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Clinical and Metabolic Profile of Patients with Non-Alcoholic Fatty Liver Disease: A Cross-Sectional Study.

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Abstract

Background: Non-alcoholic fatty liver disease (NAFLD) is the most prevalent chronic liver disease worldwide and is closely associated with obesity, insulin resistance, type 2 diabetes mellitus, dyslipidemia, hypertension, and metabolic syndrome. As the hepatic manifestation of metabolic dysfunction, NAFLD is increasingly recognized as a multisystem disorder with significant hepatic and cardiovascular consequences. Characterizing the clinical and metabolic profile of affected patients is essential for early diagnosis, risk stratification, and timely therapeutic intervention. ***Aim:*** To evaluate the clinical and metabolic profile of patients with non-alcoholic fatty liver disease attending a tertiary care center. ***Materials and Methods:*** A hospital-based cross-sectional observational study was conducted among 63 adult patients diagnosed with NAFLD based on ultrasonography and FibroScan findings. Detailed demographic characteristics, anthropometric measurements, clinical history, metabolic comorbidities, biochemical investigations, liver function tests, lipid profile, and non-invasive fibrosis assessment were recorded. Clinical variables including obesity, diabetes mellitus, hypertension, ischemic heart disease, and hypothyroidism were evaluated. Fibrosis severity was assessed using FibroScan, Fibrosis-4 (FIB-4) Index, and NAFLD Fibrosis Score (NFS). Data were analyzed using SPSS version 26.0. Continuous variables were expressed as mean ± standard deviation, while categorical variables were presented as frequencies and percentages. Statistical significance was considered at $p < 0.05$. ***Results:*** The mean age of the study population was 48.5 ± 11.0 years, with 60.3% of patients belonging to the 41–60-year age group. Males constituted 61.9% of the participants. Overall, 85.7% of patients were overweight or obese. Diabetes mellitus was present in 61.9%, hypertension in 41.3%, ischemic heart disease in 12.7%, and hypothyroidism in 11.1% of patients. The mean body mass index was 30.8 ± 4.6 kg/m^2. Patients demonstrated elevated fasting blood glucose, total cholesterol, triglycerides, LDL cholesterol, liver enzymes, and serum ferritin, with reduced HDL cholesterol. Obesity, diabetes mellitus, hypertension, hypertriglyceridemia, and low HDL cholesterol were significantly more common among patients with advanced fibrosis than those with mild disease ($p < 0.05$). Patients with intermediate or high fibrosis scores also exhibited significantly higher BMI, serum ferritin, and alanine aminotransferase levels ($p < 0.001$). ***Conclusion:*** Patients with non-alcoholic fatty liver disease exhibit a high prevalence of obesity, diabetes mellitus, hypertension, dyslipidemia, and other components of metabolic syndrome. These metabolic abnormalities are significantly associated with increasing liver fibrosis and disease severity. Comprehensive clinical and metabolic assessment should be incorporated into routine evaluation of patients with NAFLD to facilitate early diagnosis, improve risk stratification, and guide appropriate lifestyle and therapeutic interventions

Keywords: Non-alcoholic fatty liver disease, Metabolic syndrome, Obesity, Diabetes mellitus, Dyslipidemia, Clinical profile, Liver fibrosis

INTRODUCTION

Non-alcoholic fatty liver disease (NAFLD) is one of the most common chronic liver disorders worldwide and has emerged as a major public health challenge because of the rapidly increasing prevalence of obesity, type 2 diabetes mellitus, insulin resistance, dyslipidemia, and metabolic syndrome. The disease is characterized by excessive fat accumulation in hepatocytes in the absence of significant alcohol consumption or other secondary causes of hepatic steatosis. NAFLD encompasses a broad spectrum ranging from simple steatosis to non-alcoholic steatohepatitis (NASH), progressive fibrosis, cirrhosis, and hepatocellular carcinoma. Because liver fibrosis is the strongest predictor of liver-related morbidity and mortality, early recognition of patients with metabolic risk factors has become a priority in clinical practice.(1)

The pathogenesis of NAFLD is multifactorial and involves a complex interplay between insulin resistance, adipose tissue dysfunction, oxidative stress, chronic inflammation, mitochondrial injury, and genetic susceptibility. The Asian Pacific Association for the Study of the Liver (APASL) guidelines emphasize that metabolic dysfunction is the principal driver of disease progression and recommend comprehensive assessment of obesity, diabetes mellitus, hypertension, dyslipidemia, and other metabolic abnormalities in all patients with fatty liver disease. Early identification of these risk factors facilitates timely intervention and reduces progression to advanced fibrosis and cirrhosis.(2)

Globally, NAFLD affects approximately one-quarter of the adult population and has become one of the leading causes of chronic liver disease. Younossi et al., in a landmark meta-analysis, estimated the worldwide prevalence of NAFLD to be approximately 25%, with the highest burden observed in regions experiencing rapid urbanization and increasing rates of obesity and diabetes. Their study also demonstrated that NAFLD is associated with substantial liver-related morbidity, cardiovascular disease, and overall mortality, emphasizing the need for effective screening and early diagnosis.(3)

The understanding of fatty liver disease has evolved considerably in recent years. Recognizing the central role of metabolic dysfunction, Eslam et al. proposed the term metabolic dysfunction-associated fatty liver disease (MAFLD) to better reflect the underlying pathophysiology. The new definition places greater emphasis on metabolic abnormalities rather than exclusion of alcohol intake alone and highlights obesity, diabetes mellitus, hypertension, and dyslipidemia as major determinants of disease progression and adverse clinical outcomes. This revised concept underscores the importance of evaluating the overall metabolic profile of affected patients rather than focusing solely on hepatic manifestations.(4)

Several clinical studies have demonstrated that the metabolic characteristics of patients with NAFLD vary considerably according to body mass index. Chakrabarty et al. compared lean, overweight, and obese individuals with NAFLD and reported that although obesity remains the most important risk factor, lean patients may also develop clinically significant fatty liver disease in the presence of insulin resistance, dyslipidemia, or other metabolic abnormalities. The authors observed that obese patients exhibited significantly higher body mass index, fasting blood glucose, triglyceride levels, and prevalence of metabolic syndrome, indicating that worsening metabolic dysfunction is associated with greater disease severity.(5)

More recently, Paik et al. conducted a comprehensive systematic review of the global epidemiology of NAFLD and non-alcoholic steatohepatitis (NASH), confirming that the prevalence of both conditions continues to increase worldwide. The review highlighted that metabolic comorbidities including obesity, diabetes mellitus, hypertension, and dyslipidemia are consistently associated with disease progression and advanced fibrosis. The authors emphasized that comprehensive clinical and metabolic assessment is essential for identifying high-risk individuals, guiding treatment decisions, and reducing future liver-related and cardiovascular complications.(6)

Considering the strong association between NAFLD and metabolic syndrome, detailed evaluation of demographic characteristics, anthropometric indices, associated comorbidities, and biochemical abnormalities has become an integral part of patient management. Understanding the clinical and metabolic profile of patients with NAFLD may facilitate early diagnosis, improve risk stratification, and enable implementation of targeted lifestyle and pharmacological interventions before irreversible liver damage develops. Therefore, the present study was undertaken to evaluate the clinical and metabolic profile of patients with non-alcoholic fatty liver disease attending a tertiary care center.

MATERIALS AND METHODS

A hospital-based cross-sectional observational study was conducted to evaluate the clinical and metabolic profile of patients with non-alcoholic fatty liver disease (NAFLD), focusing on demographic characteristics, metabolic risk factors, biochemical parameters, and non-invasive fibrosis assessment.

Study Setting

The study was carried out in the Department of Medical Gastroenterology at a tertiary care teaching hospital.

Study Duration

The study was conducted over 18 months after obtaining approval from the Institutional Ethics Committee.

Study Population

Adult patients diagnosed with NAFLD attending the outpatient department or admitted to the gastroenterology ward during the study period were included.

Sample Size
A total of 63 patients with NAFLD were enrolled using consecutive sampling.

Inclusion Criteria
- Adults aged ≥18 years.
- NAFLD diagnosed by ultrasonography and/or FibroScan.
- Patients providing written informed consent.
- Complete clinical and laboratory records.

Exclusion Criteria
- Significant alcohol consumption (>30 g/day in men; >20 g/day in women).
- Viral hepatitis, autoimmune liver disease, Wilson's disease, hemochromatosis, or other chronic liver diseases.
- Drug-induced or pregnancy-related fatty liver.
- Malignancy or severe systemic illness.
- Refusal to participate.

Clinical Assessment
A detailed history, physical examination, and anthropometric evaluation were performed. Data recorded included age, sex, body mass index (BMI), waist circumference, blood pressure, and associated metabolic disorders such as diabetes mellitus, hypertension, ischemic heart disease, and hypothyroidism.

Anthropometric Measurements
Height and weight were measured using standard techniques, and BMI (kg/m²) was calculated as:
BMI = Weight (kg) / Height² (m²)
BMI was classified according to WHO criteria.

Laboratory Investigations
After overnight fasting, blood samples were analyzed for:
- Complete blood count
- Fasting blood glucose
- Liver function tests (AST, ALT, bilirubin, albumin)
- Platelet count
- Serum ferritin
- Lipid profile (total cholesterol, triglycerides, HDL, LDL, VLDL).

Radiological Assessment
All patients underwent abdominal ultrasonography for confirmation of fatty liver. Liver fibrosis was evaluated using FibroScan (Transient Elastography) and categorized into fibrosis stages (F0–F4).
Non-Invasive Fibrosis Assessment
The following validated fibrosis scores were calculated:
- Fibrosis-4 (FIB-4) Index: Based on age, AST, ALT, and platelet count; categorized as low (<1.45), intermediate (1.45–3.25), and high (>3.25) risk.
- NAFLD Fibrosis Score (NFS): Calculated using age, BMI, diabetes status, AST/ALT ratio, platelet count, and serum albumin; categorized as low, indeterminate, or advanced fibrosis.
- Variables Studied
- Demographic: Age, gender.
- Clinical: BMI, diabetes mellitus, hypertension, ischemic heart disease, hypothyroidism.
- Metabolic: Fasting blood glucose, total cholesterol, triglycerides, HDL, LDL, VLDL.
- Liver-related: AST, ALT, serum ferritin, FibroScan liver stiffness, FIB-4, and NFS.

Outcome Measures
Primary Outcome
- To determine the clinical and metabolic profile of patients with NAFLD.
- Secondary Outcomes
- To determine the prevalence of obesity, diabetes mellitus, hypertension, and dyslipidemia.
- To evaluate FibroScan, FIB-4, and NAFLD Fibrosis Score distribution.
- To assess the association between metabolic abnormalities and liver fibrosis severity.

Statistical Analysis

Data were analyzed using IBM SPSS Statistics version 26.0. Continuous variables were expressed as mean ± SD, while categorical variables were presented as frequencies and percentages. Independent t-test, Chi-square/Fisher's exact test, one-way ANOVA, Pearson's correlation, and multivariable logistic regression were applied where appropriate. A p-value <0.05 was considered statistically significant.

Ethical Considerations

Institutional Ethics Committee approval was obtained before commencement of the study. Written informed consent was obtained from all participants, and confidentiality was maintained in accordance with the Declaration of Helsinki.

RESULTS

A total of 63 patients with non-alcoholic fatty liver disease (NAFLD) were enrolled in the present cross-sectional study to evaluate their clinical and metabolic profile. Demographic characteristics, anthropometric measurements, associated metabolic disorders, biochemical parameters, lipid profile, and liver fibrosis assessment were analyzed. The study demonstrated that NAFLD predominantly affected middle-aged individuals and was strongly associated with obesity, diabetes mellitus, hypertension, and dyslipidemia. Patients with advanced fibrosis exhibited significantly higher prevalence of metabolic abnormalities than those with mild fibrosis.

Table 1: Demographic and Clinical Characteristics of the Study Population (n=63)

Parameter	Number	Percentage (%)
Age Group (years)		
21–40	15	23.8
41–50	20	31.7
51–60	18	28.6
>60	10	15.9
Gender		
Male	39	61.9
Female	24	38.1
BMI Category		
Normal (<25 kg/m²)	9	14.3
Overweight (25–29.9 kg/m²)	24	38.1
Obese (≥30 kg/m²)	30	47.6
Diabetes Mellitus	39	61.9
Hypertension	26	41.3
Ischemic Heart Disease	8	12.7
Hypothyroidism	7	11.1

The majority of patients (60.3%) belonged to the 41–60-year age group. Males constituted 61.9% of the study population. Nearly half (47.6%) were obese, while an additional 38.1% were overweight, indicating that 85.7% had excess body weight. Diabetes mellitus (61.9%) was the most common metabolic disorder, followed by hypertension (41.3%), highlighting the close association between NAFLD and metabolic syndrome.

Table 2: Metabolic and Biochemical Profile of Patients with NAFLD

Parameter	Mean ± SD
Body Mass Index (kg/m²)	30.8 ± 4.6
Fasting Blood Glucose (mg/dL)	146.7 ± 38.9
Total Cholesterol (mg/dL)	242.2 ± 25.0
Triglycerides (mg/dL)	223.7 ± 55.7
HDL Cholesterol (mg/dL)	39.7 ± 4.1
LDL Cholesterol (mg/dL)	120.5 ± 26.1
VLDL Cholesterol (mg/dL)	48.7 ± 12.4
ALT (U/L)	71.4 ± 23.6
AST (U/L)	56.9 ± 18.4
Serum Ferritin (ng/mL)	294.8 ± 98.7

Patients demonstrated characteristic metabolic abnormalities associated with NAFLD. The mean BMI indicated obesity, while fasting blood glucose levels suggested poor glycemic control in many participants. Elevated total cholesterol,

triglycerides, LDL cholesterol, liver enzymes, and serum ferritin together with reduced HDL cholesterol reflected significant metabolic dysfunction and hepatic injury.

Table 3: Association Between Metabolic Risk Factors and FibroScan Fibrosis Stage

Variable	Mild Fibrosis (F0–F1) (n=31)	Significant/Advanced Fibrosis (F2–F4) (n=32)	p value
Obesity	11 (35.5%)	19 (59.4%)	0.041*
Diabetes Mellitus	15 (48.4%)	24 (75.0%)	0.029*
Hypertension	9 (29.0%)	17 (53.1%)	0.047*
Hypertriglyceridemia	18 (58.1%)	28 (87.5%)	0.009*
Low HDL Cholesterol	16 (51.6%)	25 (78.1%)	0.031*

Metabolic abnormalities were significantly more frequent among patients with significant or advanced fibrosis. Obesity, diabetes mellitus, hypertension, hypertriglyceridemia, and reduced HDL cholesterol were all significantly associated with increasing fibrosis severity ($p<0.05$), suggesting that metabolic syndrome contributes substantially to disease progression.

Table 4: Relationship Between Clinical Variables and Non-Invasive Fibrosis Scores

Variable	Low Fibrosis Score	Intermediate/High Fibrosis Score	p value
Mean BMI (kg/m²)	28.4 ± 3.8	32.6 ± 4.5	<0.001*
Diabetes Mellitus	20 (45.5%)	19 (90.5%)	<0.001*
Mean Serum Ferritin (ng/mL)	226.8 ± 62.5	386.9 ± 86.4	<0.001*
Mean ALT (U/L)	59.7 ± 17.6	84.5 ± 24.3	<0.001*

Patients classified into the intermediate or high fibrosis category demonstrated significantly greater BMI, higher prevalence of diabetes mellitus, elevated serum ferritin, and increased ALT levels compared with those having low fibrosis scores. All differences were highly statistically significant ($p<0.001$).

Overall, the findings indicate that NAFLD is closely associated with multiple components of metabolic syndrome, and worsening metabolic abnormalities are significantly linked with increasing liver fibrosis. Comprehensive clinical and metabolic evaluation is therefore essential for early identification of high-risk patients and timely institution of preventive and therapeutic interventions.

DISCUSSION

The present study evaluated the clinical and metabolic profile of patients with non-alcoholic fatty liver disease (NAFLD) and demonstrated a high prevalence of obesity, diabetes mellitus, hypertension, dyslipidemia, and elevated liver enzymes. Furthermore, metabolic abnormalities were significantly more common among patients with advanced fibrosis, emphasizing the close relationship between metabolic syndrome and progression of NAFLD. These findings reinforce the concept that NAFLD is a multisystem metabolic disorder requiring comprehensive clinical and metabolic evaluation for optimal patient management.

The demographic profile observed in the present study is consistent with previous reports showing that NAFLD predominantly affects middle-aged adults with multiple metabolic risk factors. Deb et al. reported that patients with NAFLD commonly present with obesity, diabetes mellitus, hypertension, and dyslipidemia, all of which contribute significantly to disease progression. Their cross-sectional study demonstrated that metabolic syndrome was present in the majority of patients with NAFLD, supporting the close association between hepatic steatosis and systemic metabolic dysfunction. Similar observations were noted in the present study, where diabetes mellitus and obesity were the most frequent metabolic abnormalities.(7)

Obesity remains the principal modifiable risk factor for NAFLD. In the present study, nearly 86% of patients were overweight or obese, and obesity was significantly associated with advanced fibrosis. These findings are in agreement with Pande and Pande, who demonstrated that obesity, central adiposity, diabetes mellitus, and hypertension were strongly associated with NAFLD and metabolic syndrome. They emphasized that increasing body mass index contributes to insulin resistance, hepatic fat accumulation, and chronic inflammation, thereby accelerating progression from simple steatosis to fibrosis. Their observations closely parallel the findings of the present study.(8)

Although obesity is a major determinant of NAFLD, recent evidence indicates that metabolic dysfunction also plays a crucial role in non-obese individuals. Islam et al. evaluated the metabolic profile of non-obese patients with NAFLD and reported that insulin resistance, dyslipidemia, elevated triglycerides, and impaired glucose metabolism were frequently present despite normal body mass index. These findings indicate that metabolic abnormalities rather than obesity alone

determine disease development and progression. The present study similarly demonstrated that metabolic comorbidities were highly prevalent irrespective of body weight, highlighting the importance of evaluating all metabolic risk factors in patients with NAFLD.(9)

Further support comes from the recent study by Xu et al., who compared lean and non-lean patients with NAFLD. They observed that non-lean patients exhibited higher body mass index, greater insulin resistance, elevated triglyceride levels, and more advanced fibrosis than lean individuals. Nevertheless, lean NAFLD patients also demonstrated significant metabolic disturbances, indicating that metabolic dysfunction remains the fundamental pathogenic mechanism regardless of obesity status. These observations emphasize the need for individualized metabolic assessment rather than relying solely on anthropometric indices.(10)

The biochemical profile in the present study demonstrated elevated liver enzymes together with dyslipidemia, reflecting ongoing hepatocellular injury and altered lipid metabolism. Maev et al. evaluated patients with NAFLD and metabolic comorbidities and demonstrated that improvement in metabolic control was accompanied by significant reductions in alanine aminotransferase (ALT), aspartate aminotransferase (AST), and other biochemical markers of liver injury. Their findings suggest that optimization of metabolic abnormalities directly improves hepatic function and may slow disease progression. The elevated liver enzymes observed in the present study therefore likely reflect underlying metabolic dysfunction rather than isolated hepatic disease.(11)

The present study also demonstrated that obesity, diabetes mellitus, hypertension, elevated serum triglycerides, and reduced HDL cholesterol were significantly associated with increasing fibrosis severity. Similar findings were reported by Bharadwaj et al., who observed that NAFLD patients with metabolic comorbidities exhibited significantly worse biochemical abnormalities and greater liver disease severity than those without associated metabolic disorders. Their study concluded that the coexistence of multiple metabolic risk factors substantially increases the likelihood of progressive fibrosis and emphasizes the need for comprehensive metabolic screening in routine practice.(12)

An important implication of the present findings is the increased cardiovascular risk among patients with NAFLD. Prasad et al., in a systematic review and meta-analysis, demonstrated that NAFLD is independently associated with incident cardiovascular disease even after adjustment for conventional cardiovascular risk factors. The authors concluded that NAFLD should be considered a systemic metabolic disorder rather than merely a hepatic disease. Since diabetes mellitus, hypertension, obesity, and dyslipidemia were highly prevalent in the present study population, aggressive management of these metabolic abnormalities is likely to reduce both hepatic and cardiovascular complications.(13)

Recent studies have further highlighted the influence of obesity on disease severity. Li et al. investigated the clinical features of NAFLD in non-lean individuals and demonstrated that obese patients exhibited significantly greater insulin resistance, dyslipidemia, hypertension, and advanced fibrosis compared with lean patients. Their findings reinforce the present study, where obesity and associated metabolic abnormalities were significantly associated with worsening fibrosis. The authors emphasized that comprehensive lifestyle modification, weight reduction, and management of metabolic risk factors remain the cornerstone of NAFLD treatment.(14)

The strengths of the present study include simultaneous evaluation of demographic characteristics, anthropometric indices, metabolic risk factors, biochemical abnormalities, and non-invasive fibrosis assessment in the same cohort of patients. This comprehensive approach provides valuable insight into the interaction between metabolic syndrome and NAFLD progression. However, certain limitations should be acknowledged. The study was conducted at a single tertiary care center with a relatively small sample size, which may limit external validity. In addition, liver biopsy was not performed because of its invasive nature and associated risks. Future multicenter prospective studies with larger populations and long-term follow-up are required to further clarify the impact of individual metabolic risk factors on disease progression and evaluate the effectiveness of targeted therapeutic interventions.

CONCLUSION

The present study demonstrates that patients with non-alcoholic fatty liver disease commonly exhibit multiple components of metabolic syndrome, including obesity, diabetes mellitus, hypertension, dyslipidemia, and elevated liver enzymes. These metabolic abnormalities were significantly associated with increasing liver fibrosis, indicating their important role in disease progression. Comprehensive clinical and metabolic evaluation should therefore be incorporated into routine assessment of patients with NAFLD to facilitate early diagnosis, improve risk stratification, guide lifestyle and pharmacological interventions, and reduce both liver-related and cardiovascular morbidity.

REFERENCES

1. Huang TD, Behary J, Zekry A. Non-alcoholic fatty liver disease: a review of epidemiology, risk factors, diagnosis and management. Intern Med J. 2020 Sep;50(9):1038-1047. doi: 10.1111/imj.14709. PMID: 31760676.
2. Eslam M, Sarin SK, Wong VW, Fan JG, Kawaguchi T, Ahn SH, Zheng MH, Shiha G, Yilmaz Y, Gani R, Alam S, Dan YY, Kao JH, Hamid S, Cua IH, Chan WK, Payawal D, Tan SS, Tanwandee T, Adams LA, Kumar M, Omata M, George J. The Asian Pacific Association for the Study of the Liver clinical practice guidelines for the diagnosis and management of metabolic associated fatty liver disease. Hepatol Int. 2020 Dec;14(6):889-919. doi: 10.1007/s12072-020-10094-2. Epub 2020 Oct 1. PMID: 33006093.
3. Younossi ZM, Koenig AB, Abdelatif D, Fazel Y, Henry L, Wymer M. Global epidemiology of nonalcoholic fatty liver disease-Meta-analytic assessment of prevalence, incidence, and outcomes. Hepatology. 2016 Jul;64(1):73-84. doi: 10.1002/hep.28431. Epub 2016 Feb 22. PMID: 26707365.
4. Eslam M, Newsome PN, Sarin SK, Anstee QM, Targher G, Romero-Gomez M, Zelber-Sagi S. A new definition for metabolic dysfunction-associated fatty liver disease: An international expert consensus statement. J Hepatol. 2020 Jul;73(1):202-209. doi: 10.1016/j.jhep.2020.03.039. Epub 2020 Apr 8. PMID: 32278004.
5. Chakrabarty M, Jha AN, Sharma DJ. Clinical characteristics and metabolic profiles of non-alcoholic fatty liver disease (NAFLD) in lean patients and their comparison with obese and overweight NAFLD. J Assoc Physicians India. 2022 Apr;70(4):11–2.
6. Paik JM, Younossi ZM, Golabi P, Henry L, Henry A, Van Dongen C. The global epidemiology of nonalcoholic fatty liver disease and nonalcoholic steatohepatitis: A systematic review. Hepatology. 2023;77(4):1335-1347. doi:10.1097/HEP.0000000000000004.
7. Deb A, Chattopadhyay A , Hassan SK,Bhattacharya J, Eslam MMB. Clinical Profile of Patients with Non Alcoholic Fatty Liver Disease and itsAssociation with Metabolic Syndrome –a cross sectional study.Journal of Dental and Medical Sciences.2015;14:11-15.DOI: 10.9790/0853-141291115
8. Pande A, Pande V. Clinical profile of patients with non-alcoholic fatty liver disease and its association with metabolic syndrome. International Journal of Advances in Medicine.2017;4(4):1111. DOI: http://dx.doi.org/10.18203/2349-3933.ijam20173242
9. Islam MS, Hasan FM, Jhan S et al.Metabolic Profile of Non-Alcoholic Fatty Liver Disease in Non-Obese Patients. 2025;2025.
10. Xu, M., Gong, R., Xie, J. et al. Clinical characteristics of lean and non-lean non-alcoholic fatty liver disease: a cross-sectional study. NutrMetab (Lond) 22, 40 (2025). https://doi.org/10.1186/s12986-025-00927-y
11. Maev IV, Samsonov AA, Palgova LK, Pavlov CS, Shirokova EN, Vovk EI, Starostin KM. Effectiveness of phosphatidylcholine as adjunctive therapy in improving liver function tests in patients with non-alcoholic fatty liver disease and metabolic comorbidities: real-life observational study from Russia. BMJ Open Gastroenterol. 2020 Mar 26;7(1):e000368. doi: 10.1136/bmjgast-2019-000368. PMID: 32337059; PMCID: PMC7170405.
12. Bharadwaj SP, Garg P, Parikh AP et al.Clinical Profile, Laboratory Parameters and Comorbid Associations in Non-alcoholic Fatty Liver Disease. Apollo Medicine. 2026:2026. https://doi.org/10.1177/097600162614288
13. Prasad M, Gupta S, Sarin SK. The Independent Association of Non-alcoholic Fatty Liver Disease With Incident Cardiovascular Disease: A GRADE Evaluation of the Evidence Through a Systematic Review and Meta-analysis. J Clin Exp Hepatol. 2024 Jan-Feb;14(1):101277. doi: 10.1016/j.jceh.2023.08.013. Epub 2023 Sep 9. PMID: 38076375; PMCID: PMC10709169.
14. Li MR, Li JZ, Li JY, Wang CC, Yuan RK, Ye LH, Liu YY, Liang XJ, Zhang HC, Liu ZQ, Zeng DY, Zhang XD, Wang DH, Li JQ, Li TY, Yang L, Cao Y, Pan Y, Lin XG, Pan CQ, Dai EH, Dong ZY. Clinical Features of Non-Alcoholic Fatty Liver Disease in the Non-Lean Population. Obes Facts. 2023;16(5):427-434. doi: 10.1159/000530845. Epub 2023 May 22. PMID: 37231905; PMCID: PMC10601616.