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The Role Of Indian Diabetic Risk Score In Predicting Metabolic Dysfunction Associated Steatotic Liver Diease In Non-Diabetic Population

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Abstract

Background: Metabolic Dysfunction–Associated Steatotic Liver Disease (MASLD) represents a continuum of hepatic involvement ranging from uncomplicated fat accumulation to inflammatory injury, progressive fibrosis, cirrhosis, and ultimately hepatocellular carcinoma. In many non-diabetic individuals, MASLD remains clinically silent and is often driven by metabolic derangements such as abdominal adiposity, insulin resistance, and lipid abnormalities. Identifying individuals at risk at an early stage is essential to halt disease progression and reduce long-term hepatic and cardiovascular morbidity. The Indian Diabetes Risk Score (IDRS), a simple and validated screening instrument for diabetes, may also reflect underlying metabolic risk and thereby serve as a potential indicator for MASLD.

Aim: To assess the utility of the Indian Diabetes Risk Score as a predictor of MASLD in adults without diabetes.

Materials and Methods: A hospital-based cross-sectional study was carried out over an 18-month period at Aarupadai Veedu Medical College and Hospital, enrolling 93 non-diabetic adults aged 18–65 years. All participants were evaluated using the IDRS, along with detailed anthropometric measurements and biochemical investigations including fasting blood sugar, HbA1c, lipid profile, and liver function tests. Abdominal ultrasonography was performed to detect and grade hepatic steatosis. Statistical analysis involved chi-square testing and Pearson's correlation, with statistical significance defined as $p<0.05$.

Results: The mean age of the study cohort was 42.76 ± 14.46 years, with females comprising 62.4% of participants. Higher IDRS categories showed a significant association with ultrasonographic evidence of fatty liver ($\chi^2 = 30.16$, $p = 0.01$), with most high-risk individuals demonstrating grade 1 or grade 2 steatosis. IDRS scores exhibited significant positive correlations with age ($r = 0.587$), fasting blood sugar ($r = 0.440$), HbA1c ($r = 0.573$), body mass index ($r = 0.545$), and waist circumference ($r = 0.451$). In addition, ultrasonographic abnormalities were significantly linked to advancing age and elevated fasting glucose levels.

Conclusion: The Indian Diabetes Risk Score emerges as a practical, non-invasive, and cost-effective tool for identifying non-diabetic individuals at increased risk of MASLD. Its use in routine clinical settings may facilitate early recognition and prompt lifestyle-based interventions, thereby helping to prevent progression to advanced liver disease and related metabolic complications.

Keywords: MASLD, IDRS, Ultrasonography, Non-Diabetic, Obesity, Metabolic Risk

Introduction

Metabolic dysfunction–associated steatotic liver disease (MASLD) represents a continuum of liver pathology ranging from simple hepatic steatosis to non-alcoholic steatohepatitis (NASH), progressive fibrosis, cirrhosis, and hepatocellular carcinoma.[1,2] Occurring in the absence of significant alcohol intake, MASLD has emerged as a major global public health concern and is now widely recognized as the hepatic manifestation of metabolic syndrome.[3,4] Its development reflects a complex interplay between central obesity, insulin resistance, dyslipidemia, and other metabolic derangements.[5,6] The global burden of MASLD has increased substantially in recent decades. In Western countries, its high prevalence is largely attributed to the rising rates of obesity, sedentary lifestyles, and type 2 diabetes mellitus (T2DM). However, developing nations such as India are experiencing a parallel increase driven by rapid urbanization, lifestyle changes, and a nutritional shift toward energy-dense diets. MASLD is gradually replacing alcoholic liver disease and viral hepatitis as the most common cause of persistently elevated liver enzymes and is becoming a leading indication for liver transplantation worldwide.[7] Several risk factors have been consistently linked to MASLD, including T2DM, obesity, dyslipidemia, hypothyroidism, and polycystic ovarian syndrome (PCOS). Among these, insulin resistance plays a central role by promoting hepatic fat accumulation and driving progression toward inflammation and fibrosis. Importantly, individuals with MASLD are at heightened risk not only for advanced liver disease but also for cardiovascular morbidity and mortality, making early identification a clinical priority.[8,9]

The Indian Diabetes Risk Score (IDRS), developed by the Madras Diabetes Research Foundation, is a validated and easily applicable screening tool for early detection of diabetes in the community. It incorporates four simple parameters—age, abdominal obesity, physical activity, and family history of diabetes—and categorizes individuals into low (<30), moderate (30–50), and high (>60) risk groups.[10–12] Given the close metabolic link between insulin resistance, diabetes, and MASLD, it is plausible that IDRS may also serve as an indirect predictor of MASLD. If validated, this approach could offer a cost-effective and scalable method for identifying individuals at high risk of MASLD in the general population.[11,12] The present study therefore aims to evaluate the utility of IDRS as a screening tool for MASLD, with the goal of facilitating earlier detection and timely preventive interventions before progression to advanced liver disease.

Material & Method

The present study was conducted at Aarupadai Veedu Medical College and Hospital as a hospital-based cross-sectional study over a period of 18 months. The study population comprised non-diabetic individuals aged above 18 years who attended the outpatient and inpatient departments of the institution during the study period. A total sample size of 100 participants was included. The required sample size was calculated using the formula $n \geq Z^2(1-\alpha/2) \times Sen\ (1-Sen) / d^2 \times P$, where sensitivity (Sen), expected prevalence (P), and precision (d) were considered. Based on a similar study by Dwijen D et al., the expected sensitivity of the Indian Diabetes Risk Score (IDRS) in predicting metabolic dysfunction–associated steatotic liver disease (MASLD) was taken as 0.95, with an assumed prevalence of 0.25. The level of significance was fixed at 5% and precision at 10%, yielding a calculated sample size of 93, which was rounded off to 100. Participants were recruited using a convenient sampling method.

Adults between 18 and 65 years of age who were non-diabetic and had no known history of liver disease were included in the study. Individuals with diabetes mellitus, previously diagnosed liver disease, pregnancy, prior bariatric surgery, or a history of hepatotoxic drug use were excluded. After obtaining written informed consent, a detailed clinical history was recorded and a thorough physical examination was performed for each participant. The Indian Diabetes Risk Score was calculated and documented for all subjects. Subsequently, biochemical investigations including fasting blood sugar, HbA1c, liver function tests, and fasting lipid profile were carried out. Viral serology for hepatitis B surface antigen and hepatitis C virus was performed to exclude viral hepatitis. All participants also underwent abdominal ultrasonography for assessment of hepatic steatosis. Ultrasonographic criteria used for diagnosing fatty liver included increased hepatic echogenicity relative to the renal cortex, reduced penetration of ultrasound waves, poor visualization of intrahepatic vascular structures due to ill-defined portal vein walls, and hepatomegaly with liver span exceeding 15.5 cm along the mid-clavicular line. Based on these findings, fatty liver was graded accordingly. The IDRS was calculated using four parameters—age, waist circumference, physical activity, and family history of diabetes—with a maximum score of 100. Scores were categorized as low risk (<30), moderate risk (30–50), and high risk (≥60).

Statistical Analysis

All collected data were entered into Microsoft Excel and analyzed using SPSS version 26.0. Continuous variables were summarized as mean with standard deviation, while categorical variables were expressed as frequencies and percentages. Data were presented using tables, figures, bar diagrams, and pie charts. Associations between categorical variables were assessed using the chi-square test, and correlations between IDRS scores, ultrasonographic findings, and clinical or biochemical parameters were analyzed using Pearson's correlation coefficient. A p-value of less than 0.05 was considered statistically significant for all analyses.

Results

Present study included total of 93 cases fulfilling inclusion criteria, with mean age of 42.76±14.46yrs

Table 1: Distribution of variables

		Count	N %
Agewise	18-35yr	31	33.3%
	35-50yrs	33	35.5%
	>50yrs	29	31.2%
Gender	Female	58	62.4
	Male	35	37.6
Comorbiditie s	Nil	49	52.7
	Hypothyroidism	21	22.5
	PCOS	10	10.7
	Systemic Hypertension	16	17.2
Smoking	No	72	77.4
	Yes	21	22.6
Alcohol	No	80	86.0
	Yes	13	14.0
BMI category	18.5-24.9	25	26.9
	25.0-29.9	25	26.9
	30.0-34.9	31	33.3
	35.0-39.9	6	6.5
	>40.0	6	6.5

The age-wise distribution shows that the study population was relatively evenly spread across the three age groups. Participants aged 35–50 years constituted the largest proportion (35.5%), followed closely by those 18-35 years (33.3%) and those older than 50 years (31.2%). The gender distribution shows a predominance of females in the study population, with 58 participants (62.4%) being female and 35 participants (37.6%) being male. Among those with comorbid conditions, hypothyroidism was the most frequently observed (21; 22.5%), followed by systemic hypertension (16; 17.2%) and polycystic ovarian syndrome (PCOS) (10; 10.7%). The majority of participants were non-smokers (72; 77.4%), and 86% were non-alcoholic.

One-third falling in the BMI range of 30.0–34.9 kg/m² (33.3%). Normal BMI (18.5–24.9 kg/m²) and overweight status (25.0–29.9 kg/m²) were equally represented, each accounting for 26.9% of the study population, while higher obesity classes (BMI ≥35 kg/m²) constituted a smaller proportion (13%).

Table 2: Showing the IDRS grade distribution

		Count	N %
IDRS grade	Low risk	12	12.9%
	Moderate risk	33	35.5%
	High risk of having diabetes	48	51.6%
	Total	93	100.0%
USG	N	34	36.6%
	G1	46	49.5%
	G2	13	14.0%

Table 3: Comparison of USG with IDRS score grade

	USG			Chi-square
	N	G1	G2	

		Count	N %	Count	N %	Count	N %	(p-value)
IDRS score grade	Low risk	12	35.3%	0	0.0%	0	0.0%	30.16 **(0.01)***
	Moderate risk	14	41.2%	16	34.8%	3	23.1%	
	High risk of having diabetes	8	23.5%	30	65.2%	10	76.9%	
*p<0.05 is statistically significant.								

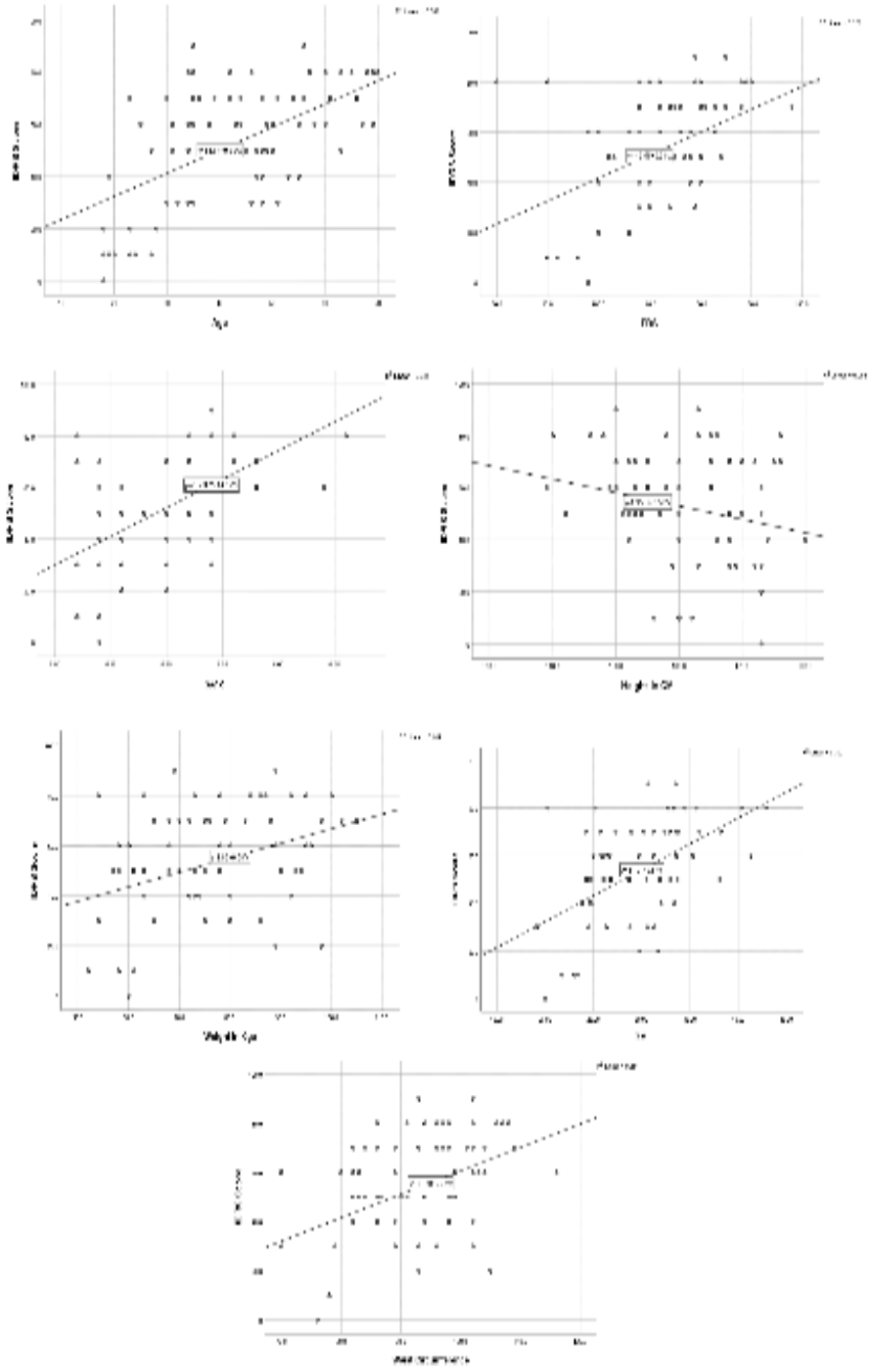

Figure 1: Correlation of IDRS with various parameters

Low IDRS scores were confined to participants with normal ultrasonography, indicating minimal metabolic or structural liver changes, whereas individuals in the high-risk IDRS category predominantly exhibited G1 and G2 abnormalities, reflecting a strong association between higher diabetes risk and fatty liver changes.

The moderate-risk group showed a mixed distribution but was more common in normal and G1 categories. Overall, increasing IDRS scores were closely linked with progressively abnormal USG findings, supporting IDRS as a useful predictor of underlying hepatic pathology. Correlation analysis revealed significant associations between the IDRS score and multiple demographic, biochemical, and anthropometric variables. Age showed a strong positive correlation with IDRS ($r = 0.587$, $p < 0.001$), indicating an increasing risk of diabetes with advancing age. Fasting blood sugar ($r = 0.440$, $p < 0.001$) and HbA1c ($r = 0.573$, $p < 0.001$) were also positively correlated, demonstrating that poorer glycemic status was associated with higher IDRS scores. Anthropometric parameters such as body weight ($r = 0.382$, $p < 0.001$), body mass index ($r = 0.545$, $p < 0.001$), and waist circumference ($r = 0.451$, $p < 0.001$) showed moderate to strong positive correlations, highlighting the contribution of general and central obesity to increased diabetes risk. In contrast, height exhibited a weak but statistically significant negative correlation with IDRS ($r = -0.237$, $p = 0.018$), suggesting that shorter stature was modestly associated with higher diabetes risk. Overall, these findings emphasize that advancing age, adverse glycemic parameters, and increased adiposity are major contributors to higher IDRS scores, reflecting the multifactorial determinants of diabetes risk.

The distribution of body mass index (BMI) across the ultrasound-defined groups (G1, G2, and G3) demonstrated a statistically significant association ($\chi^2 = 23.909$, $p = 0.001$), indicating that BMI varied significantly between the groups. The lower BMI was significantly higher in cases with normal USG findings, whereas the cases with G1 and G2 showing the higher BMI.

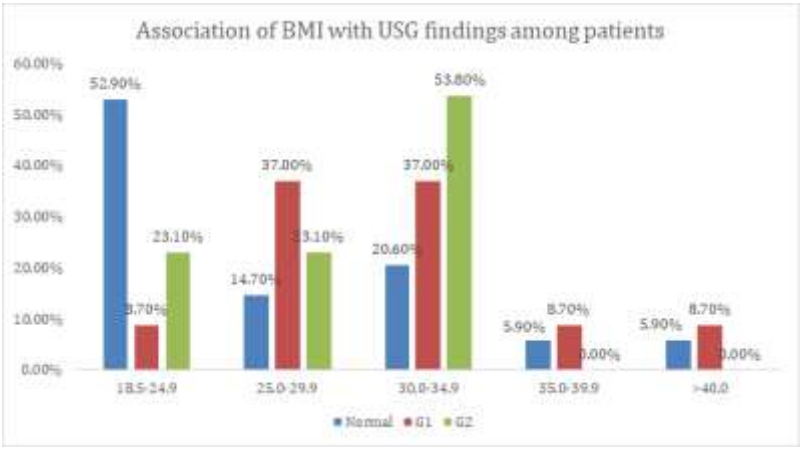

Figure 2: Association of BMI with USG findings among patients

Discussion

This study examined the usefulness of the Indian Diabetes Risk Score (IDRS) in detecting non-diabetic individuals who may be at risk for metabolic dysfunction–associated steatotic liver disease (MASLD), thereby facilitating early recognition and timely preventive strategies before progression to advanced liver pathology. A total of 93 participants fulfilling the eligibility criteria were enrolled, with a mean age of 42.76 ± 14.46 years. The age distribution was relatively balanced, although individuals between 35–50 years constituted the largest proportion (35.5%), followed by those below 35 years (33.3%) and those above 50 years (31.2%), indicating that the risk of MASLD spans across adult age groups. The study population demonstrated a clear female predominance, with women accounting for 62.4% of participants and men comprising 37.6%, suggesting greater representation of females in this non-diabetic cohort. Similar demographic trends have been observed in earlier studies. Usha PK et al. reported a mean age of 40.13 ± 15 years with males constituting 53.5% of the study population, reflecting a modest male predominance in their cohort.[13] Wahiduzzaman M et al. documented a slightly older population with a mean age of 49.11 ± 12.25 years and a female predominance of 59.8%, although nearly two-thirds of their participants had coexisting type 2 diabetes mellitus.[14] In contrast, Das D et al. reported a male preponderance with a male-to-female ratio of 1.64:1 and a mean age of 41.5 years.[15] These inter-study variations may be attributed to differences in population characteristics, metabolic profiles, and healthcare-seeking behavior; however, the broadly comparable age ranges across studies underscore the relevance of IDRS-based screening for MASLD risk assessment in diverse adult populations.

Ultrasonographic evaluation in the present study demonstrated that nearly half of the participants exhibited Grade 1 (G1) fatty liver changes, accounting for 49.5% of cases, making it the most common abnormal finding, while Grade 2 (G2) changes were observed in 14.0% of participants; the remaining 36.6% had normal ultrasonographic findings. This indicates that a substantial proportion of the non-diabetic study

population already harbored early hepatic steatosis, predominantly of mild grade. A statistically significant association was observed between IDRS risk categories and ultrasonographic findings ($\chi^2 = 30.16$, $p = 0.01$), highlighting a clear gradient of worsening liver involvement with increasing IDRS scores. Participants classified as low risk by IDRS were confined exclusively to the normal USG category and were absent in both G1 and G2 groups, suggesting minimal underlying metabolic or structural hepatic alterations in this subset. In contrast, individuals in the high-risk IDRS category constituted the majority of those with abnormal USG findings, contributing to 65.2% of G1 and 76.9% of G2 cases, while those with moderate risk were distributed across all USG categories, with greater representation in normal and G1 grades than in G2. These findings reinforce the ability of IDRS to reflect underlying metabolic derangements manifesting as ultrasonographically detectable fatty liver changes. Similar observations have been reported by Anbalagan VP et al., who documented a NAFLD prevalence of 24.7% in their population, with significantly higher rates among individuals with high (30.4%) and medium (21%) IDRS scores compared to the low-risk group (15.8%; trend χ^2, $p = 0.022$), supporting the role of IDRS as a practical community-level screening tool for NAFLD.[16] Mori K et al. likewise reported a markedly higher prevalence of NAFLD among individuals with high (67.7%) and medium (16%) IDRS scores compared to those with low scores (7.4%), with a highly significant trend ($p < 0.001$), further validating the applicability of IDRS beyond diabetes risk stratification.[17]

In addition, correlation analysis in the present study demonstrated significant positive associations between IDRS and age, fasting blood sugar, HbA1c, body weight, BMI, and waist circumference, underscoring the close interplay between advancing age, worsening glycemic indices, and increasing adiposity in elevating metabolic risk. Ultrasonographic abnormalities were also significantly correlated with age and fasting blood sugar, suggesting that early glycemic alterations contribute to hepatic steatosis even before the onset of overt diabetes. These findings align with Ray G et al., who identified BMI, triglycerides, LDL cholesterol, and HbA1c as key predictors of NAFLD severity among non-diabetic and prediabetic individuals, emphasizing dyslipidemia and insulin resistance as central drivers of disease progression.[18] Further supporting evidence from Usha PK et al. demonstrated the usefulness of IDRS in identifying high-risk individuals in urban populations, while Wahiduzzaman M et al. highlighted the amplified risk of NAFLD in the presence of diabetes and family history of liver disease. [13,14] Collectively, these findings substantiate the role of IDRS as a simple, cost-effective, and non-invasive tool that mirrors metabolic dysfunction and reliably predicts ultrasonographic evidence of MASLD in non-diabetic individuals, making it valuable for large-scale screening and early preventive intervention.

Limitations

This study has certain limitations that should be considered while interpreting the findings. Being a cross-sectional design, it establishes associations but does not allow inference of a causal relationship between IDRS and the development or progression of metabolic dysfunction–associated steatotic liver disease. The use of a convenient sampling method and a single-center hospital-based population may limit th low-up precluded assessment of disease progression, recurrence, or the impact of lifestyle modification e generalizability of the results to the wider community. Ultrasonography, although practical and non-invasive, is operator dependent and less sensitive in detecting mild steatosis, which may have led to underestimation of early disease. Liver biopsy, the definitive diagnostic modality, could not be performed due to ethical and feasibility constraints. In addition, the absence of long-term fol over time. Larger, multicentric studies with longitudinal follow-up and inclusion of advanced imaging or histological assessment would strengthen the evidence and help validate IDRS as a robust screening tool for MASLD.

This study highlights the Indian Diabetes Risk Score (IDRS) as a practical, simple, and non-invasive screening tool for identifying non-diabetic individuals who are at increased risk of metabolic dysfunction–associated steatotic liver disease (MASLD). Even in the absence of overt diabetes, a considerable proportion of participants showed impaired fasting glucose, excess body weight, and ultrasonographic evidence of fatty liver, indicating underlying metabolic derangements. The significant association observed between higher IDRS categories and increasing grades of fatty liver on ultrasonography demonstrates the usefulness of IDRS in predicting MASLD risk among non-diabetic individuals. In addition, IDRS showed strong positive correlations with age, fasting blood sugar, HbA1c, body weight, body mass index, and waist circumference, reflecting the close link between adiposity, glycemic status, and metabolic dysfunction. Ultrasonographic abnormalities were also significantly related to advancing age and fasting glucose levels, further emphasizing the role of early metabolic changes in hepatic steatosis. Overall, these findings support the role of IDRS as an effective community-level screening tool that can facilitate early identification and timely lifestyle-based interventions to reduce future metabolic and liver-related complications.

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Conflict of interest: Nil

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