynsumbu@gmail.com

Background and Aim: Several non-invasive tests are used to assess liver fibrosis and cirrhosis in patients with liver disease. However, most validation studies have not included populations in sub-Saharan Africa. This study aimed to evaluate the diagnostic performance of the APRI and FIB-4 scores in a Congolese cohort.

Patients and Methods: A cohort of patients in Kinshasa underwent FibroScan and laboratory testing to calculate APRI and FIB-4 scores. Pearson correlation, sensitivity, specificity, and ROC curve analyses were used to evaluate the performance of these non-invasive scores against FibroScan. Cirrhosis was defined as liver stiffness ≥14 kPa by FibroScan. Thresholds for APRI and FIB-4 scores predicting cirrhosis were set at ≥ 1.5 and ≥ 2.67, respectively.

Results: The study included 316 patients (mean ± SD age: 48.1 ± 14.1 years; 60.8% male; 10.1% with diabetes; 37.1% obese; 14.2% with hepatitis B; 6.7% with hepatitis C; 25.6% with a history of alcohol use). The Pearson correlation between APRI and FibroScan was $r = 0.210$ ($p < 0.001$), while the correlation between FIB-4 and FibroScan was better ($r = 0.478$, $p < 0.001$). In subgroup analyses, FIB-4 correlated with FibroScan only among patients with alcohol use or hepatitis B or C, APRI only correlated with FibroScan in alcohol dependent patients. The sensitivity and specificity of APRI were 29.7% and 97.9% respectively, compared to 60.0% and 93.3% for FibroScan. The areas under the ROC curve were 0.8462 for APRI and 0.8312 for FIB-4, with thresholds lower than those reported in the literature: 0.422 for APRI and 1.285 for FIB-4, but these varied according to the subgroup.

Conclusion: APRI and FIB-4 scores demonstrate high specificity but low sensitivity for diagnosing cirrhosis in this population. Their diagnostic performance is notably better in patients with alcohol-related liver disease or viral hepatitis, but poor among those with diabetes or obesity.

Keywords: APRI, FIB-4, FibroScan, hepatitis, MASH, alcohol, cirrhosis, DR Congo

Introduction

For several decades, non-invasive tests have been employed to evaluate liver fibrosis, thereby avoiding the traumatic complications associated with liver biopsy puncture (LBP) in at-risk patients.[1,2] Although indirect, these tests enable the monitoring of numerous liver conditions—including viral hepatitis, alcoholic hepatitis, and metabolic dysfunction-associated steatohepatitis (MASH)—and help track their progression toward cirrhosis. A key advantage is their repeatability in the same patient over time.

Currently, FibroScan is among the most widely recommended non-invasive methods for assessing liver fibrosis.[3] Cirrhosis is strongly suspected when liver stiffness, as measured by FibroScan, exceeds 14 kPa, while values below 2.5 kPa effectively rule out fibrosis.[4] Although biopsy remains the gold standard for evaluating liver pathology, FibroScan has become a practical alternative for fibrosis assessment, particularly because it samples a significantly larger liver area.

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In contrast, liver biopsy may yield false-negative results due to sampling limitations.[5] Despite these benefits, FibroScan is not yet routinely used in the Democratic Republic of Congo (DR Congo).

Among blood-based alternatives to biopsy, FibroTest and ActiTest are frequently recommended.[6,7] These tests rely on a panel of serological markers, including alpha-2-macroglobulin, haptoglobin, apolipoprotein A1, gamma-glutamyl transpeptidase (GGT), and total bilirubin. However, some of these biomarkers are seldom measured in clinical laboratories across sub-Saharan Africa (SSA).[8] More accessible and affordable alternatives, such as the AST to Platelet Ratio Index (APRI) and the Fibrosis-4 Index (FIB-4), are based on routine laboratory parameters—transaminases (ALT, AST) and platelet count. Nonetheless, several studies have demonstrated that these scores have relatively low sensitivity and specificity for detecting advanced fibrosis or cirrhosis.[9–11] Notably, most evaluations of APRI and FIB-4 have been conducted in Western countries, Asia, North America, and North Africa.[9–14] To support improved liver disease monitoring in Kinshasa and to guide clinical decisions using locally available tests, the primary aim of this study was to compare the diagnostic performance of FIB-4 and APRI scores against FibroScan for cirrhosis detection. Secondary objectives included evaluating the performance of these scores across different patient groups—alcohol users, individuals with chronic hepatitis B or C, and obese or diabetic patients.

Materials and Methods

Nature, Period, and Framework of the Study

This study reports a consecutive series of patients referred for FibroScan between February 2022 and February 2024. Referrals originated from hepato-gastroenterology and endocrinology/diabetology departments across 13 hospitals in the City Province of Kinshasa: Médecins de Nuit, Ngaliema Center, Centre Hospitalier Initiative Plus (CHIP), Centre Hospitalier Universitaire Renaissance (CHUR), Clinique La Vie (CLV), Centre Médical de Kinshasa (CMK), Direction de l'Action Sociale et Sanitaire/CNSS, Hôpital Biamba Marie Mutombo (HBMM), Hj Hospital, Promedis, Vitalia Medical Center, and Yven Clinic. FibroScan assessments were conducted at two sites: Clinique Médecins de Nuit and Ngaliema Medical Center.

Patient Selection

Eligible participants were aged 18 years or older and had a history of diabetes mellitus, obesity, chronic alcohol use, or viral hepatitis B and/or C. Written informed consent was required. Exclusion criteria included pregnancy, hematological disorders, hepatic or extrahepatic tumors, sepsis, and/or hemolysis. Taking into account the number of patients in these hepatology departments and the 5% margin of error, the minimum sample size according to Slovin's formula was 316 patients.

Parameters of Interest

The study collected the following parameters: age, sex, body mass index (BMI), alcohol use, underlying liver disease, aspartate aminotransferase (ASAT) and alanine aminotransferase (ALAT) levels, platelet count, and FibroScan results.

APRI Score

The AST to Platelet Ratio Index (APRI) score was calculated using the formula: APRI = [(patient's ASAT / upper limit of normal ASAT) × 100] / platelet count (10^9/L).[13]

An APRI score < 0.5 suggests a high negative predictive value for liver fibrosis, while a score of ≥ 1.5 indicates a high positive predictive value for liver cirrhosis. Intermediate values are of limited diagnostic utility.[13]

FIB-4 Score

The Fibrosis-4 (FIB-4) score, an algorithmic index combining age, transaminase levels (ASAT and ALAT), and platelet count, was computed as: FIB-4 = (age × ASAT)/[platelet count (10^9/L) × √ALAT].[14]

A FIB-4 score < 1.3 is associated with a high negative predictive value for fibrosis, whereas a score ≥ 2.67 indicates a high positive predictive value for cirrhosis. Intermediate scores are less informative.[14]

FibroScan

We used a FibroScan Mini+430 device in accordance with the manufacturer's guidelines. An M probe was employed for patients with a BMI < 30 kg/m², and an XL probe for those with a BMI ≥ 30 kg/m². Liver stiffness (fibrosis) was assessed by elastography, which evaluates elasticity as a function of depth and time. The FibroScan converts shear wave velocity into kiloPascals (kPa). The final liver stiffness value was calculated as the mean of 10 valid measurements.[4]

For fibrosis, 5 stages were chosen

- F0: elasticity score ≤2.5 kPa, corresponding to absence of fibrosis
- F1: elasticity score between 2.6 kPa and 7 kPa, corresponding to minimal fibrosis
- F2: elasticity score between 7.1 kPa and 9.5 kPa, corresponding to moderate fibrosis
- F3: elasticity score between 9.6 kPa and 14 kPa, corresponding to severe fibrosis
- F4: elasticity score >14 kPa, corresponding to cirrhosis.

Statistical Analyses

Validated data were entered into Excel and analyzed using SPSS version 21.0 and STATA. Qualitative variables are presented as proportions, and quantitative variables as means ± standard deviations (SD) or medians with interquartile ranges (IQR: 25th–75th percentiles). The chi-square test was used to compare categorical variables. For continuous variables, the Student's *t*-test was applied when the distribution was normal, and the Mann–Whitney *U*-test when it was non-Gaussian. The correlation between APRI and FIB-4 scores and liver stiffness measured by FibroScan was evaluated using Pearson's correlation coefficient. Diagnostic performance of APRI and FIB-4 was assessed by calculating sensitivity, specificity, positive predictive value (PPV), and negative predictive value (NPV), using FibroScan as the reference standard. Thresholds for cirrhosis and absence of fibrosis were defined according to literature-based cut-offs. Predictive accuracy for cirrhosis across all thresholds was illustrated using receiver operating characteristic (ROC) curves.

Ethical Considerations

The study complied with ethical principles outlined in the Declaration of Helsinki for research involving human subjects. FibroScan is a non-invasive procedure and poses no risk to patients. Informed consent was obtained from all participants, and confidentiality of personal data was strictly maintained. The study protocol was approved by the Ethics Committee of the School of Public Health, University of Kinshasa, under approval number ESP/CE/143/2024.

Results

General Characteristics of the Study Population

A total of 316 patients were included (60.8% men and 39.2% women), with their clinical and biological characteristics detailed in Table 1. The study population included diabetics (10.1%), obese individuals (37.1%), patients with hepatitis B (14.2%), hepatitis C (6.7%), and alcohol use disorder (25.6%). Laboratory findings revealed thrombocytopenia (18.2%), elevated AST (28.2%), and elevated ALT (29.4%). Compared to women, men were older, consumed more alcohol, had higher mean AST and ALT levels, and lower platelet counts. In contrast, a higher proportion of women were obese.

APRI and FIB-4 and EKPa/FibroScan Scores

APRI, FIB-4, and FibroScan scores indicating no or minimal fibrosis were observed in 81.3%, 63.6%, and 72.8% of patients, respectively. Scores suggestive of cirrhosis were found in 5.4% (APRI), 9.5% (FIB-4), and 11.7% (FibroScan). Intermediate values indicating moderate to severe fibrosis were reported in 13.3% of patients using APRI, 26.9% using FIB-4, and 15.5% using FibroScan, with F2 and F3 stages accounting for 7.6% and 7.9%, respectively (Figure 1).

Figures 2–4 present the median and interquartile ranges (25th–75th percentiles) of FibroScan, APRI, and FIB-4 scores across the entire cohort and subgroups, including alcoholic patients, diabetic/obese patients, and those with chronic hepatitis B and/or C. Diabetic/obese patients showed lower APRI, FIB-4, and liver stiffness (EKPa) values compared to other subgroups.

Table 1 Clinical and Demographic Characteristics of Patients

Variables	All	Men	Women	p
Age, years	48.1 ± 14.1	49.7 ± 13.8	45.8 ± 14.4	0.008
Age <30 years	17 (5.4)	6 (3.1)	11 (8.9)	0.043
30–59 years old	224 (70.9)	135 (70.3)	89 (71.8)	
≥60 years old	75 (23.7)	51 (26.6)	24 (19.4)	
Diabetes mellitus	32 (10.1)	16 (8.3)	16 (12.9)	0.189
Alcohol	81 (25.6)	63 (32.8)	18 (14.5)	<0.001
BMI, kg/m^2	29.0 ± 6.4	27.3 ± 5.2	31.5 ± 7.2	<0.001
<18.5	6 (1.9)	3 (1.6)	3 (2.4)	0.683
18.5–24.4	79 (25.1)	62 (32.5)	17 (13.7)	<0.001
25.0–24.9	113 (35.9)	77 (40.3)	36 (29.0)	0.041
≥30	117 (37.1)	49 (25.7)	68 (54.8)	<0.001
HBs Ag+	45 (14.2)	34 (17.7)	11 (8.9)	0.028
HCV Ab+	21 (6.7)	11 (5.7)	10 (8.1)	0.416
Platelets × $10^6/mm^3$	219.8 ± 95.6	204.4 ± 83.8	243.7 ± 107.5	<0.001
Thrombocytopenia	59 (18.7)	40 (20.8)	19 (15.3)	0.220
ALAT UI/L	22.9 (16.0–36.0)	26.6 (19.2–39.5)	18.5 (13.9–25.0)	<0.001
High ALAT	89 (28.2)	59 (30.7)	30 (24.2)	0.207
ASAT UI/L	21.6 (17.0–31.2)	23.7 (19.0–32.9)	18.8 (16.0–26.4)	<0.001
High ASAT	93 (29.4)	59 (30.7)	34 (27.4)	0.528
Elasticity score, kPa	5.2 (4.2–7.8)	5.5 (4.4–8.7)	5.1 (4.0–6.8)	0.075

Notes: Results are presented as mean ± SD, median with interquartile (25th and 75th percentiles) and as absolute frequencies (%).

Abbreviations: ALAT, alanine aminotransferase; ASAT, aspartate aminotransferase; BMI, body mass index; HBsAg, hepatitis B surface antigen; HCV Ab, hepatitis C virus antibody; kPa, kilopascal.

Performance of APRI and FIB-4 Scores Compared to FibroScan

In the full cohort, APRI scores correlated weakly with FibroScan (r = 0.210), whereas FIB-4 showed a moderate correlation (r = 0.478). Subgroup analysis revealed that FIB-4 correlated with FibroScan only in alcoholic patients and

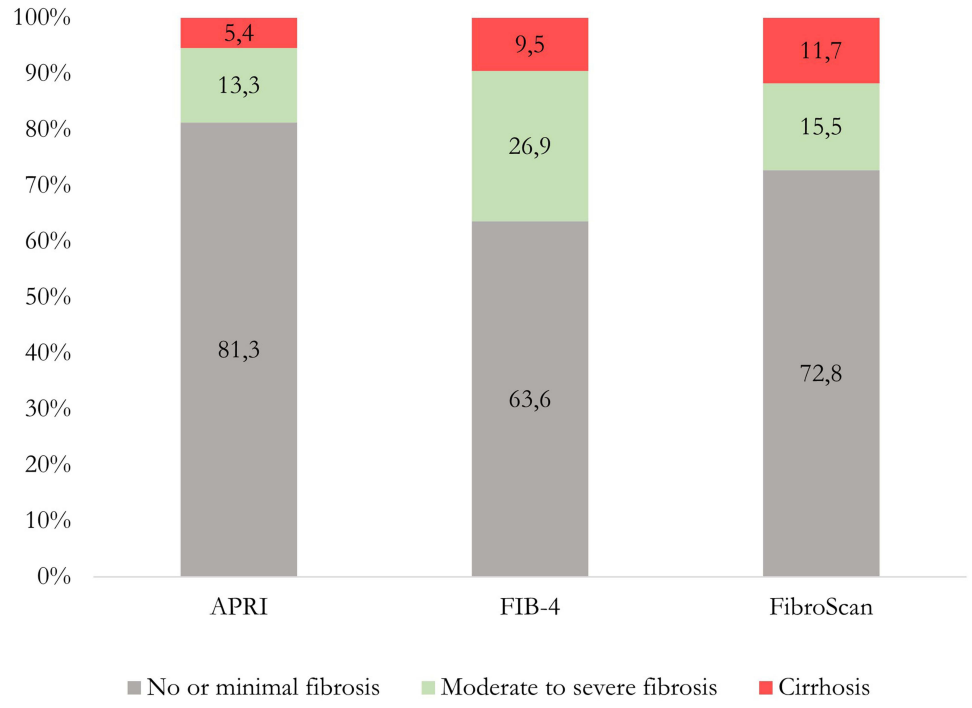

Figure 1 Proportion of patients with mild, moderate to severe fibrosis, or cirrhosis depending on the tests used.

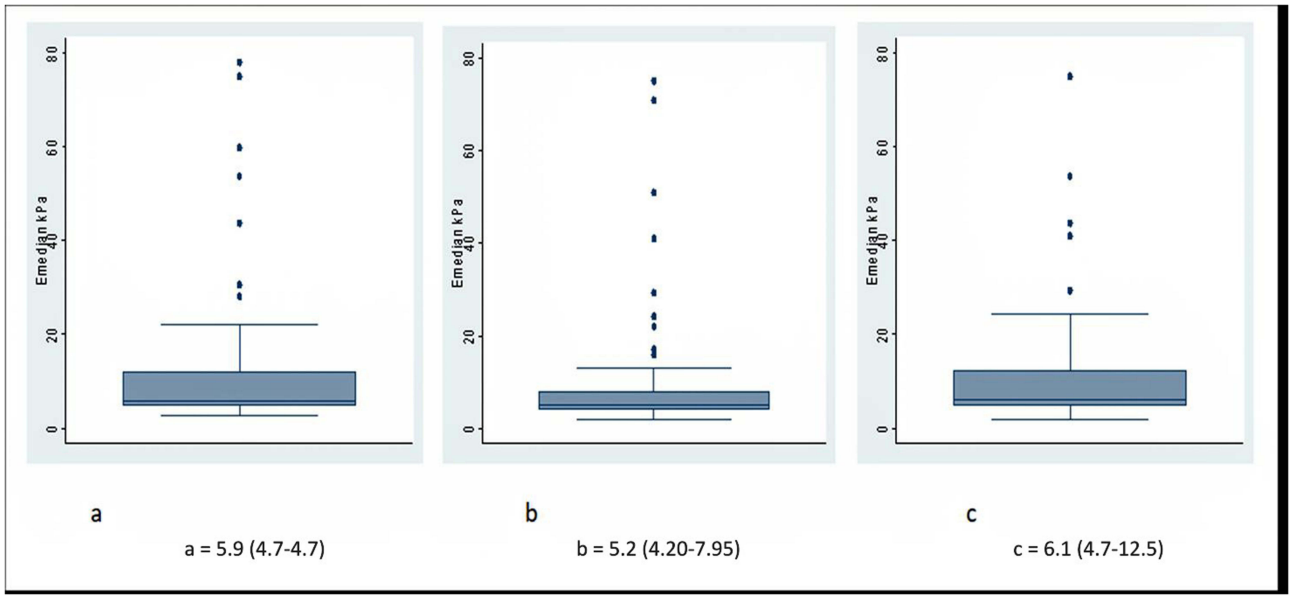

Figure 2 FibroScan of alcoholic (**a**), diabetic/obese (**b**), and hepatitis B/C (**c**) patients.

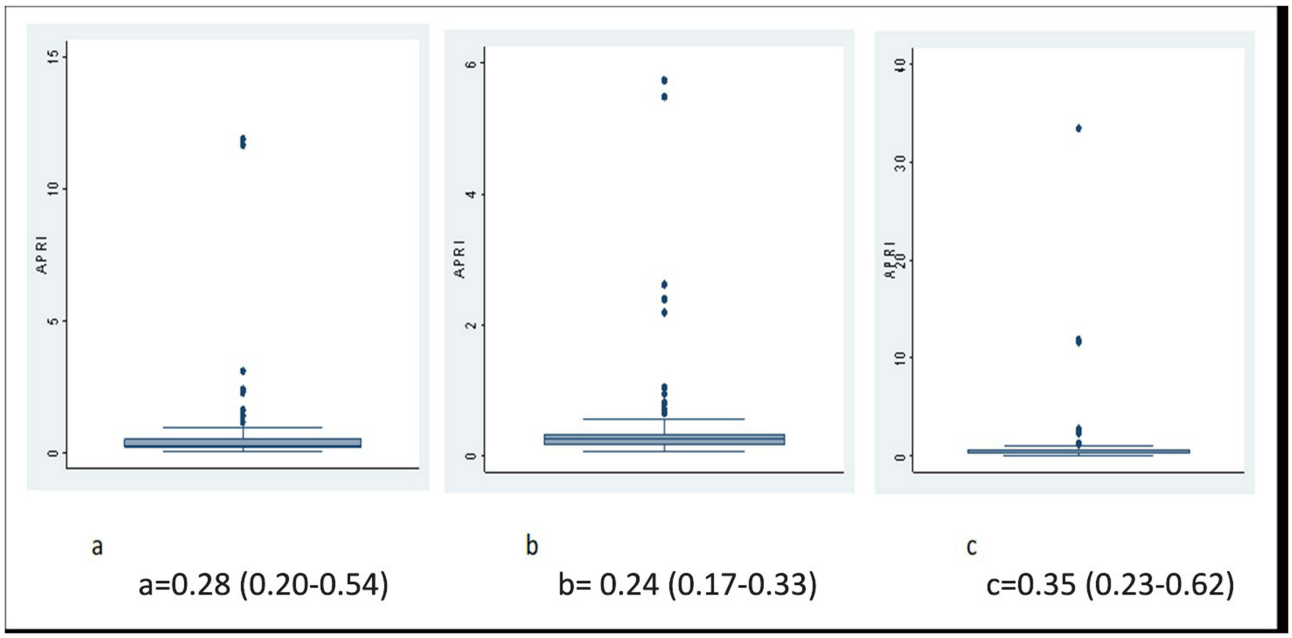

Figure 3 APRI scores of alcoholic (**a**), diabetic/obese (**b**), and hepatitis B/C (**c**) patients.

those with viral hepatitis B and/or C. No significant correlation was observed between APRI and FibroScan in alcoholic patients (Table 2).

Table 3 summarizes the diagnostic performance of APRI thresholds < 0.5 and ≥ 1.5, which are conventionally used to predict the absence of fibrosis and presence of cirrhosis, respectively. Sensitivity, specificity, positive predictive value (PPV), and negative predictive value (NPV) are reported in comparison to FibroScan classifications of normal liver stiffness (F0–F1) and cirrhosis (F4).

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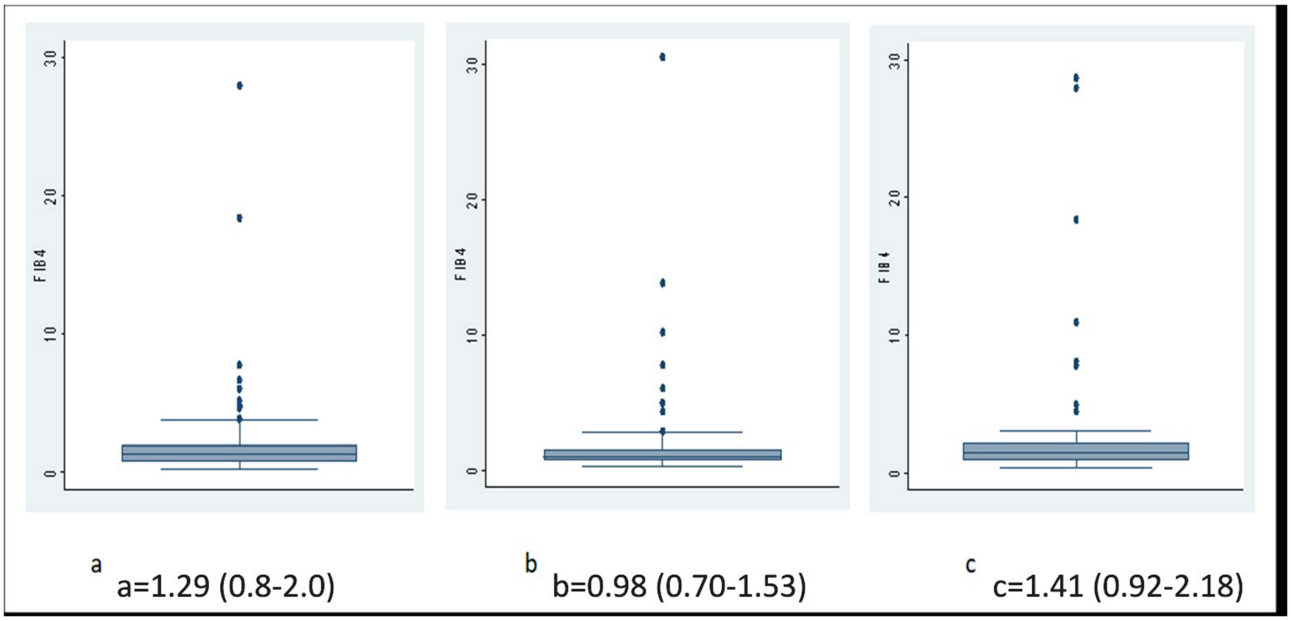

Figure 4 FIB-4 scores of alcoholic (**a**), diabetic/obese (**b**), and hepatitis B/C (**c**) patients.

At the thresholds of FIB-4 scores < 1.3 and ≥ 2.67 predictors of absence of fibrosis and cirrhosis respectively, Table 4 reports the sensitivity, specificity, PPV and NPV compared to the thresholds of normal FibroScan (F0 and F1) or suggestive of liver cirrhosis (F4).

Table 2 Pearson Correlation of APRI and FIB-4 Scores with FibroScan

	All	Diabetes/Obese	Chronic Alcoholism	Hepatitis B/C
APRI r	0.210	0.126	0.558	0.196
p	<0.001	0.165	<0.001	0.115
FIB-4 r	0.448	0.153	0.628	0.680
p	<0.001	0.092	<0.001	<0.001

Table 3 Performance of APRI Score Results Compared to FibroScan

	Prediction of Normal Liver	Prediction of Cirrhosis
Sensitivity	91.2	29.7
Specificity	45.5	97.9
PPV	81.3	64.7
NPV	66.7	91.3

Table 4 Performance of FIB-4 Score Results Compared to FibroScan Results

	Prediction of Normal Liver	Prediction of Cirrhosis
Sensitivity	74.2	60.0
Specificity	66.3	93.3
PPV	85.5	48.6
NPV	49.5	95.6

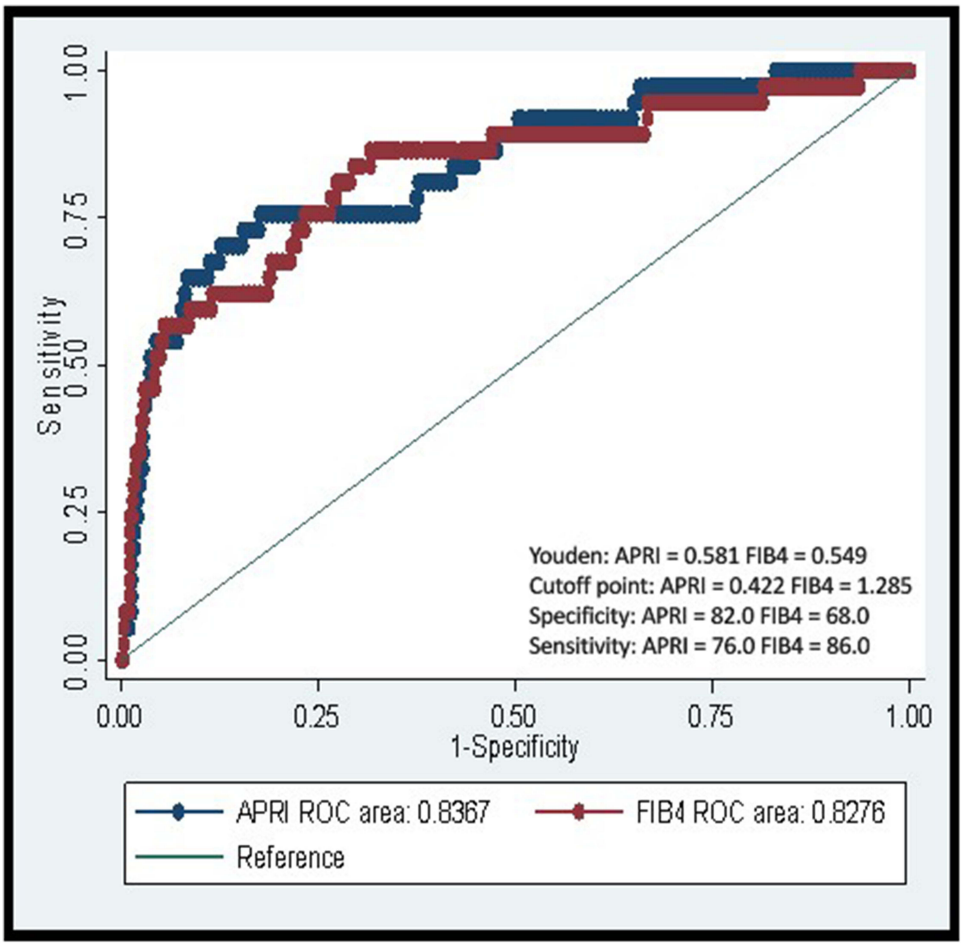

Figure 5 APRI and FIB-4 score thresholds predicting cirrhosis/FibroScan in the entire group.

Predictive accuracy for cirrhosis across all thresholds was illustrated using receiver operating characteristic (ROC) curves (Figures 5–7).

Discussion

Our findings demonstrate that, although APRI and FIB-4 scores correlate with FibroScan in this population, the conventional thresholds used to detect cirrhosis lack sensitivity but maintain good specificity. Diagnostic performance was higher in alcoholic and viral hepatitis B/C patients, but notably poor in obese and diabetic individuals.

The APRI and FIB-4 scores are derived from blood levels of platelets and transaminases (ALAT and ASAT). It is well established that patients with minimal or moderate liver fibrosis are typically asymptomatic. As fibrosis progresses to cirrhosis, clinical signs often remain absent for years before becoming apparent at advanced stages.[15] While ALAT is relatively specific to liver pathology, elevated ASAT can result from a range of conditions affecting the blood, skeletal muscle, heart, kidneys, brain, and pancreas.[16] These factors contribute to the low sensitivity observed with APRI and FIB-4. In this context, our findings are consistent with previous studies showing that APRI and FIB-4 are not reliable alternatives to either liver biopsy or FibroScan for the screening of liver fibrosis and cirrhosis.[9–14]

A high specificity observed between these two tests and FibroScan—approaching unity—suggests that when these tests are positive, they reliably identify patients with liver cirrhosis. This finding is consistent with previous literature[9–14] and can be attributed to the fact that thrombocytopenia, the most common cytopenia in cirrhosis, along with elevated transaminases, are markers of advanced disease.[15] While splenic sequestration of platelets increases in the context of splenomegaly due to portal hypertension, thrombocytopenia in advanced cirrhosis is primarily caused by reduced hepatic

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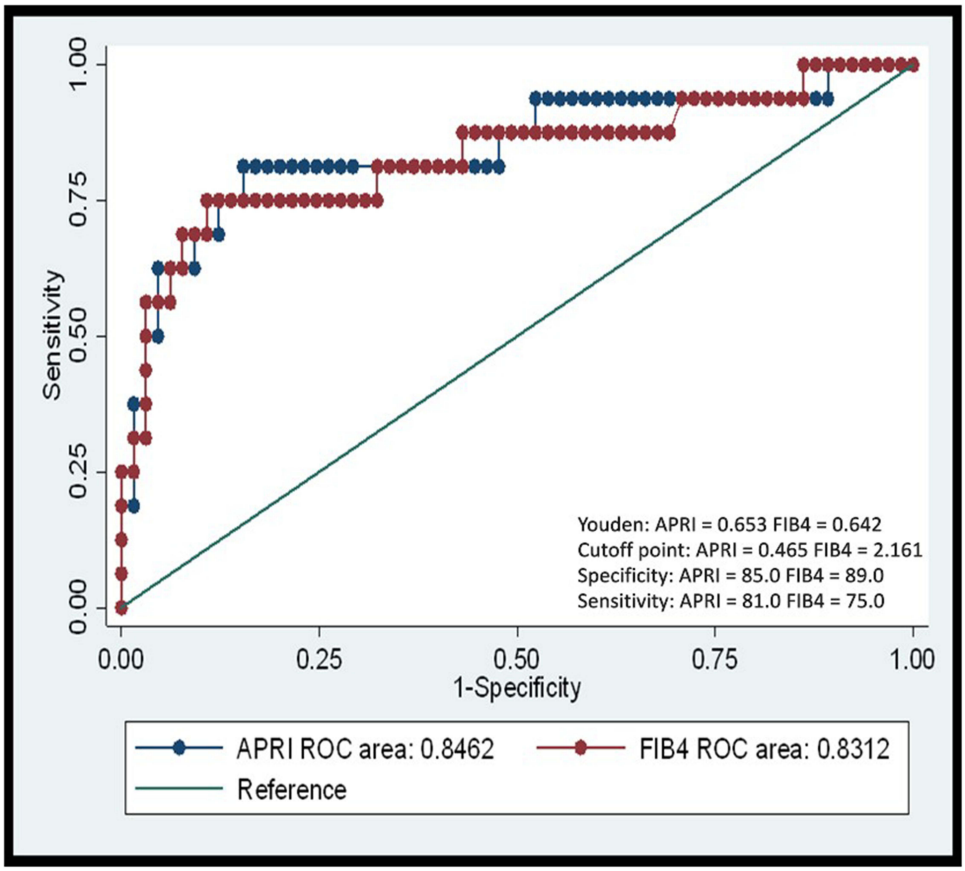

Figure 6 APRI and FIB-4 score thresholds predicting cirrhosis/FibroScan in alcoholics.

production of thrombopoietin, leading to decreased platelet synthesis, rather than splenic pooling.[17] The use of ASAT in the numerator of the APRI formula, and its placement above ALAT in the FIB-4 ratio, warrants discussion given ALAT's greater specificity for hepatic injury. Prioritizing ALAT over ASAT, in our view, may enhance the specificity of these two tests.

Multiple Western studies have found the APRI and FIB-4 tests to be more effective in patients with hepatitis C.[18,19] Indeed, most alternative biomarkers to liver biopsy were initially developed and validated in the context of hepatitis C. Although these tests are also employed in other liver diseases—such as hepatitis B, MASH, and alcoholic liver disease—their interpretation is more complex in these contexts. In our study, the FIB-4 test demonstrated good correlation with FibroScan in patients with alcoholic liver disease and in those with a history of hepatitis B or C. The APRI test, however, showed a statistically significant correlation with FibroScan only among alcoholic patients. Nonetheless, the relatively small sample sizes within these subgroups preclude definitive conclusions.

Few studies have examined the diagnostic performance of APRI and FIB-4 in obese or diabetic populations.[20] One such study reported that the ALAT/ASAT ratio, FIB-4, and the NAFLD fibrosis score can reliably rule out advanced fibrosis in a substantial proportion of MASH patients, thereby supporting a more selective use of liver biopsy.[21] Tests such as FibroTest, ActiTest®, AshTest®, and newer-generation diagnostics including NashTest 2 and SteatoTest 2 may be more appropriate for evaluating patients with MASH, as well as those with viral hepatitis and/or alcoholic liver disease.[20,21]

At the EKPa/FibroScan thresholds indicative of cirrhosis, the areas under the ROC curve (AUROCs) for APRI and FIB-4 were 0.8462 and 0.8312, respectively—values consistent with those reported in the literature.[22,23] However, the APRI and FIB-4 thresholds predicting cirrhosis and the absence of liver fibrosis in our study were lower than those found in prior studies.[9–14,22,23] This discrepancy suggests that the thresholds for these scores should be adjusted downward in

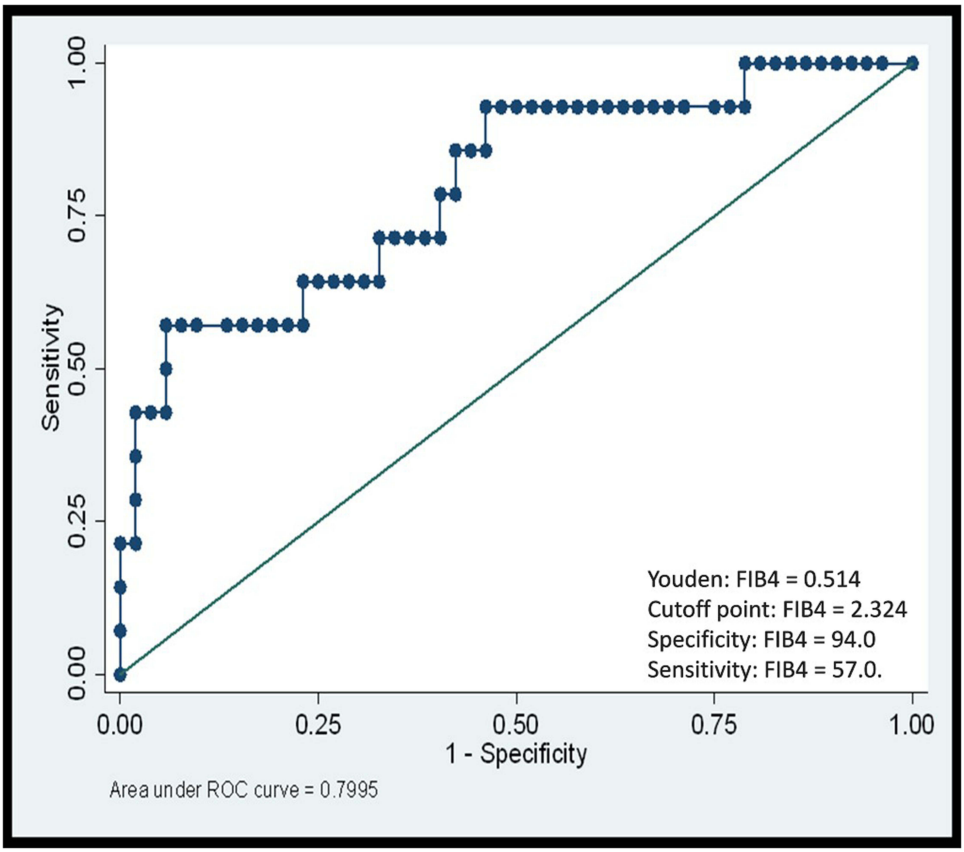

Figure 7 FIB-4 score thresholds predicting cirrhosis/FibroScan in patients with viral hepatitis B/C.

our population. Including more patients with decompensated cirrhosis might have aligned our results more closely with existing data. Conversely, raising the thresholds would delay the identification and management of cirrhosis-related complications, since the markers used in these scores—platelets, ALT, and AST—tend to reflect advanced disease rather than its onset. A recent meta-analysis in African populations showed that the WHO-recommended APRI and FIB-4 thresholds are excessively high in sub-Saharan African populations. For APRI, a lower threshold had been proposed to predict cirrhosis in black populations (> 0.65), which appears to corroborate our results.[24]

Our study has several limitations that must be considered when interpreting the findings. First, the sample size was relatively small. Second, FibroScan assessments were performed by multiple operators. Third, PBH did not perform the measurements. Despite these limitations, this is the first study to evaluate these non-invasive tests in the Democratic Republic of Congo. It contributes to defining the role of APRI and FIB-4 and highlights the diagnostic value of FibroScan, particularly for the early detection of liver fibrosis.

Conclusion

Although APRI and FIB-4 correlated well with FibroScan results, their accuracy in detecting cirrhosis in Congolese patients was limited. Nevertheless, both tests showed good specificity, performing better in patients with alcohol-related liver disease and viral hepatitis B or C than in those with diabetes or obesity. Our findings support the need to lower APRI and FIB-4 thresholds for predicting cirrhosis in this population.

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Author Contributions

All authors made a significant contribution to the work reported, whether that is in the conception, study design, execution, acquisition of data, analysis and interpretation, or in all these areas; took part in drafting, revising or critically reviewing the article; gave final approval of the version to be published; have agreed on the journal to which the article has been submitted; and agree to be accountable for all aspects of the work.

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Disclosure

The authors declare that the research was conducted without any commercial or financial relationships that could be viewed as a potential conflict of interest.

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