RESEARCH PAPER

Diagnostic Performance of Non-Invasive Fibrosis Scores for Detection of Advanced Fibrosis in Indian Patients with NAFLD: A Systematic Review

Dr. Samadhi Charan Venkata Siva Saikumar[1], Dr. Nadipally Sai Rohith[2], Dr. Subramaniyan Kumarasamy MD[3]

[1] Postgraduate, SRM Medical College Hospital and Research Centre, Kattankulathur.
Email: scvssk005@gmail.com

[2] Postgraduate, SRM Medical College Hospital and Research Centre, Kattankulathur.
Email: Rohi.nadipally@gmail.com

[3] Professor, Dept of General Medicine, SRM Medical College Hospital and Research Centre.
Email: subramak1@srmist.edu.in

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ABSTRACT

Background: Metabolic dysfunction-associated steatotic liver disease (MASLD) is highly prevalent in India and is frequently associated with metabolic comorbidities such as type 2 diabetes mellitus and obesity. Early identification of advanced fibrosis is critical for risk stratification and management; however, liver biopsy remains impractical for large-scale screening. Non-invasive fibrosis scores such as Fibrosis-4 (FIB-4), NAFLD fibrosis score (NFS), and AST-to-platelet ratio index (APRI) have emerged as accessible alternatives, though their diagnostic performance in Indian populations remains variable.

Objective: To systematically evaluate the diagnostic performance of non-invasive fibrosis scores for detecting advanced fibrosis among Indian patients with MASLD/NAFLD.

Methods: A systematic literature review was conducted using PubMed to identify relevant studies published between January 2024 and March 2026. Eligible studies included original research conducted in Indian adult populations with MASLD/NAFLD, evaluating non-invasive fibrosis scores against FibroScan or liver biopsy. Data on study characteristics, index tests, fibrosis cut-offs, and diagnostic performance metrics (sensitivity, specificity, AUC) were extracted and synthesized qualitatively.

Results: Six studies comprising 2,932 patients were included. FIB-4 was evaluated in all studies, demonstrating sensitivity ranging from 67.2% to 85.3% and specificity from 13.7% to 80.4%, with AUC values between 0.607 and 0.806. NFS and APRI showed comparable but variable performance, with NFS demonstrating higher sensitivity in diabetic cohorts and APRI showing relatively higher specificity in some populations. Considerable heterogeneity was observed in fibrosis cut-off thresholds (≥8 to ≥13.1 kPa) and study populations, contributing to variability in diagnostic accuracy.

Conclusion: Non-invasive fibrosis scores demonstrate moderate and variable diagnostic performance in Indian MASLD/NAFLD populations. While FIB-4 remains the most widely used screening tool, its accuracy is influenced by metabolic factors such as diabetes and obesity. A stepwise approach incorporating elastography is essential for optimal risk stratification in clinical practice.

Keywords: NAFLD, MASLD, Fibrosis-4, NAFLD Fibrosis Score, APRI, Non-invasive, Systematic Review, Indian Population.

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Introduction

Metabolic dysfunction-associated steatotic liver disease (MASLD) has emerged as a public health challenge of the 21st century. Recent estimates suggest that it affects more than one-third of the global population, and the prevalence rises to nearly 70 % among individuals with type 2 diabetes mellitus (T2DM) or obesity [1]. Such figures reflect lifestyle changes linked to urbanization, sedentary behavior and dietary excesses. MASLD is often

asymptomatic until advanced stages, making early detection essential to prevent progression to fibrosis, cirrhosis and hepatocellular carcinoma (HCC) [2]. Recognizing the metabolic basis of this condition, international consensus has replaced the term "non-alcoholic fatty liver disease" (NAFLD) with "steatotic liver disease" (SLD); MASLD represents the most prevalent form of SLD [3]. A recent meta-analysis of over 11 million individuals reported a pooled global SLD prevalence of 37.5 %, while the prevalence reached 70.2 % among those with T2DM and 70.7 % among overweight/obese people. These statistics underscore the metabolic underpinnings of MASLD and highlight its syndemic interaction with obesity and diabetes [4].

The clinical consequences of MASLD are profound. Steatosis can progress to inflammation, fibrosis and eventually cirrhosis or HCC [5]. In fact, MASLD has become the fastest growing cause of hepatocellular carcinoma in several countries and is now the leading etiology of HCC in Sweden. Liver biopsy remains the gold standard for staging fibrosis, but its invasive nature, potential sampling error and prohibitive cost render it unsuitable for widespread screening. This has stimulated interest in non-invasive tests such as serum-based indices (e.g. Fibrosis-4 [FIB-4], NAFLD fibrosis score [NFS] and APRI), elastography and emerging biomarkers, which offer pragmatic alternatives for community-level risk assessment [1]. Current guidelines advocate a stepwise approach in which simple scores are applied in primary care to triage patients who then undergo imaging or specialist evaluation; however, globally there remains no formal recommendation for MASLD screening in the general population.

The burden of MASLD in India is particularly concerning. Data from the national Phenome India cohort reveal an age-adjusted MASLD prevalence of 38.9 %, with 33 % of females and 45.9 % of males affected. The study also reported that the crude prevalence of liver fibrosis was 3.9 % overall and 6.3 % among individuals with MASLD, underscoring the silent progression of the disease [6]. Globally, NAFLD prevalence varies by region—Latin America (44 %), the Middle East and North Africa (36.5 %), South Asia (33.8 %) and Western Europe (25 %)—and India's pooled NAFLD prevalence is about 38.6 %. Urban cohorts in Delhi and Chennai report steatosis in over half of adults, and 6.3 % of MASLD patients have significant fibrosis [7–10]. Notably, individuals with metabolic comorbidities are disproportionately affected: two-thirds (66.4 %) of diabetics in the Phenome cohort had MASLD and 9.1 % had fibrosis, while among overweight and obese MASLD patients the prevalence of fibrosis was roughly 6.5 % [11].

Together, these statistics demonstrate that MASLD is highly prevalent in India and often progresses silently to advanced fibrosis, particularly in people with diabetes, obesity or other components of metabolic syndrome. Despite this, most Indian data derive from hospital-based cohorts, and the diagnostic performance of widely used non-invasive scores in the Indian context remains unclear. Given the massive pool of undiagnosed MASLD and the limited accessibility of liver biopsy, there is a pressing need to evaluate simple, cost-effective non-invasive fibrosis scores in Indian populations to guide resource-appropriate screening strategies. The present systematic review addresses this gap by synthesizing evidence on the diagnostic performance of FIB-4, NFS and APRI for detecting advanced fibrosis among Indian patients with MASLD or NAFLD.

METHODOLOGY

Study Design and Reporting Framework

This systematic literature review was conducted to evaluate the diagnostic performance of non-invasive fibrosis scores for detecting advanced fibrosis among Indian patients with non-alcoholic fatty liver disease (NAFLD) or metabolic dysfunction–associated steatotic liver disease (MASLD). The review was designed and reported in accordance with the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) 2020 guidelines. A time-restricted approach was adopted to ensure inclusion of the most recent evidence reflecting current diagnostic practices and evolving epidemiology of NAFLD in the Indian population.

Eligibility Criteria

Studies were considered eligible if they were original research articles conducted in Indian populations and included adult patients (≥18 years) diagnosed with NAFLD or MASLD based on imaging modalities such as ultrasound or FibroScan, or on clinical criteria. Only studies evaluating at least one non-invasive fibrosis score, including Fibrosis-4 (FIB-4), NAFLD Fibrosis Score (NFS), AST to Platelet Ratio Index (APRI), BARD score, or other validated scoring systems, were included. Eligible studies were required to report diagnostic performance outcomes such as sensitivity,

specificity, area under the receiver operating characteristic curve (AUC/ROC), or predictive values, and must have used FibroScan (vibration-controlled transient elastography) or liver biopsy as the reference standard for fibrosis assessment.

Studies published between January 2024 and March 2026 were included to ensure contemporaneity of evidence. Only full-text articles published in English and indexed in PubMed were considered. Review articles, systematic reviews, meta-analyses, editorials, case reports, conference abstracts, and studies lacking diagnostic performance data were excluded. Studies conducted outside India or involving mixed populations without extractable Indian-specific data were also excluded.

PICO Framework

The research question was structured using the Population, Intervention, Comparator, and Outcome (PICO) framework to ensure clarity in study selection and data extraction.

Table 1: PICO framework

Component	Description	Search Terms
Population	Adult Indian patients diagnosed with NAFLD or MASLD	"NAFLD", "MASLD", "fatty liver", "India", "Indian population"
Intervention	Non-invasive fibrosis scoring systems including FIB-4, NFS, APRI, BARD, and related indices	"FIB-4", "NAFLD fibrosis score", "APRI", "BARD", "non-invasive score"
Comparator	FibroScan (VCTE) or liver biopsy as reference standard	"FibroScan", "transient elastography", "liver stiffness", "biopsy"
Outcome	Detection of advanced fibrosis (≥F3 or defined LSM thresholds), diagnostic accuracy measures	"advanced fibrosis", "sensitivity", "specificity", "AUC", "ROC"

Search Strategy

A comprehensive literature search was conducted using **PubMed** as the primary database to identify relevant studies evaluating the diagnostic performance of non-invasive fibrosis scores in Indian patients with NAFLD or MASLD. The search strategy combined Medical Subject Headings (MeSH) and free-text terms related to the disease condition, non-invasive diagnostic tools, fibrosis assessment, and the Indian population. Boolean operators ("AND", "OR") were used to combine search terms appropriately, and truncation and synonyms were applied where relevant to maximize retrieval of eligible studies.

The search was restricted to studies published between **January 2024 and March 2026**, limited to **human studies and English language publications**. Additional manual screening of reference lists of included studies was performed to identify any potentially relevant articles not captured through the electronic search.

Table 2: Comprehensive PubMed search strategy outlining the conceptual framework, associated keywords, and Boolean operators used to retrieve relevant studies

Concept	**Keywords / Terms**	**Boolean Logic**
Disease	"NAFLD", "Non-alcoholic fatty liver disease", "MASLD", "Metabolic dysfunction-associated steatotic liver disease"	OR
Fibrosis / Outcome	"fibrosis", "advanced fibrosis", "liver fibrosis", "hepatic fibrosis"	OR
Index Tests	"FIB-4", "Fibrosis-4", "NAFLD fibrosis score", "NFS", "APRI", "BARD", "non-invasive score", "noninvasive marker"	OR
Diagnostic Accuracy	"diagnostic accuracy", "sensitivity", "specificity", "ROC", "AUC", "predictive value"	OR
Population	"India", "Indian population"	OR

Study Selection Process

All identified records were screened independently based on titles and abstracts to assess eligibility. Studies that met the inclusion criteria or were

deemed potentially relevant were retrieved in full text for further evaluation. Full-text articles were assessed against predefined eligibility criteria, and studies not meeting these criteria were excluded with documented reasons. The final selection of studies was included in the qualitative synthesis, and the study selection process was documented using a PRISMA flow diagram.

Data Extraction

Data were extracted using a standardized data extraction framework to ensure consistency across studies. Extracted variables included study characteristics such as author, year of publication, study design, setting, sample size, and population demographics. Additional data included details of NAFLD diagnosis, type of non-invasive fibrosis scores evaluated, reference standards used, fibrosis cut-off values, and reported diagnostic performance outcomes including sensitivity, specificity, and AUC values. Data extraction was performed carefully to ensure accuracy and completeness of information relevant to the study objectives.

Data Synthesis

A qualitative synthesis approach was adopted due to heterogeneity in study design, population characteristics, and reported diagnostic thresholds across included studies. Diagnostic performance of non-invasive fibrosis scores was summarized using descriptive comparisons of sensitivity, specificity, and AUC values across studies. Results were presented in structured tables and synthesized narratively to highlight patterns, variability, and consistency in diagnostic performance within the Indian population. No meta-analysis was performed due to variability in methodologies and reporting across studies.

Results:

Study Selection

A total of 186 records were identified through PubMed database searching. After removal of duplicates (n = 32), 154 records were screened based on title and abstract. Of these, 121 studies were excluded due to irrelevance, non-Indian populations, or absence of diagnostic performance data. Full-text assessment was performed for 33 articles, of which 27 were excluded due to review design, lack of FibroScan or biopsy comparison, or incomplete reporting of diagnostic outcomes. Finally, 6 studies met the predefined eligibility criteria and were included in the qualitative synthesis.

Study Characteristics

A total of **6 studies comprising 2,932 patients** were included in the analysis. Sample sizes ranged from 130 to 1,070 participants. The majority of studies were cross-sectional in design, including both single-center and multicentric studies, with one prospective observational study and one retrospective observational study.

Most studies were conducted in tertiary care settings across India, including Kochi, Chennai, New Delhi, and West Bengal, with multicentric representation in two studies involving multiple diabetes or tertiary centers. The included populations comprised both general NAFLD/MASLD patients and high-risk subgroups, particularly individuals with type 2 diabetes mellitus. The mean or median age ranged from approximately 43 to 59 years, with male predominance across studies (56%–81%). Common comorbidities included type 2 diabetes mellitus, hypertension, obesity, dyslipidemia, and metabolic syndrome, reflecting the underlying metabolic risk profile of the studied populations. NAFLD or MASLD diagnosis was primarily based on imaging modalities such as ultrasound or FibroScan, along with clinical and metabolic criteria. All studies utilized FibroScan as the reference standard for fibrosis assessment. The detailed characteristics of the included studies are summarized in Table 1.

Index Tests and Reference Standards

Across the included studies, the most commonly evaluated non-invasive fibrosis score was FIB-4, assessed in all five studies. APRI and NAFLD fibrosis score (NFS) were evaluated in four and three studies, respectively. Additional indices such as fibrotic NASH index (FNI) and composite or novel scores were reported in individual studies but were not consistently evaluated across studies. FibroScan (vibration-controlled transient elastography) was used as the reference standard in all included studies. None of the studies utilized liver biopsy as a reference standard. Liver stiffness measurement (LSM) thresholds were used to define fibrosis stages, with variation observed across studies.

Score-wise Diagnostic Performance

The diagnostic performance of non-invasive fibrosis scores demonstrated variability across studies. FIB-4 was evaluated in all five studies and showed sensitivity ranging from 67.2% to 85.3%, while specificity ranged from 13.7% to 80.4%. The AUC values for FIB-4 varied between 0.607 and 0.806, indicating moderate to good discriminatory ability. In diabetic populations, FIB-4 demonstrated higher sensitivity but markedly lower specificity compared

to non-diabetic cohorts. The NAFLD fibrosis score (NFS) was evaluated in three studies and demonstrated sensitivity up to 84.1%, with AUC values generally above 0.70 in certain studies. However, variability in performance was observed across different study populations. APRI was evaluated in four studies and demonstrated sensitivity ranging from approximately 62% to 82%, with specificity reaching up to 84.4% in some studies. AUC values for APRI ranged from approximately 0.62 to 0.77, reflecting moderate diagnostic accuracy.

Comparative Diagnostic Performance

Comparative evaluation across studies indicated that no single non-invasive fibrosis score consistently demonstrated superior diagnostic performance across all populations. FIB-4 was the most frequently studied score and showed relatively consistent performance, particularly in terms of sensitivity, although specificity varied considerably. NFS demonstrated higher sensitivity in some studies, particularly in diabetic populations, while APRI showed relatively higher specificity in certain cohorts. In one study, APRI demonstrated the highest AUC compared to FIB-4 and NFS, whereas in another study, FIB-4 and NFS showed better discriminatory ability than APRI. Overall, variability in performance across scores was evident, with differences observed depending on study population, particularly in cohorts with high prevalence of metabolic risk factors.

Variability in Fibrosis Cut-offs

Considerable variability was observed in the liver stiffness measurement thresholds used to define advanced fibrosis across studies. Cut-off values ranged from ≥8.0 kPa to ≥13.1 kPa. Some studies defined significant fibrosis at lower thresholds (e.g., ≥8.0–8.2 kPa), whereas others used higher thresholds such as ≥9.7 kPa or ≥13.1 kPa for defining advanced fibrosis. This variation in cut-off values reflects differences in study design, patient populations, and institutional practices, and contributes to heterogeneity in reported diagnostic performance across studies.

Correlation with FibroScan

All included studies assessed the performance of non-invasive fibrosis scores in comparison with FibroScan-derived liver stiffness measurements. A positive association between higher fibrosis scores and increased liver stiffness was observed across studies. However, the strength of agreement varied. In some studies, moderate agreement between FIB-4 and FibroScan was observed, while in others, particularly in diabetic populations, poor agreement was reported despite high sensitivity. Correlation coefficients were not uniformly reported across studies, but overall trends indicated that higher score values were associated with increased likelihood of advanced fibrosis as defined by FibroScan.

Author (Year)	Study Design	Setting	n	Population	Age	Male %	Comorbidities	NAFLD Diagnosis	Index Tests	Reference Standard	Fibrosis Cut-off	Outcomes
Joseph et al. (2026) [12]	Cross-sectional	Tertiary care center, Kochi (India)	300	MASLD patients (adults 30–70 years)	52.4 ± 11.2	79.0%	T2DM (62.3%), Hypertension (67.7%), Dyslipidemia (81.7%)	Imaging-based diagnosis of MASLD + metabolic dysfunction criteria	FIB-4, APRI, NLR, PLR, NPAR	FibroScan (VCTE: LSM + CAP)	Advanced fibrosis: F3–F4 vs F0–F2 (LSM: F3 ≥9.1 kPa, F4 ≥10.4 kPa)	FIB-4: AUC 0.806, Sens 69.2%, Spec 80.4%; APRI: AUC 0.772, Sens 82.0%, Spec 62.7%
Sanyal et al. (2025) [13]	Cross-sectional, multicentric	8 diabetes centers, West Bengal (India)	351	T2DM patients with NAFLD	51 ± 9	56%	T2DM (100%), elevated BMI (25.8 ± 4.2), dysglycemia	Imaging + clinical NAFLD diagnosis	FIB-4, NFS, FNI, APRI	FibroScan (VCTE)	Advanced fibrosis ≥F3 (LSM ≥13.1 kPa); Significant fibrosis ≥F2 (≥10 kPa)	FIB-4 & NFS: AUROC >0.8 for advanced fibrosis; APRI lower accuracy
Bhayani et al. (2024) [14]	Prospective observational	Apollo Hospitals, Chennai (India)	130	NAFLD patients (adult)	Not explicitly reported (range-based	76.9%	Metabolic syndrome (65.4%), Diabetes (36.9%),	Ultrasound-based NAFLD diagnosis	FIB-4, NFS, APRI	FibroScan (VCTE)	Advanced fibrosis ≥F3 (LSM ≥9.7 kPa)	APRI: AUC 0.768 (best); NFS:

					distribution)		Obesity (90.8%)					0.714; FIB-4: 0.675
Bhuvaneswar et al. (2025) [15]	Retrospective observational	Two tertiary diabetes centers, Chennai (India)	1070	T2DM patients (Asian Indian population)	55.1 ± 11.5	~63% (male predominant)	T2DM (100%), obesity (BMI 27.9 ± 4.8), metabolic risk factors	Clinical + FibroScan-based MASLD identification	FIB-4, NFS, APRI	FibroScan (VCTE)	Advanced fibrosis ≥F3 (LSM ≥9.7 kPa)	NFS: Sens 84.1% (highest); FIB-4: Sens 67.2%; APRI: Spec 84.4% (highest)
Kumar et al. (2024) [16]	Retrospective observational	Sir Ganga Ram Hospital, New Delhi (India)	609	MASLD patients (adult OPD cohort)	Median 43 years	81%	T2DM (24%), Hypertension (33%), High visceral fat	Imaging-based MASLD diagnosis	FIB-4, APRI, NFS (compared with DVF15 score)	FibroScan (VCTE)	Significant fibrosis ≥8.2 kPa	FIB-4: AUC 0.607; APRI: 0.620; NFS: 0.613
Datta et al. (2025) [17]	Multicentric cross-sectional (prospective data)	3 tertiary centers (Kolkata, Chennai, Kolkata)	472	T2DM and non-T2DM MASLD patients (propensity-matched)	~59 years	~70%	T2DM (50% cohort), Hypertension, Dyslipidemia, Elevated BMI	Ultrasound / ALT-based MASLD diagnosis	FIB-4	FibroScan (VCTE)	Significant fibrosis ≥8 kPa	FIB-4: Sens 85.3%, Spec 13.7% (T2DM); AUC ~0.62

Interpretation of the Findings

The six included Indian studies collectively enrolled nearly 3 000 participants and evaluated non-invasive fibrosis scores—primarily FIB-4, NAFLD fibrosis score (NFS) and APRI—against FibroScan-derived liver stiffness. These studies demonstrated that FIB-4 was the most frequently assessed index and generally achieved moderate diagnostic accuracy: sensitivity ranged from 67 % to 85 %, while specificity varied widely from 14 % to 80 %. APRI and NFS also showed moderate performance but tended to trade sensitivity for specificity. A recent meta-analysis provides context for these observations: when FIB-4 was evaluated across multiple international cohorts, low cut-off values (around 1.3–1.67) produced a pooled sensitivity of 0.74 and specificity of 0.62, whereas high cut-off values (2.67–3.25) reduced sensitivity to 0.33 but increased specificity to 0.92 [18]. This trade-off mirrors the variable performance seen in the Indian studies and underscores that no single score consistently outperforms others across all populations. The broad range of liver stiffness thresholds used by Indian investigators (≥8 kPa to ≥13.1 kPa) further contributes to variability in reported performance.

Comparison with Past Evidence and Guidelines

Global practice guidelines and observational studies help to contextualise these findings. European and primary-care guidelines recommend FIB-4 and NFS as first-line screening tools because they use routine biomarkers—age, aspartate aminotransferase, alanine aminotransferase and platelet count for FIB-4; and BMI, impaired fasting glucose/diabetes and serum albumin additionally for NFS—making them inexpensive and widely available [1]. Both scores, however, have limited sensitivity and specificity when used alone, prompting recommendations for sequential strategies: patients are initially triaged with a simple score and those with intermediate or high values proceed to imaging-based techniques such as vibration-controlled transient elastography (VCTE) [19]. The same guidelines acknowledge that APRI, although less validated in NAFLD, correlates significantly with FibroScan measurements and can serve as a surrogate marker when elastography is unavailable [20].

Recent reviews highlight important nuances. Low cut-offs for FIB-4 (<1.3) and NFS (<–1.455) provide high sensitivity to rule out advanced fibrosis, whereas high cut-offs (≥3.25 and >0.676, respectively) provide high specificity to rule in disease; about one-third of patients, however, fall into a grey zone between these thresholds [21–23]. Obesity appears to attenuate test performance: in one prospective study, the area under the ROC curve for FIB-4 declined from 0.97 to 0.84 in obese individuals and for NFS from 0.97 to 0.80. Such data resonate with the Indian findings where cohorts with high body-mass index or prevalent metabolic syndrome showed lower AUC values [24–26]. The AASLD practice guidance also summarises that FIB-4 values <1.3 and NFS values <−1.44 suggest low risk, whereas FIB-4 ≥2.67 and NFS ≥0.672 indicate high risk; nevertheless, these scores are not considered accurate in patients younger than 35 years, with obesity or with type 2 diabetes. This recommendation aligns with the Indian studies' inconsistent performance in diabetic cohorts.

Mechanisms Underlying Score Performance

Understanding why these scores behave differently helps interpret the Indian data. FIB-4 includes age in its numerator; as a result, older age alone increases the score and may generate false positives in elderly patients, whereas younger patients—even with significant fibrosis—may have low scores. NFS adds BMI and diabetes, factors that directly reflect metabolic burden but may also blunt specificity in lean individuals. A meta-analysis focused on diabetic NAFLD patients found that even those with FIB-4 values below 1.3 can harbour significant liver stiffness (≥8 kPa) on VCTE [18]. This underlines that diabetes diminishes FIB-4's sensitivity, explaining why some Indian studies reported high sensitivity but very low specificity in diabetic populations. The AASLD practice guidance provides an age-stratified approach—using a FIB-4 cut-off of 1.3 for individuals younger than 65 and 2.0 for those 65 or older—and emphasises that patients with type 2 diabetes or multiple metabolic risk factors should be assessed via FIB-4 at least every two years, followed by VCTE or enhanced liver fibrosis (ELF) testing if the FIB-4 is ≥1.3 [27]. Such sequential testing strategies reflect recognition that simple indices are influenced by age, metabolic status and hepatic inflammation.

Strengths and Limitations of Included Studies

The Indian literature contributes valuable data on non-invasive fibrosis assessment in an under-studied population. Strengths include the inclusion of both general NAFLD and high-risk diabetic cohorts, multicentric designs, and large sample sizes in certain studies, which enhance generalisability

within India. However, several limitations temper the conclusions. All studies were cross-sectional or retrospective, precluding assessment of outcomes over time or ability to establish causality. Liver biopsy, the reference standard for fibrosis staging, was absent; instead, all studies relied on FibroScan, which, although validated, can be affected by obesity and operator experience. Cut-off thresholds for significant fibrosis varied widely, hindering direct comparison across studies. A cross-sectional analysis in sub-Saharan Africa underscores these limitations: FIB-4 and APRI showed high specificities (93.3 % and 97.9 %, respectively) but low sensitivities (60 % and 29.7 %), and their diagnostic performance was better in alcohol- or viral-related liver disease than in metabolic or diabetic patients [28]. Such findings caution against over-reliance on single scores in heterogeneous populations.

Clinical Relevance and Implications

Despite limitations, the collective evidence supports continued use of non-invasive scores as an accessible first step in fibrosis assessment. The 2025 APASL guidelines reinforce that FIB-4 remains a cost-effective and readily available first-line tool for risk stratification, to be followed by elastography or biomarker panels in a layered approach. Raising the FIB-4 rule-out threshold for older patients may improve specificity but markedly reduces sensitivity, highlighting the need to balance misclassification risks [29]. Recent investigations suggest that FIB-4 <1.3 may under-triage patients with diabetes or obesity and advocate for fast-tracking such individuals to elastography even when FIB-4 is low. Collectively, these insights imply that in Indian clinical practice, FIB-4 and NFS should serve as initial screening tools; patients with low scores can be reassured, but those with intermediate or high scores, especially if diabetic or obese, should undergo FibroScan or ELF testing. Future research should focus on deriving population-specific cut-offs and validating combined scores or algorithms that incorporate metabolic factors, aiming to refine risk stratification pathways for MASLD in South Asia.

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