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Research Article

Metabolic Profile of Non-Alcoholic Fatty Liver Disease in Non-Obese Patients

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Abstract

Background: NAFLD is a growing menace globally, with an estimated global prevalence of 25.2%. It affects 10 to 24 percent of the general population in various countries. The reported global prevalence rate of non-obese NAFLD varies widely, ranging from 3% to almost 30%. Asian studies also report that NASH is frequently found in non-obese NAFLD. In Bangladesh, about one-third of the population is affected by NAFLD.

Aim: The purpose of this study was to evaluate the metabolic profile of NAFLD in non-obese patients attending a tertiary care hospital.

Materials and methods: This cross-sectional study was conducted in department of medicine and department of gastroenterology and hepatology at Rajshahi Medical College Hospital, Rajshahi from January 2022 to June 2022. Total 100 patients were enrolled by purposive sampling technique.

Results: Among 100 patients, mean age was 40.82 years with female predominance (53%). Most of the patients were normotensive (77%) and non-diabetic (55%) and non-smoker (52%) but 57% had hypothyroidism. The body mass index in male was 21.32 ± 1.3 (SD) kg/m^2 and body mass index female was 20.5 ± 2.15 (SD) kg/m^2. The waist circumference in male was 76.572 ± 5.395 (SD) cm and in female was 74.512 ± 5.523 (SD) cm. Among the respondents 30% had Fasting Blood glucose > 5.5 mmol/L and 40% had Blood glucose 2 h after breakfast > 11.1 mmol/L. Majority of the respondents fasting lipid profile showed cholesterol level ≥ 200 mg/dl in 73%, triglyceride level ≥ 200 mg/dl in 72%, LDL ≥ 130 mg/dl in 58% and HDL level ≤ 40 mg/dl was 51% patients. Among the respondents 60% had TSH > 5 mIU /L and 57% had Free T4 < 0.7 ng/dl. Among the respondents 57% had aspartate aminotransferase (AST) > 40 U/L, 56% had alanine aminotransferase (ALT) > 40 U/L and 46% had gamma-glutamyl transferase (GGT) > 30 U/L. Majority of respondents 36% had Grade 1 fatty liver followed in decreasing order by 34% had Grade 3 fatty liver and 30% had Grade 2 fatty liver.

Conclusion: Non-obese NAFLD is likely a different entity than obese NAFLD, with its unique genetic predisposition. This study found that components of metabolic syndrome were quite frequent among study population. More than half of the study population had altered level of Liver function enzyme, hypothyroidism and dyslipidemia and approximately 45% of patients had diabetes mellitus.

Introduction

Non-alcoholic Fatty Liver Disease (NAFLD), a component of metabolic syndrome (MetS), in which excessive fat accumulates in the liver in the absence of chronic viral hepatitis or other secondary causes of fat accumulation such as, excessive consumption of alcohol or certain drugs [1,2]. NAFLD comprises a spectrum of conditions, ranging from hepatic steatosis without inflammation (non-alcoholic fatty liver; NAFL) and non-alcoholic steatohepatitis (NASH) to cirrhosis [3]. With an estimated global prevalence of 25%, now it has become the most common chronic liver disease [2]. Although obesity is considered a pivotal factor in the development of NAFLD, yet it is also seen in non-obese individuals with a BMI of < 25 kg/m^2, residing in both developing and developed countries [4,5]. Usually NAFLD in lean persons remains under-recognized as

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the lack of obvious traditional risk factors. The prevalence of NAFLD in non-obese subjects or lean NAFLD varies from 7% in the United States to as high as 19% in Asia [6,7]. With limited data, 25.6% of NAFLD patients in Bangladesh were found non-obese [8].

NAFLD in non-obese individuals is a separate clinical entity having phenotypic distinctiveness with the possibility of a different pathophysiology [5]. Moreover, non-obese patients with NAFLD had lower NAFLD activity scores, lower fibrosis stage, and lower liver stiffness measurement by transient elastography compared with obese patients with NAFLD [9]. Most of the mechanisms responsible for developing NAFLD are linked to metabolic issues, such as, changes in fat and glucose homeostasis. In particular, insulin resistance (IR) plays a critical role in the development of NAFLD as it does in other components of MetS (obesity, type 2 diabetes mellitus and dyslipidemia) [10]. On the other hand, the underlying pathophysiologic basis of NAFLD in non-obese subjects remains uncertain and also conflicting. Genetic polymorphisms acting together with environmental influences, such as dietary composition and gut microbiome may have an important role. Polymorphisms in genes affecting lipid metabolism, oxidative stress, IR and immune regulation have been identified as predisposing factors for the development of NAFLD [5].

NAFLD is strongly related with metabolic syndrome, dyslipidemia, type 2 DM [11]. However, NAFLD in non-obese patients are often asymptomatic and compared to obese NAFLD patients (BMI > 25 kg/m^2), they have lower fasting glucose, insulin resistance, systolic and diastolic blood pressure, BMI, waist circumference, and laboratory aspartate aminotransferase [AST], alanine aminotransferase [ALT], and Gamma-Glutamyl Transferase [GGT] [5,12]. On the contrary, they contained higher Body Mass Index (BMI), blood pressure, fasting blood glucose, and higher prevalence of dyslipidemia and MetS than non-obese healthy persons [3]. Again, it is also reported that, the metabolic features of NAFLD in non-obese subjects vary across ethnicities. For example, lean NAFLD patients from Asian-Indians showed 2- to 3-fold increased insulin resistance (IR) and 2-fold more hepatic steatosis in comparison with other nations (Caucasians, Hispanics, Black and Eastern Asians) [13].

In addition, with limited data contexting NAFLD in non-obese, one study from our country revealed that, lean NAFLD patients are male predominance and metabolically similar to obese ones [8]. Although NAFLD among non-obese subjects belong to the lower stages of fibrosis, they are also at higher risk for developing of severe liver disease [14]. Not only that, they share a common altered metabolic and cardiovascular profile with the obese NAFLD patients, leading to collective risk for adverse cardiometabolic outcomes, including diabetes and ischemic heart disease with high morbidity and mortality [12]. To date, very little is known about metabolic profile of NAFLD in non-obese patients [8]. Recent evidence highlights the role of the gut microbiota in the development of NAFLD. Alterations in the intestinal microbial composition, known as dysbiosis, may influence hepatic fat accumulation through increased intestinal permeability, systemic inflammation, and altered bile acid metabolism. Microbial metabolites such as Short-Chain Fatty Acids (SCFAs), endotoxins (e.g., lipopolysaccharide), and ethanol production can exacerbate hepatic steatosis and insulin resistance. These mechanisms are believed to contribute to the onset and progression of NAFLD, including in non-obese individuals. Understanding the gut-liver axis may provide new therapeutic targets in managing non-obese NAFLD. That is why, the aim of this study was to evaluate the metabolic profile of the NAFLD in non-obese subjects [15-18].

Materials and method

This cross-sectional study was conducted in the department of medicine and department of gastroenterology and hepatology at Rajshahi Medical College Hospital, Rajshahi, Bangladesh from January 2022 to June 2022. A total of 100 NAFLD patients of > 18 years of age having BMI of < 25 kg/m^2, after fulfilling the inclusion and exclusion criteria were enrolled by purposive sampling technique. **Inclusion criteria:** a) Age ≥ 18 years of both male and female b) BMI of < 25 kg/m^2 c) Patients having fatty infiltration of liver in ultrasonography d) Reported no alcohol use or a weekly alcohol use of < 210 g for male patients and < 140 g for female. **Exclusion criteria:** a) Evidence of Hepatitis B and hepatitis C b) Evidence of drug induced fatty liver c) Other specific liver disease: hemochromatosis, Wilson's disease or auto immune liver disease d) pregnant women.

Hypothyroidism was defined as a serum thyroid-stimulating hormone (TSH) level > 5.0 mIU/L and/or free T4 < 0.7 ng/dL, in accordance with standard laboratory reference values.

Socioeconomic status was categorized using monthly household income:

- *Low-income class:* < 10,000 BDT
- *Middle-income class:* 10,000 - 30,000 BDT
- *High-income class:* > 30,000 BDT

This classification was adapted from income-based stratification used in public health research settings in Bangladesh.

Statistical analysis

Data were analyzed using SPSS version 22.0 (IBM Corporation, Armonk, NY, USA). Descriptive statistics such as mean and Standard Deviation (SD) were calculated for continuous variables. Categorical variables were summarized using frequencies and percentages.

Associations between categorical variables—such as metabolic syndrome and fatty liver grade—were assessed using the Chi-squared test. Statistical significance was considered at a p-value < 0.05.

Where applicable, 95% Confidence Intervals (CIs) were computed to assess estimate precision. For categorical association strength (e.g., fatty liver grade vs metabolic syndrome), Cramer's V was used to determine effect size.

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Results

This cross-sectional study was done on 100 patients diagnosed with Nonalcoholic Fatty Liver Disease (NAFLD) in Non-Obese Patients in the department of Medicine and Department of gastroenterology & Hepatology of Rajshahi Medical College Hospital.

Majority respondents belonged to age group 36 - 50 years (35%) and followed in decreasing order by 26 - 35 years (24%), 51 - 60 years (17%), 18 - 25 years (16%) and > 60 years (8%). Mean age was 40.82 ± 13.39 (SD) years. Majority respondents were female (53%) (Figure 1).

The majority of respondents were from low-income backgrounds (46%) followed in decreasing order by middle class (36%) and rich (18%). The majority of respondents were from low-income backgrounds (46%) followed in decreasing order by middle class (36%) and rich (18%). Majority of the respondents were non-government employed (36%) followed in decreasing order by Housewife (21%), Unemployed (14%), Business (10%), government employee (10%) and others (9%). Majority respondents resided in rural area (69%) and 31% resided in urban area. Majority of respondent's education level were below SSC (41%) followed in decreasing order by SSC (25.6%), graduate and above (16%) and HSC (9%) and below primary (8%). Among total population 77% did not have hypertension and 23% had hypertension. 55% did not have diabetes mellitus and 45% had diabetes mellitus. 57% had hypothyroidism and 43% did not had hypothyroidism. Majority respondents had history of smoking 48% and 52% were nonsmoker.

Table 1 is showing anthropometric measurement in patients of NAFLD in non-obese patients. The body mass index in male was 21.32 ± 1.3 (SD) kg/m^2 and body mass index female was 20.5 ± 2.15 (SD) kg/m^2. The waist circumference in male was 76.572 ± 5.395 (SD) cm and in female was 74.512 ± 5.523 (SD) cm.

Table 2 showing level of sugar profile in patients among the NAFLD in nonobese patients. Among the respondents 30% had Fasting Blood glucose > 5.5 mmol/L and 40% had Blood glucose 2 h after breakfast > 11.1mmol/L.

Table 3 showing fasting lipid profile in NAFLD in non-obese patients among the respondents. Majority of the respondents fasting lipid profile showed cholesterol level ≥ 200 mg/dl in 73%, triglyceride level ≥ 200 mg/dl in 72%, LDL ≥ 130 mg/dl in 58% and HDL level ≤ 40 mg/dl was in 51% patients.

Table 4 showing level of thyroid function profile in patients among the NAFLD in non- obese patients. Among the respondents 60% had TSH > 5 mIU /L and 57% had Free T4 < 0.7 ng/dl.

Table 5 showing level of liver function profile in patients of the NAFLD in non-obese patients. Among the respondents 57% had aspartate aminotransferase (AST) > 40 U/L, 56% had alanine aminotransferase (ALT) > 40 U/L and 46% had gamma-glutamyl transferase (GGT) > 30 U/L.

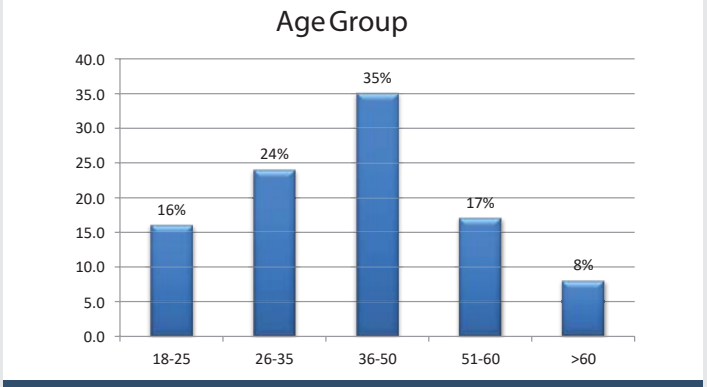

Figure 1: Distribution of respondents by age (*n* = 100).

Table 1: Anthropometric measurement in patients of NAFLD in non-obese patients (*n* = 100).

Anthropometric Measurement	Mean ± SD (Male)	Mean ± SD (Female)	Reference Range
BMI (kg/m²)	21.32 ± 1.3	20.5 ± 2.15	18.5 - 24.9 (Normal)
Waist Circumference (cm)	76.572 ± 5.395	74.512 ± 5.523	Varies by population

Table 2: Sugar profile in patients of NAFLD in non-obese patients (*n* = 100).

Level of Sugar (mg/dl)	Frequency (n)	Percentage (%)	Reference Range
Fasting Blood glucose > 5.5 mmol/L	30	30%	Normal: ≤ 5.5 mmol/L
Blood glucose 2 h After Breakfast >11.1 mmol/L	40	40%	Normal: ≤ 7.8 mmol/L

Table 3: Fasting Lipid profile in patients of NAFLD in non-obese patients (*n* = 100).

Fasting Lipid Profile	Frequency (n)	Percentage (%)	Reference Range
Cholesterol ≥ 200 mg/dl	73	73%	Desirable: < 200 mg/dl
Triglyceride ≥ 200 mg/dl	72	72%	Normal: <150 mg/dl
LDL ≥130 mg/dl	58	58%	Optimal: < 100 mg/dl
HDL ≤ 40 mg/dl	51	51%	Normal: > 40 mg/dl (Men), > 50 mg/dl (Women)

Table 4: Thyroid function profile in patients of NAFLD in non-obese patients (*n* = 100).

Level of Thyroid Function Profile	Frequency (n)	Percentage (%)	Reference Range
TSH > 5 mIU/L	60	60%	Normal: 0.4 - 4.0 mIU/L
Free T4 < 0.7 ng/dl	57	57%	Normal: 0.8 - 2.0 ng/dl

Table 5: Liver function test profile in patients of NAFLD in non-obese patients (*n* = 100).

Level of Liver Function Test Profile	Frequency (n)	Percentage (%)	Reference Range
AST > 40 U/L	57	57%	Normal: 10 - 40 U/L
ALT > 40 U/L	56	56%	Normal: 7 - 56 U/L
GGT > 30 U/L	46	46%	Normal: 8 - 61 U/L (varies by gender)

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Table 6 showing grade of fatty liver findings by ultrasonography in patients of the NAFLD in non-obese patients. Majority of respondents 36% had Grade 1 fatty liver followed in decreasing order by 34% had Grade 3 fatty liver and 30% had Grade 2 fatty liver.

Table 7 showing association between outcomes of metabolic syndrome with grade of fatty liver in patients of the NAFLD in non-obese was found to be statistically significant ($p < 0.05$). According to the study, metabolic syndrome was present when grade of fatty liver was increased.

p - value calculated using Chi-squared test. Statistical significance considered at p < 0.05.

Discussion

Nonalcoholic fatty liver disease (NAFLD) refers to a group of conditions characterized by hepatic steatosis in the absence of significant alcohol consumption. NAFLD is commonly seen in patients with metabolic abnormalities associated with obesity, such as type II diabetes, dyslipidemia, and metabolic syndrome. Evidently, however, not all obese subjects develop NAFLD and more importantly NAFLD can be found in non-obese individuals. While NAFLD occurring in non-obese subjects has been reported in children and adults of all ethnicities, it appears to be recognized more frequently in Asians, even when strict ethnicity-specific body mass index criteria are used to define obesity. Studies based on liver biopsies suggest that the prevalence of nonalcoholic steatohepatitis (NASH) and fibrosis does not differ significantly between non-obese NAFLD and NAFLD in obese patients. Visceral obesity as opposed to general obesity, high fructose and cholesterol intake, and genetic risk factors (e.g., PNPLA3) may be associated with non-obese NAFLD. In general, NASH is associated with increased mortality, primarily from cardiovascular causes, independent of other metabolic factors. While data regarding the mortality impact of non-obese NAFLD are not as mature, it may be important to identify high-risk non-obese NAFLD patients and manage their metabolic profile. Currently, lifestyle modification to reduce visceral adiposity, including dietary changes and physical activity remains the standard of care in patients with non-obese NAFLD [19]. The development of nonalcoholic fatty liver disease (NAFLD) is strongly associated with the metabolic syndrome as shown by the fact that approximately 90% of NAFLD patients have more than one feature of metabolic syndrome and about 33% have three or more criteria. The physiopathology, epidemiology and therapeutic considerations of the disease are reviewed here. Lipotoxicity plays a predominant role in the pathophysiology of both entities [20-34].

Table 6: Grade of fatty liver findings on ultrasonography in patients of NAFLD in non-obese patients (n = 100).

Grade of Fatty Liver	Frequency (n)	Percentage (%)	Reference Range
Grade 1	34	34%	Mild fatty infiltration
Grade 2	30	30%	Moderate fatty infiltration
Grade 3	36	36%	Severe fatty infiltration

Table 7: Association between metabolic syndrome and grade of fatty liver in patients with NAFLD in non-obese patients (n = 100).

Metabolic Syndrome	Grade 1 (n = 34)	Grade 2 (n = 30)	Grade 3 (n = 36)	p -value	Reference Range
Present	3 (3%)	23 (23%)	36 (36%)	0.001	A p - value < 0.05 indicates statistical significance
Absent	31 (31%)	7 (7%)	0 (0%)		--

This cross-sectional study was done on 100 patients diagnosed with Nonalcoholic Fatty Liver Disease (NAFLD) in non-obese Patients in the department of Medicine and department of Gastroenterology and Hepatology of Rajshahi Medical College Hospital.

The findings indicated, majority respondents belonged to age group 36 - 50 years (35%) and followed in decreasing order by 26 - 35 years (24%), 51 - 60 years (17%), 18 - 25years (16%) and > 60 years (8%). Mean age was 40.82 ± 13.39 (SD) years. In Lok Wei, et al.'s study, they also found that alcoholic fatty Liver Disease (NAFLD) was more common in 40-50 years age group of patients which corresponds with our study result. They mentioned mean age of non-obese group as 48 ± 11 years [35].

According to this study, majority respondents of non-alcoholic fatty liver disease were female (53%). Summart, et al. found most of the patients diagnosed with NAFLD were female which corresponds with our result. The results of this study also suggested that women are at higher risk of NAFLD than men. This has been attributed to natural changes in female physiology, such as IR, central obesity, adipose distribution and sex hormones [36].

Our study showed majority of respondents were from low-income backgrounds (46%) followed in decreasing order by middle class (36%) and rich (18%). Moreover, most of the respondents were non-government employed (36%) followed in decreasing order by Housewife (21%), Unemployed (14%), Business (10%), government employee (10%) and others (9%). Zawdie, et al. also found that most the patients diagnosed with non-alcoholic fatty liver disease were employed and belong to poor and middle-class socio-economic condition which corresponds with our study result [37].

In our study, majority respondents resided in rural area (69%) and 31% resided in urban area. Furthermore, most of the respondent's education level were below SSC (41%) followed in decreasing order by SSC (25.6%), graduate and above (16%) and HSC (9%) and below primary (8%). According to Alam, et al's study, which was done in Bangladesh, most of the patients with diagnosed NAFLD were from rural area and most of their education level was below SSC level which was similar to our result [38].

The findings indicated result, among total population, 23% had hypertension. In Kumar, et al. study, they also found that most of patients of non-alcoholic fatty liver disease in non-obese patients were non-hypertensive which corresponds with our result [3]. In our study, 55% were non-diabetes mellitus and 45% had diabetes mellitus. According to Zawdie, et al.'s study, Seventy Three percent patients of the NAFLD along with type 2 diabetic mellitus. They also found that the type 2

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DM was associated with NAFLD to affect the liver throughout the world. As our study was done in non-obese patient the proportion of diabetic patient was comparatively less than other study [37]. Moreover in our study total population 57% had hypothyroidism. In Gokmen, et al's study, they also found hypothyroidism was commonly found in non-alcoholic fatty liver disease patients which corresponds with our result [39].

Present study showed male were 47%. Smoking is one of the risk factors of known to influence the development of non-alcoholic fatty liver disease and in our country, most smokers are male. In this study, 61% of respondents reported a history of smoking. Rezayat, et al. also found that smoking was significantly associated with non-alcoholic fatty liver disease and our study also found that most patients of non-alcoholic fatty liver disease had history of smoking. In Bangladesh most female were found nonsmoker. Therefore, both studies showed similar finding [40].

The findings indicated, among the non-alcoholic fatty liver disease in non-obese patients the body mass index in male was 21.32 ± 1.3 (SD) kg/m^2 and body mass index female was 20.5 ± 2.15 (SD) kg/m^2. Moreover, the waist circumference in male was 76.572 ± 5.395 (SD) cm and in women was 74.512 ± 5.523 (SD) cm. Kausik, et al's study which was done India, also found the BMI in non-obese patients with NAFLD was 22.70 ± 3.9(SD) kg/m^2 and waist circumference was 73.01 ± 9.12 (SD) cm with was similar with our current study. They also found Asians have increased body fat compared with Europeans, even at the same BMI. This may also explain why a normal BMI was an independent risk factor for NAFL in our study [41].

Our study finding showed non-alcoholic fatty liver disease in non-obese patients had 30% had Fasting Blood glucose > 5.5 mmol/L and 40% had Blood glucose 2 hours after breakfast > 11.1 mmol/L. Mathew, et al. found that there was a direct relationship between glucose intolerance and severity of NAFLD with increasing pre-diabetes and diabetes, as we move from Grade 1 to Grade 3 NAFLD, with Grade 3 having a very high percentage of diabetic patients. Most of the patients had fasting and 2 hours after breakfast sugar more than normal level which corresponds with our study result [42].

The findings indicated, the fasting lipid profile showed cholesterol level ≥ 200 mg/dl in 73%, triglyceride level ≥ 200 mg/dl in 72%, LDL ≥ 130 mg/dl in 58% and HDL level ≤ 40 mg/dl was 51% patients. In Kausik, et al.'s study, they also found most of the patients had cholesterol level ≥ 200 mg/dl which similar with our study [41]. Hermant, et al.'s study also found dyslipidemia in patients with NAFLD is atherogenic in nature and it is characterized by increased levels of serum triglycerides and decreased levels of HDL cholesterol [43].

In our study, the thyroid function profile in non-alcoholic fatty liver disease in non-obese patients60% had TSH > 5 mIU /L and 57% had free T4 < 0.7 ng/dl. Yahyaog, et al. study found that TSH was increased than normal level and free T4 decreased than normal level which corresponds with our study result. They also found that relationship exists between NAFLD and thyroid dysfunction [39].

According to study result, liver function profile in patients of the NAFLD in non-obese patients 57% had aspartate aminotransferase (AST) > 40 U/L, 56% had alanine aminotransferase (ALT) > 40 U/L and 46% had gamma-glutamyl transferase (GGT) > 30 U/L. In Kausik, et al study, they found altered liver function enzyme and elevated AST, ALT, GGT which corresponds our study result [41].

Our study result showed liver findings by ultrasonography in patients of the NAFLD in non-obese patients 36% had Grade 1 fatty liver followed in decreasing order by 34% had Grade 3 fatty liver and 30% had Grade 2 fatty liver. In Paul, et al. study, they found that Grade I and II fatty liver by USG commonly found in non-alcoholic fatty liver disease in non-obese patients which similar with our result [44].

There was a significant correlation between the grade of fatty liver diagnosed by ultrasonography and several biochemical markers. Patients with grade 3 fatty liver had notably higher prevalence of metabolic syndrome (100%), elevated ALT (≥ 40 U/L in 56%), AST (≥ 40 U/L in 57%), and GGT (≥ 30 U/L in 46%). Additionally, as the grade of fatty liver increased, fasting blood glucose levels and dyslipidemic features such as triglycerides ≥ 200 mg/dl (72%) and cholesterol ≥ 200 mg/dl (73%) were more prevalent. This association underlines the parallel progression of imaging-based fatty liver severity and biochemical derangements. Such findings support the use of combined ultrasonographic and laboratory evaluations for staging NAFLD in non-obese individuals.

Our findings indicated, association had found between outcomes of metabolic syndrome with grade of fatty liver in patients of the NAFLD in non-obese was found to be statistically significant ($p < 0.05$). Metabolic syndrome tends to be present when grade of fatty liver was increased. Kuen, et al. stud also found the associations between the severity of NAFLD and the presence of metabolic syndrome was significant when the grade of fat in liver increased the metabolic syndrome was more frequent in patients [45].

Conclusion

Non-obese NAFLD appears to be a distinct clinical entity with unique metabolic characteristics and genetic predisposition. In this study, **57%** of non-obese patients with NAFLD had hypothyroidism, and 45% had diabetes mellitus. Dyslipidemia was highly prevalent, with 73% exhibiting elevated cholesterol (≥ 200 mg/dl), 72% showing high triglycerides (≥ 200 mg/dl), 58% with elevated LDL (≥ 130 mg/dl), and 51% with low HDL (≤ 40 mg/dl). Liver enzyme abnormalities were frequent, with AST > 40 U/L in 57% and ALT > 40 U/L in 56% of patients. Thyroid dysfunction was significant, with TSH > 5 mIU/L in 60% and Free T4 < 0.7 ng/dL in 57% of cases.

Additionally, metabolic syndrome was notably more prevalent among individuals with higher grades of fatty liver, with 100%.

Limitations

The study was based on a single center, so result may vary with other institutional study and may not reflect the

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population. In this study sample size was small due to time constraint.

Recommendations

A large scale study involving greater number of patients in multiple centers is recommended to draw more definitive conclusions on this issue.

References

1. Chalasani N, Younossi Z, Lavine JE, Diehl AM, Brunt EM, Cusi K. The diagnosis and management of non-alcoholic fatty liver disease: Practice Guideline by the American Association for the Study of Liver Diseases, American College of Gastroenterology, and the American Gastroenterological Association. Hepatology. 2012;55(6):2005–23. Available from: https://doi.org/10.1002/hep.25762

2. 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;64(1):73–84. Available from: https://doi.org/10.1002/hep.28431

3. Kumar R, Rastogi A, Sharma MK, Bhatia V, Garg H, Bihari C. Clinicopathological characteristics and metabolic profiles of non-alcoholic fatty liver disease in Indian patients with normal body mass index: Do they differ from obese or overweight non-alcoholic fatty liver disease? Indian J Endocrinol Metab. 2013;17(4):665–71. Available from: https://doi.org/10.4103/2230-8210.113758

4. Das K, Das K, Mukherjee PS, Ghosh A, Ghosh S, Mridha AR, et al. Nonobese population in a developing country has a high prevalence of nonalcoholic fatty liver and significant liver disease. Hepatology. 2010;51:1593–602. Available from: https://doi.org/10.1002/hep.23567

5. Kumar R, Mohan S. Non-alcoholic Fatty Liver Disease in Lean Subjects: Characteristics and Implications. J Clin Transl Hepatol. 2017;5(3):216–23. Available from: https://doi.org/10.14218/jcth.2016.00068

6. Fan J, Kim S, Wong VW. New Trends on Obesity and NAFLD in Asia. J Hepatol. 2017;67(4):862–73. Available from: https://doi.org/10.1016/j.jhep.2017.06.003

7. Younossi ZM, Stepanova M, Negro F, Hallaji S. Nonalcoholic Fatty Liver Disease in Lean Individuals in the United States. Medicine (Baltimore). 2012;91(6):319–27. Available from: https://doi.org/10.1097/md.0b013e3182779d49

8. Alam S, Gupta UD, Alam M. Clinical, anthropometric, biochemical, and histological characteristics of nonobese nonalcoholic fatty liver disease patients of Bangladesh. Indian J Gastroenterol. 2014;33(5):452–7. Available from: https://doi.org/10.1007/s12664-014-0488-5

9. Leung JC, Loong TC, Wei JL, Chan AW, Choi PC, Wong VW, et al. Histological Severity and Clinical Outcomes of Nonalcoholic Fatty Liver Disease in Non-obese Patients. Hepatology. 2017;65(1):54–64. Available from: https://doi.org/10.1002/hep.28697

10. Maximos M, Bril F, Sanchez PP, Lomonaco R, Orsak B, Biernacki D, et al. The Role of Liver Fat and Insulin Resistance as Determinants of Plasma Aminotransferase Elevation in Nonalcoholic Fatty Liver Disease. Hepatology. 2015;61(1):153–60. Available from: https://doi.org/10.1002/hep.27395

11. Wattacheril J, Sanyal AJ. Lean NAFLD: An Underrecognized Outlier. Curr Hepatol Rep. 2016;15(2):134–9. Available from: https://doi.org/10.1007/s11901-016-0302-1

12. Sookoian S, Pirola CJ. Systematic review with meta-analysis: risk factors for non-alcoholic fatty liver disease suggest a shared altered metabolic and cardiovascular profile between lean and obese patients. Aliment Pharmacol Ther. 2017;46(2):85–95. Available from: https://doi.org/10.1111/apt.14112

13. Petersen KF, Dufour S, Feng J, Befroy D, Dziura J, Dalla Man C, et al. Increased prevalence of insulin resistance and nonalcoholic fatty liver disease in Asian-Indian men. Proc Natl Acad Sci U S A. 2006;103(48):18273–7. Available from: https://doi.org/10.1073/pnas.0608537103

14. Hagström H, Nasr P, Ekstedt M, Hammar U, Stål P, Hultcrantz R, et al. Risk for development of severe liver disease in lean patients with nonalcoholic fatty liver disease: A long-term follow-up study. Hepatol Commun. 2018;2(1):48–57. Available from: https://doi.org/10.1002/hep4.1124

15. VanWagner LB, Armstrong MJ. Lean NAFLD: A not so benign condition? Hepatol Commun. 2018;2(1):5–8. Available from: https://pubmed.ncbi.nlm.nih.gov/29404505/

16. Loomba R, Sanyal AJ. The global NAFLD epidemic. Nat Rev Gastroenterol Hepatol. 2013;10(11):686–90. Available from: https://doi.org/10.1038/nrgastro.2013.171

17. Wong S, Chan W. Epidemiology of non-alcoholic fatty liver disease in Asia. Indian J Gastroenterol. 2020. Available from: https://doi.org/10.1007/s12664-020-01018-x

18. Aby E, Saab S. Nonobese Nonalcoholic Fatty Liver Disease. Clin Liver Dis. 2017;10(5):130–3. Available from: https://doi.org/10.1002/cld.674

19. Kim D, Kim WR. Nonobese Fatty Liver Disease. Clin Gastroenterol Hepatol. 2017;15(4):474–85. Available from: https://doi.org/10.1016/j.cgh.2016.08.028

20. Alam S, Fahim SM, Chowdhury MAB, Hassan MZ, Azam G, Mustafa G. Prevalence and risk factors of non-alcoholic fatty liver disease in Bangladesh. JGH Open. 2018;2(2):39–46. Available from: https://doi.org/10.1002/jgh3.12044

21. Dowman JK, Tomlinson JW, Newsome PN. Pathogenesis of non-alcoholic fatty liver disease. QJM. 2010;103(2):71–83. Available from: https://doi.org/10.1093/qjmed/hcp158

22. Than NN, Newsome PN. A concise review of non-alcoholic fatty liver disease. Atherosclerosis. 2015;239(1):192–202. Available from: https://doi.org/10.1016/j.atherosclerosis.2015.01.001

23. Albhaisi S, Chowdhury A, Sanyal AJ. Non-alcoholic fatty liver disease in lean individuals. JHEP Rep. 2019;1(4):329–41. Available from: https://doi.org/10.1016/j.jhepr.2019.08.002

24. Perumpail B, Li A, John N, Sallam S, Shah N, Kwong W, et al. The therapeutic implications of the gut microbiome and probiotics in patients with NAFLD. Diseases. 2019;7(27):1–12. Available from: https://doi.org/10.3390/diseases7010027

25. Ahn H, Weaver M, Lyon D, Choi E, Fillingim RB. Physiol Behav. 2017;176(10):139–48.

26. Huang T, Behary J, Zekry A. Non-alcoholic fatty liver disease (NAFLD): a review of epidemiology, risk factors, diagnosis and management. Intern Med J. 2019;50(9):1038–47. Available from: https://doi.org/10.1111/imj.14709

27. Feng RN, Du SS, Wang C, Li YC, Liu LY, Guo FC. Lean-non-alcoholic fatty liver disease increases risk for metabolic disorders in a normal weight Chinese population. World J Gastroenterol. 2014;20(47):17932–40. Available from: https://doi.org/10.3748/wjg.v20.i47.17932

28. Naderian M, Kolahdoozan S, Sharifi AS, Garmaroudi G, Yaseri M, Poustchi H. Assessment of lean patients with non-alcoholic fatty liver disease in a middle income country; prevalence and its association with metabolic disorders: a cross-sectional study. Arch Iran Med. 2017;20(4):211–7. Available from: https://pubmed.ncbi.nlm.nih.gov/28412824/

29. Kumar R, Mohan S. Non-alcoholic Fatty Liver Disease in Lean Subjects: Characteristics and Implications. J Clin Transl Hepatol. 2017;(1):1–8. Available from: https://doi.org/10.14218/jcth.2016.00068

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30. Kim NH, Kim JH, Kim YJ, Yoo HJ, Kim HY, Seo JA, et al. Clinical and metabolic factors associated with development and regression of nonalcoholic fatty liver disease in nonobese subjects. Liver Int. 2014;34(4):604–11. Available from: https://doi.org/10.1111/liv.12454

31. Kim HJ, Kim HJ, Lee KE, Kim DJ, Kim SK, Ahn CW, et al. Metabolic significance of nonalcoholic fatty liver disease in nonobese, nondiabetic adults. Arch Intern Med. 2004;164(19):2169–75. Available from: https://doi.org/10.1001/archinte.164.19.2169

32. Alam S, Gupta UD, Alam M, Kabir J, Chowdhury ZR, Alam AKMK. Clinical, anthropometric, biochemical, and histological characteristics of nonobese nonalcoholic fatty liver disease patients of Bangladesh. Indian J Gastroenterol. 2014;33(5):452–7. Available from: https://doi.org/10.1007/s12664-014-0488-5

33. WHO Expert Consultation. Appropriate body-mass index for Asian populations and its implications for policy and intervention strategies. Lancet. 2004;363(9403):157–63. Available from: https://doi.org/10.1016/s0140-6736(03)15268-3

34. Almeda-Valdés P, Cuevas-Ramos D, Aguilar-Salinas CA. Metabolic syndrome and non-alcoholic fatty liver disease. Ann Hepatol. 2009;8(Suppl 1):S18–24. Available from: https://pubmed.ncbi.nlm.nih.gov/19381120/

35. Wei JL, Leung JC, Loong TC, Wong GL, Yeung DK, Chan RS, et al. Prevalence and severity of nonalcoholic fatty liver disease in non-obese patients: a population study using proton-magnetic resonance spectroscopy. Am J Gastroenterol. 2015;110(9):1306–14. Available from: https://doi.org/10.1038/ajg.2015.235

36. Thinkhamrop B, Chamadol N, Kim CS, Khuntikeo N, Songthamwat M. Gender differences in the prevalence of nonalcoholic fatty liver disease in the Northeast of Thailand: a population-based cross-sectional study. F1000Res. 2017;6:1630. Available from: https://doi.org/10.12688/f1000research.12417.2

37. Zawdie B, Tadesse S, Wolide AD, Nigatu TA, Bobasa EM. Non-alcoholic fatty liver disease and associated factors among type 2 diabetic patients in Southwest Ethiopia. Ethiop J Health Sci. 2018;28(1):19–30. Available from: https://doi.org/10.4314/ejhs.v28i1.4

38. Alam S, Gupta UD, Alam M, Kabir J, Chowdhury ZR, Alam AKMK. Clinical, anthropometric, biochemical, and histological characteristics of nonobese nonalcoholic fatty liver disease patients of Bangladesh. Indian J Gastroenterol. 2014;33(5):452–7. Available from: https://doi.org/10.1007/s12664-014-0488-5

39. Yahyaoglu F, Ataoglu HE, Tufan TU. FT3/FT4 ratio predicts non-alcoholic fatty liver disease independent of metabolic parameters in patients with euthyroidism and hypothyroidism. Clinics. 2016;71(4):221–5. Available from: https://doi.org/10.6061/clinics/2016(04)08

40. Rezayat AA, Moghadam MD, Nour G, Shirazinia M, Ghodsi H, Reza M. Association between smoking and non-alcoholic fatty liver disease: a systematic review and meta-analysis. J Int Med Res. 2018;46(6):227–33. Available from: https://doi.org/10.1177/2050312117745223

41. Das K, Das K, Mukherjee PS, Ghosh A, Ghosh S, Mridha AR, et al. Nonobese population in a developing country has a high prevalence of nonalcoholic fatty liver and significant liver disease. Hepatology. 2010;51(5):1593–602. Available from: https://doi.org/10.1002/hep.23567

42. Karnataka S, Mathew T, Vidyasagar S, Varma MD, Nandakrishna B, Holla AM. Glucose intolerance and insulin resistance in nonalcoholic fatty liver disease: a hospital-based cross-sectional study. J Obes Metab Res. 2017;4(3):68–73. Available from: https://journals.lww.com/jodb/fulltext/2017/08030/glucose_intolerance_and_insulin_resistance_in.2.aspx

43. Brunelli SM, Waikar SS, Bateman BT, Chang TI, Joannidis M, Thakar CV, et al. Preoperative statin use and postoperative acute kidney injury. Am J Med. 2013;126(1):22–9. Available from: https://doi.org/10.1016/j.amjmed.2012.06.021

44. Angulo P. Nonalcoholic fatty liver disease. N Engl J Med. 2002;346(16):1221–31. Available from: https://doi.org/10.1056/nejmra011775

45. Yang KC, Hung HF, Lu CW, Chang HH, Lee LT, Huang KC. Association of non-alcoholic fatty liver disease with metabolic syndrome independently of central obesity and insulin resistance. Sci Rep. 2016;6:27034. Available from: https://doi.org/10.1038/srep27034

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