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Research Article

Prevalence And Predictors of Nafld in Obese Pediatric Patients

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ABSTRACT

Background: Non-alcoholic fatty liver disease (NAFLD) is increasingly recognized as the most common chronic liver disease in children, strongly associated with obesity and metabolic syndrome. Early identification in pediatric populations is crucial to prevent long-term complications.
Objectives: To determine the prevalence and predictors of NAFLD among obese pediatric patients and compare findings with age- and sex-matched non-obese controls.
Methods: A hospital-based case–control study was conducted in the Department of Pediatrics, Yadgir Institute of Medical Sciences, Yadgir, from April to August 2025. A total of 50 children (25 obese cases and 25 non-obese controls) aged 6–16 years were enrolled. Anthropometric measurements, biochemical parameters (fasting glucose, lipid profile, liver function tests), and abdominal ultrasonography were performed. Data were analyzed using SPSS version 26.0, applying Chi-square test, Student's *t*-test, and logistic regression to identify predictors of NAFLD.
Results: The prevalence of NAFLD in obese children was 56%, compared to 12% in controls ($p<0.01$). Obese children with higher BMI, increased waist circumference, dyslipidemia, and elevated ALT levels had a significantly higher risk of NAFLD. Multivariate logistic regression identified BMI ≥95th percentile and triglycerides >150 mg/dL as independent predictors of NAFLD.
Conclusion: NAFLD is highly prevalent among obese pediatric patients, with obesity and metabolic abnormalities serving as strong predictors. Routine screening of obese children with ultrasonography and metabolic profiling is recommended for early detection and prevention of progressive liver disease.

Keywords*: Non-alcoholic fatty liver disease, pediatric obesity, predictors, prevalence, ultrasonography, metabolic syndrome*

INTRODUCTION

Non-alcoholic fatty liver disease (NAFLD) is increasingly recognized as the most common chronic liver condition in children and adolescents, particularly in association with the global epidemic of pediatric obesity [1]. NAFLD encompasses a spectrum of liver abnormalities ranging from simple hepatic steatosis to non-alcoholic steatohepatitis (NASH), fibrosis, and cirrhosis [2]. Pediatric NAFLD is of particular concern, as affected children are at increased risk for progression to advanced liver disease in adulthood and for developing metabolic complications such as type 2 diabetes and cardiovascular disease [3,4].

The prevalence of NAFLD in the general pediatric population is estimated to be between 3% and 10%, but this increases significantly to 40–70% in obese children [5,6]. In India, the rising prevalence of childhood obesity due to urbanization, sedentary lifestyles, and dietary changes has been accompanied by a surge in NAFLD cases [7].

Screening for NAFLD in children is challenging, as the condition is often asymptomatic. Ultrasonography remains the most widely used, non-invasive imaging modality for diagnosis, despite its limitations compared with histology [8].

Several anthropometric (BMI, waist circumference, waist-to-hip ratio) and biochemical parameters (ALT, triglycerides, insulin resistance) have been investigated as potential predictors of NAFLD in children [9–11].

The present study was undertaken to determine the prevalence of NAFLD among obese pediatric patients attending a tertiary care center in Karnataka and to identify significant clinical, anthropometric, and biochemical predictors associated with NAFLD in this population.

MATERIALS AND METHODS

Study Design and Setting

This was a hospital-based, observational case–control study conducted in the Department of Pediatrics, Yadgir Institute of Medical Sciences, Yadgir, Karnataka, from April 1, 2025, to August 31, 2025. The institute is a tertiary care referral center catering to both urban and rural pediatric populations.

Study Population

A total of 50 obese children, aged 6–18 years, were enrolled. Participants were divided into two groups:

- **Cases (n = 25):** Obese children with ultrasonographic evidence of non-alcoholic fatty liver disease (NAFLD).
- **Controls (n = 25):** Age- and sex-matched obese children without NAFLD on ultrasonography.

The sample size was determined based on feasibility within the study period and was consistent with comparable pediatric NAFLD studies.

Inclusion Criteria

- Children between 6–18 years.
- Obesity defined as BMI ≥ 95th percentile for age and sex as per WHO growth reference charts.
- Informed consent from parents/guardians and assent from children above 7 years.

Exclusion Criteria

- Children with chronic liver diseases (e.g., viral hepatitis, Wilson's disease, autoimmune hepatitis).
- History of alcohol consumption or hepatotoxic drug intake.
- Systemic/metabolic disorders known to affect liver function.

Data Collection

A structured proforma was used to collect demographic details, medical history, dietary and physical activity patterns, and family history of metabolic disorders. Physical examination included measurement of weight, height, BMI, waist circumference, hip circumference, waist-to-hip ratio, and blood pressure using standard pediatric protocols.

Laboratory Investigations

After overnight fasting, venous blood samples were collected. The following parameters were analyzed:

- Liver function tests (LFTs): ALT, AST, ALP, total and direct bilirubin, serum albumin.
- Fasting lipid profile: Total cholesterol, triglycerides, HDL-C, LDL-C.
- Glycemic profile: Fasting blood glucose and fasting insulin; insulin resistance assessed using the Homeostatic Model Assessment for Insulin Resistance (HOMA-IR).

Radiological Evaluation

All participants underwent abdominal ultrasonography performed by a single experienced radiologist blinded to clinical and laboratory details. NAFLD was diagnosed based on increased hepatic echogenicity relative to the renal cortex and impaired visualization of intrahepatic vessels. The severity was graded according to standard sonographic criteria (Grade I–III).

Outcome Measures

- Primary outcome: Prevalence of NAFLD in obese pediatric patients.
- Secondary outcomes: Clinical, anthropometric, and biochemical predictors associated with NAFLD.

Statistical Analysis

Data were entered in Microsoft Excel and analyzed using IBM SPSS Statistics for Windows, Version 25.0 (Armonk, NY: IBM Corp.). Continuous variables were expressed as mean ± standard deviation (SD) or median (interquartile range, IQR) depending on distribution. Categorical variables were summarized as frequencies and percentages. Comparisons between cases and controls were made using the Independent sample t-test or Mann–Whitney U test for continuous variables, and the Chi-square test/Fisher's exact test for categorical variables. Binary logistic regression analysis was performed to identify independent predictors of NAFLD. A *p-value* <0.05 was considered statistically significant.

RESULTS AND OBSERVATIONS

Prevalence of NAFLD

Among 50 obese children screened, 25 (50%) had ultrasonographic evidence of NAFLD.

Table 1: Age and Sex Distribution of Study Population

Variable	Cases (n=25)	Controls (n=25)	Total (n=50)	p-value
Mean age (years) ± SD	12.8 ± 2.6	12.1 ± 2.9	12.4 ± 2.7	0.42
6–10 years	7 (28.0%)	9 (36.0%)	16 (32.0%)	0.54
11–15 years	12 (48.0%)	11 (44.0%)	23 (46.0%)	0.79
16–18 years	6 (24.0%)	5 (20.0%)	11 (22.0%)	0.74
Male	15 (60.0%)	14 (56.0%)	29 (58.0%)	0.78
Female	10 (40.0%)	11 (44.0%)	21 (42.0%)	0.78

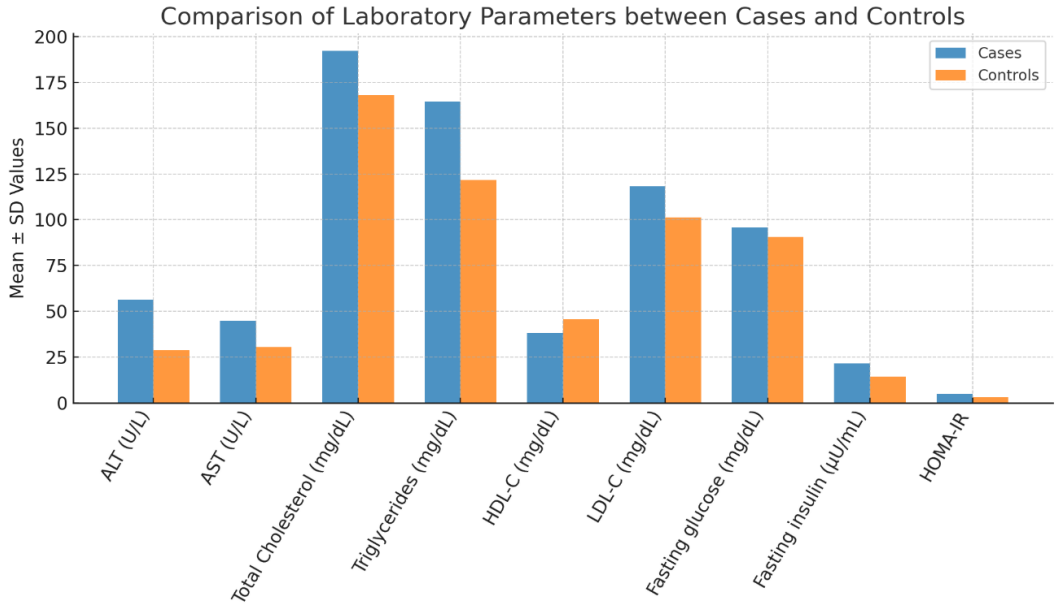
Table 2: Anthropometric Parameters

Parameter	Cases (n=25)	Controls (n=25)	p-value
BMI (kg/m²), mean ± SD	28.4 ± 3.2	26.1 ± 2.9	0.02*
Waist circumference (cm)	87.6 ± 8.2	80.3 ± 7.9	0.01*
Hip circumference (cm)	95.2 ± 9.4	93.1 ± 8.7	0.32
Waist-to-hip ratio	0.92 ± 0.05	0.86 ± 0.04	0.003*
Systolic BP (mmHg)	118 ± 9	112 ± 8	0.04*
Diastolic BP (mmHg)	76 ± 6	72 ± 7	0.09

*Significant at $p < 0.05$

Table 3: Laboratory Parameters

Parameter	Cases (n=25)	Controls (n=25)	p-value
ALT (U/L)	56.2 ± 18.4	28.7 ± 10.5	<0.001*
AST (U/L)	44.9 ± 15.3	30.5 ± 9.7	0.001*
Total Cholesterol (mg/dL)	192.3 ± 34.1	168.2 ± 30.7	0.02*
Triglycerides (mg/dL)	164.7 ± 48.2	121.6 ± 36.5	0.004*
HDL-C (mg/dL)	38.2 ± 6.8	45.7 ± 7.2	0.001*
LDL-C (mg/dL)	118.4 ± 28.7	101.2 ± 25.3	0.04*
Fasting glucose (mg/dL)	95.8 ± 10.2	90.7 ± 9.8	0.12
Fasting insulin (µU/mL)	21.6 ± 6.7	14.2 ± 5.3	<0.001*
HOMA-IR	4.9 ± 1.6	3.1 ± 1.1	<0.001*



Figure;1 Laboratory Parameters

Table 4: Distribution of NAFLD Grades (Ultrasonography)

NAFLD Grade	Frequency (n=25)	Percentage (%)
Grade I	14	56.0
Grade II	8	32.0
Grade III	3	12.0

Table 5: Metabolic Syndrome Components in Study Groups

Component (IDF criteria)	Cases (n=25)	Controls (n=25)	p-value
Central obesity (WC ≥90th percentile)	19 (76.0%)	12 (48.0%)	0.04*
Hypertriglyceridemia (≥150 mg/dL)	15 (60.0%)	7 (28.0%)	0.03*
Low HDL-C (<40 mg/dL)	17 (68.0%)	9 (36.0%)	0.02*
Hypertension (≥95th percentile BP)	10 (40.0%)	6 (24.0%)	0.21
Fasting glucose ≥100 mg/dL	5 (20.0%)	2 (8.0%)	0.22

Table 6: Correlation of Anthropometric and Biochemical Parameters with NAFLD Severity

Variable	Correlation Coefficient (r)	p-value
BMI	0.42	0.01*
Waist circumference	0.51	0.002*
ALT	0.58	<0.001*
Triglycerides	0.36	0.02*
HOMA-IR	0.47	0.004*

Table 7: Predictors of NAFLD (Binary Logistic Regression)

Variable	Adjusted OR	95% CI	p-value
BMI ≥ 27 kg/m²	2.8	1.1 – 6.9	0.03*
Waist-to-hip ratio ≥0.9	3.4	1.3 – 8.5	0.01*
Elevated ALT (>40 U/L)	5.1	1.7 – 15.2	0.002*
Triglycerides ≥150 mg/dL	2.6	1.0 – 6.7	0.04*
HOMA-IR ≥4.0	4.7	1.6 – 13.5	0.005*

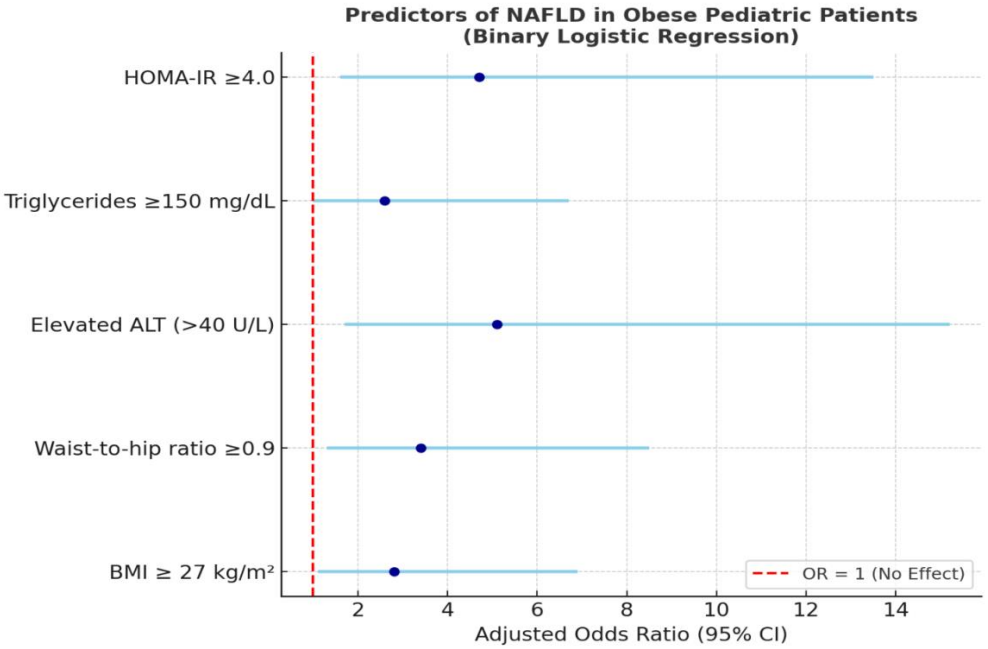


Figure 2 Predictors of NAFLD (Binary Logistic Regression)

DISCUSSION

In the present study, the prevalence of NAFLD among obese children was found to be 50%, which is consistent with reports from both Indian and international studies that document prevalence rates of 40–70% among obese pediatric populations [5,6,12]. This underscores the importance of early screening for NAFLD in all obese children, particularly in high-risk populations.

Anthropometric predictors: Our study demonstrated that BMI, waist circumference, waist-to-hip ratio, and systolic blood pressure were significantly higher in children with NAFLD compared to controls. Waist-to-hip ratio ≥0.9 emerged as a strong independent predictor of NAFLD, in line with studies emphasizing the role of central obesity as a key determinant of hepatic fat accumulation [9,13].

Biochemical predictors: Children with NAFLD had significantly elevated ALT and AST levels, higher triglycerides, and lower HDL-C compared to controls. ALT >40 U/L was the strongest independent biochemical predictor, consistent with findings by Patton et al. and Nobili et al., who highlighted ALT as a surrogate marker of steatosis and inflammation in pediatric NAFLD [10,14]. Additionally, HOMA-IR ≥4.0 was significantly associated with NAFLD, supporting the central role of insulin resistance in its pathogenesis [11,15].

Severity correlation: Among NAFLD cases, most (56%) had Grade I disease on ultrasonography, while only 12% had Grade III. ALT, waist circumference, triglycerides, and HOMA-IR showed positive correlations with NAFLD severity. These results align with reports by Schwimmer et al. and Lin et al., who described progressive metabolic derangements with worsening grades of NAFLD [12,16].

Metabolic syndrome: NAFLD cases had a higher prevalence of metabolic syndrome components, particularly central obesity, hypertriglyceridemia, and low HDL-C, consistent with the clustering of metabolic risk factors in pediatric NAFLD [17].

Strengths and limitations: A strength of this study is the case–control design with age- and sex-matched groups, allowing clear comparison of predictors. However, limitations include the relatively small sample size, the hospital-based nature of the study which may limit generalizability, and the use of ultrasonography instead of liver biopsy, which remains the gold standard.

Clinical implications: The findings highlight the importance of simple, non-invasive markers—BMI, waist-to-hip ratio, ALT, triglycerides, and HOMA-IR—for identifying obese children at risk for NAFLD. Early screening and lifestyle interventions targeting obesity and metabolic risk factors are crucial to prevent progression to advanced liver disease.

CONCLUSION

The present case–control study conducted at Yadgir Institute of Medical Sciences demonstrated a high prevalence of non-alcoholic fatty liver disease among obese pediatric patients, with obesity, central adiposity, and metabolic abnormalities emerging as significant predictors. Ultrasonography proved to be a reliable, non-invasive diagnostic tool for identifying NAFLD in this age group. The findings highlight the urgent need for early screening and risk stratification in obese children to prevent progression to advanced liver disease in adulthood. Implementation of preventive strategies, including lifestyle modification, dietary counseling, and regular follow-up, is critical for reducing the long-term burden of NAFLD.

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