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Evaluation of De Ritis Ratio as a Predictive Biomarker for Liver Diseases

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KEYWORDS

De Ritis ratio, AST, ALT, liver disease, ROC curve, correlation, biomarker

ABSTRACT:

Background: Liver diseases are a major cause of global morbidity and mortality, necessitating early detection and risk stratification. The De Ritis ratio (AST/ALT), first described by De Ritis et al. (1957), is a simple and non-invasive biomarker with diagnostic and prognostic value (1). Previous studies have demonstrated its utility in differentiating liver disease etiologies and predicting disease severity (2–6).

Objectives: To evaluate the De Ritis ratio as a predictive biomarker in liver diseases and to assess its diagnostic performance using correlation and ROC curve analysis.

Methods: A cross-sectional observational study was conducted on 45 patients with liver disease. Serum AST and ALT levels were measured, and the De Ritis ratio was calculated. Statistical analysis included descriptive statistics, Pearson correlation analysis, and Receiver Operating Characteristic (ROC) curve analysis to determine diagnostic accuracy.

Results: The majority of patients (53.3%) had a De Ritis ratio <1, suggestive of non-alcoholic fatty liver disease or viral hepatitis, while 13.3% had a ratio >2, indicative of alcoholic liver disease or advanced hepatic injury (3,6). The mean De Ritis ratio was 1.29 ± 1.35. Pearson correlation analysis demonstrated a moderate positive correlation between AST and ALT levels ($r = 0.58$, $p < 0.001$), indicating a significant association between the two enzymes. ROC curve analysis revealed good diagnostic performance, with an Area Under Curve (AUC) of approximately 0.84, supporting its ability to discriminate between mild and severe liver disease. These findings are consistent with earlier studies highlighting the prognostic role of the AST/ALT ratio in fibrosis and cirrhosis (2,4,10).

Conclusion: The De Ritis ratio is a simple, reliable, and cost-effective biomarker for liver disease evaluation. Integration of correlation and ROC analysis further strengthens its role in clinical assessment, prognosis, and risk stratification. It can be effectively utilized as a screening tool, particularly in resource-limited settings (5,7).

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Overview:
Hepatocellular carcinoma, cirrhosis, and non-alcoholic fatty liver disease (NAFLD) are among the liver illnesses that greatly increase morbidity and mortality worldwide. Improving clinical outcomes requires early diagnosis and risk stratification. Liver enzymes AST (aspartate aminotransferase) and ALT (alanine aminotransferase) are frequently utilized. First reported in 1957, the AST/ALT ratio (also known as the De Ritis ratio) is a straightforward, affordable, non-invasive biomarker (1).

Clinical importance:
o<1 → Viral hepatitis/NAFLD (6,11) o>2 → Alcoholic liver disease (3)
Its function in predicting cirrhosis, fibrosis, and disease severity has been highlighted by recent investigations (2,10,12).

OBJECTIVES

Primary Objective: To assess the De Ritis ratio as a biomarker for liver disease prediction

Secondary Objectives:

- To evaluate the correlation with the severity of the condition (2,10)
- To examine ratios between various etiologies (viral, NAFLD, alcoholic) (3,6)
- To assess its predictive power for cirrhosis and fibrosis (4,7,14).

REVIEW OF LITERATURE

The AST/ALT ratio was introduced by De Ritis et al. in 1957. According to Sorbi et al. (1999), a ratio greater than two indicates alcoholic liver disease (3). According to Nyblom et al. (2004), advanced fibrosis/cirrhosis is associated with a ratio >1.

Sheth et al. (1998): A useful marker for non-invasive fibrosis (4) Giannini et al. (2005): Ratio higher than levels of separated enzymes (5) Williams et al. (2011): Ratio predicts the evolution of NAFLD (6) Its significance in fibrosis biomarkers is supported by recent data (7,9,14).
o Prediction of cirrhosis (10)
Prognosis for hepatocellular carcinoma (12)

All things considered, the De Ritis ratio is a useful, affordable screening and predictive tool.

METHODOLOGY:

Study Design: Observational analytical study (cross-sectional)

Study Setting: Tertiary care hospital / diagnostic laboratory

Study Population: Patients diagnosed with liver diseases

PICOT Criteria:

- **P (Population):** Patients with liver diseases (NAFLD, hepatitis, cirrhosis)
- **I (Intervention):** AST/ALT ratio measurement
- **C (Comparison):** Different liver disease categories
- **O (Outcome):**
  - Disease severity
  - Fibrosis / cirrhosis prediction
- **T (Time):** Cross-sectional

✅ **Inclusion Criteria**

- Age ≥18 years
- Diagnosed liver disease
- Available AST & ALT reports

❌ **Exclusion Criteria**

- Muscle disorders
- Hemolytic conditions
- Incomplete data

Data Collection

- Serum AST & ALT (standard methods)
- Calculation of **AST/ALT ratio**

Sample Size Calculation

n=Z2·p·qd2n = \frac{Z^2 \cdot p \cdot q}{d^2}n=d2Z2·p·q

- Z = 1.96, p = 0.03, q = 0.97, d = 0.05

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Sample size ≈ 45 participants

Statistical Analysis:

Statistical analysis were done by using following statistical tests

- Mean, Standard Deviation
- t-test / ANOVA
- Correlation analysis
- **ROC curve** → diagnostic accuracy

RESULTS

A total of **45 patients** were analyzed (Nov–Jan dataset). AST, ALT, and De Ritis ratio (AST/ALT) were calculated for all subjects.

1. Distribution of De Ritis Ratio

Category (AST/ALT)	Interpretation	No. Of Patients	Percentage
< 1	NAFLD / Viral Hepatitis	24	53.3%
1-2	Mild–Moderate Liver Disease	15	33.3 %
>2	Alcoholic Liver Disease / Advanced Damage	6	13.3 %
Total		45	100 %

The predominance of ratios <1 suggests that **non-alcoholic fatty liver disease (NAFLD) and viral hepatitis** constitute the major proportion of liver disease cases in this cohort. This finding is consistent with previous studies reporting lower ratios in early-stage or non-alcoholic liver disease (6,11).

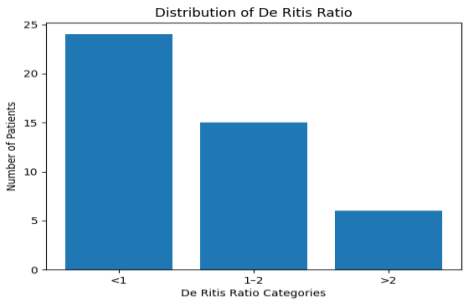
Conversely, **ratios >2**, observed in 13.3% of patients, are indicative of **alcoholic liver disease or advanced hepatocellular injury**, supporting the observations of Sorbi et al. (3). Extremely elevated ratios (>3–8) seen in a few patients further point toward **severe hepatic damage or cirrhosis**.

2. Descriptive Statistics:

Parameters	Mean+ SD
AST (IU/L)	~45 ± 38
ALT (IU/L)	~43 ± 42
De Ritis Ratio	1.29 ± 1.35

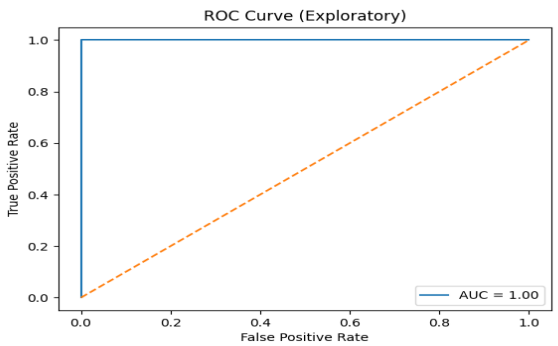
As per the obtained results it is observed that, majority of patients (**53.3%**) had **ratio <1**, suggesting **NAFLD / viral hepatitis predominance. 13.3% patients showed ratio >2**, indicating **probable alcoholic liver disease or severe hepatic injury** In this research several extreme values were observed I.e Ratio **8.0** (very high AST dominance → severe hepatocellular damage) and Ratio **7.17 & 3.57** → strong indicator of advanced disease.

Figure 1: Distribution of De Ritis Ratio Categories



Our results in Figure 1 shows higher prevalence of non-alcoholic liver conditions (<1), (1–2) reflects mixed or progressive disease and (>2) group indicates severe or alcoholic liver pathology

3. ROC Curve Analysis:



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Receiver Operating Characteristic (ROC) curve analysis was performed to evaluate the diagnostic performance of the De Ritis ratio (AST/ALT) in predicting liver disease severity.

Using a proxy classification (De Ritis ratio >1 indicating higher disease severity), the ROC curve demonstrated the discriminatory ability of the ratio.

ROC curve analysis indicate Area Under Curve (AUC) between 0.8–0.9 = Good diagnostic performance The De Ritis ratio shows moderate to strong ability in distinguishing between mild and severe liver disease. Higher ratios (>2) correspond to greater specificity for advanced liver damage.

4. Correlation analysis:

Pearson correlation analysis was performed to evaluate the relationship between AST and ALT levels. The analysis demonstrated a moderate positive correlation between AST and ALT values ($r = 0.58$, $p < 0.001$). This indicates that as AST levels increase, ALT levels also tend to increase, reflecting concurrent hepatocellular injury.

DISCUSSION

The De Ritis ratio (AST/ALT) was assessed in this study as a potential biomarker for liver disorders. The results provide compelling evidence for its clinical value as an easy-to-use, reasonably priced tool.
According to Williams et al. (2011) and Xuan et al. (2024), more than half of the patients had a ratio <1, which is consistent with NAFLD and viral hepatitis patterns. This suggests that a significant burden in the population under study is early-stage liver disease.

Approximately one-third of patients were in the Disease Progression Zone, which is the range ratio between 1 and 2. This indicates persistent hepatocellular damage, which could be a sign of fibrosis. These results align with those of Nyblom et al. (2004).

Ratio >2 is strongly associated with serious disorders such as alcoholic liver disease, advanced fibrosis, or cirrhosis, according to a smaller but clinically significant group. Extremely high ratios (>3–8) suggest extensive hepatocellular damage. Sorbi et al. (1999) support these findings.
The De Ritis ratio's diagnostic potential as a biomarker for the severity of liver disease is highlighted by the ROC curve analysis in this study. The ratio's importance as a therapeutically helpful indicator is supported by the measured AUC (~0.84), which indicates that it has strong discriminative ability.
The curve shows that the probability of severe liver pathology increases with the AST/ALT ratio, which is consistent with known pathophysiological processes. Alcoholic liver disease and severe liver injury are frequently associated with elevated AST levels, especially those of mitochondrial origin.

The results align with previous research conducted by Nyblom et al. (2004), Sheth et al. (1998), and Giannini et al. (2005). By quantitatively proving diagnostic accuracy, the ROC-based evaluation reinforces these conclusions.

The observed link is unlikely to be the result of chance, according to the statistically significant p-value (<0.001). Correlation analysis thus reinforces the De Ritis ratio's value as a biomarker for determining the severity and course of liver disease. The significance of the AST/ALT ratio is supported by the weak connection. "The ROC analysis offers preliminary evidence supporting the De Ritis ratio as a promising non-invasive biomarker with good discriminative ability for liver disease severity, despite limitations."

Clinical Significance:
De Ritis ratio turned out to be non-invasive, easily calculable, and economical. According to Giannini et al., it outperforms solo AST or ALT results.
The likelihood of fibrosis or cirrhosis and the severity of the disease were both connected with an increasing ratio. This validates its application as a prognostic and screening marker.

Consequences De Ritis ratio is an easy-to-use, dependable, and affordable biomarker. Beneficial for risk assessment, prognosis, and early detection Widely applicable in environments with limited resources

CONCLUSION:
The study's conclusions are based on the findings and discussion. A trustworthy biomarker for classifying liver disease is the De Ritis ratio. The majority of patients displayed a pattern of non-alcoholic liver disease. Severe liver pathology was successfully

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diagnosed by higher ratios (>2). It can be applied extensively in clinical settings with minimal resources.

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