

## Prevalence of Non-Alcoholic Fatty Liver Disease in Patients of Type-2 Diabetes Mellitus with Concomitant Risk Factors

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Conflict of interest: Nil

### Abstract

**Introduction:** Non-alcoholic fatty liver disease (NAFLD) is a distinct hepatic condition characterized by abnormal fat accumulation in liver cells, mostly in the form of triglycerides, which exceed 5% of liver weight, histologically resembling alcohol induced liver damage. Nonalcoholic fatty liver disease (NAFLD) appears to be the hepatic manifestation of metabolic syndrome, and is increasingly recognized as a major contributor to the burden of chronic liver disease world-wide

**Aims:** To provide a well —powered prospective validation of a relationship between Non-Alcoholic Fatty Liver Disease in Type-2 Diabetes Mellitus Patients with risk factors like increased BMI and abnormal lipid profile for diagnosis, prognosis, tailoring and management of Non Alcoholic Fatty Liver Disease.

**Materials and Methods:** It was a Cross Sectional Observational Study this study was conducted from 18 months from April 2020 to October 2021 at IPGME&R and SSKM Hospital, Kolkata-20. 100 patients were studied

**Result:** We examined that, in NAFLD Group, the mean ALT of patients was  $54.5833 \pm 7.7750$  and in without NAFLD Group, the mean ALT of patients was  $50.9500 \pm 4.8461$  which was statistically significant ( $p=0.0099$ ) and in NAFLD Group, the mean HDL of patients was  $51.7333 \pm 4.1817$  and in without NAFLD Group, the mean HDL of patients was  $51.4750 \pm 4.4375$  which was not statistically significant ( $p=0.7684$ ).

**Conclusion:** The study found a strong positive correlation between Type-2 Diabetes Mellitus severity and NAFLD severity, suggesting older age, high BMI, elevated lipid profile, and TSH level as predictors for NAFLD severity, necessitating early diagnosis and timely management.

**Keywords:** TYPE-2 DIABETES, Non-Alcoholic Fatty Liver Disease (NAFLD), Metabolic Syndrome and Concomitant Risk Factors.

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### Introduction

The development of NAFLD is associated with type-2 diabetes mellitus, hyperlipidemia, obesity, and hypothyroidism. According to our research, the degree of NAFLD and the duration and severity of Type-2 Diabetes Mellitus were strongly positively correlated. According to our research, individuals who are older, have a higher body mass index (BMI), a higher lipid profile, and a higher TSH level shouldn't be disregarded as indicators of the severity of non-alcoholic fatty liver disease. Following up with individuals who have Type-2 DM is therefore essential to ensuring an early diagnosis and prompt management of NAFLD. Nonalcoholic fatty liver disease (NAFLD) is becoming more widely acknowledged as a significant contributor to the global burden of

chronic liver disease and appears to be the hepatic manifestation of metabolic syndrome. When excessive alcohol consumption is not present, a broad range of fatty liver abnormalities, including simple steatosis, cirrhosis, steatohepatitis, and hepatocellular carcinoma (HCC), are referred to as nonalcoholic fatty liver disease (NAFLD). According to epidemiological research, the general Indian population has a 9–32% prevalence of NAFLD, with a higher frequency among individuals who are overweight or obese and those who have diabetes or pre-diabetes. According to reports, the prevalence of NAFLD in Indian patients with type 2 diabetes ranges between 12.5–87.5%. There is a considerable correlation between the prevalence of NAFLD and both insulin

resistance and dyslipidemia. Although the prevalence of hypertriglyceridemia varies greatly within NAFLD case series, all available data connect it to NAFLD.[1,2] Typically, NAFLD is either found by chance during a regular laboratory test or as part of a work-up for other illnesses including diabetes, hypertension, or morbid obesity. There are numerous ways to gauge the severity of NAFLD, which covers a broad clinical spectrum. The best diagnostic procedure for staging liver steatosis, inflammation, and fibrosis is liver biopsy; however, its application in patients with non-progressive fatty liver diseases is restricted due to ethical and medical concerns. [3,4] When compared to histological findings, liver ultrasonography, the gold standard approach, shows a good correlate with histological findings of fatty infiltration, with a sensitivity and specificity of 83% and 93%, respectively. [5] Although there is ample evidence linking type 2 diabetes to both microvascular and macrovascular problems, it has only recently been recognized that NAFLD is a significant consequence of type 2 diabetes. There is proof that cirrhosis is more likely to occur in T2DM patients with NAFLD than in those without the disease. [6,7] Patients with type 2 diabetes NAFLD may also be at risk for liver failure, even though cardiovascular disease is the primary source of excess morbidity and mortality in this condition. [8,9] To determine the prevalence of NAFLD in patients with type-2 diabetes and its relationship to other risk variables that predict the same condition, an observational descriptive study is carried out. In order to diagnose, prognosticate, customize, and manage nonalcoholic fatty liver disease, it is necessary to give a well-powered prospective validation of the association between nonalcoholic fatty liver disease and risk variables such as elevated body mass index and aberrant lipid profiles in patients with type 2 diabetes mellitus.

## Material and Methods

**Study Design:** Cross Sectional Observational Study.

**Study Setting:** This was a single-centre study.

**Place of Study:** IPGME & R and SSKM Hospital, Kolkata-20.

**Period of Study:** 18 months from April 2020 to October 2021.

**Study Population:** Non-Alcoholic Type-2 Diabetic patients of either sex in the age group of 18 to 60 years admitted in General Medicine Department of IPGME&R and SSKM Hospital

**Sample Size:** A sample size of 100 patients were studied.

**Inclusion Criteria:** Non Alcoholic Type-2 Diabetic Patients without any primary Liver disease.

**Exclusion Criteria:** Patients with known alcoholic liver disease, patients taking hepatotoxic drugs and patients with carcinoma of liver were excluded from the study

## Study Variables

1. Personal Profile: Age, Gender, Religion, Occupation, Address, Height, Weight, BMI, Addiction History, Family History.
2. Clinical Profile: General Physical Examination, Systemic Examination

## Laboratory Investigations

1. Complete blood count (CBC)
2. Blood sugar: fasting, postprandial and HbA1c
3. Lipid Profile
4. LFT
5. RFT
6. PT/INR/APTT
7. HbsAg, Anti HCV, ICTC
8. Thyroid Function Test
9. USG Whole Abdomen
10. ECG & Echocardiography

**Ethical Clearance:** Synopsis of the proposed study along with all relevant administrative and ethical documents was submitted to the Institutional Ethics Committee IPGME&R and SSKM Hospital for its approval and necessary action. The study started only after a clearance from ethical committee and written informed consent was provided for all study population. Only after written consent patients were included in the study.

**Procedure:** A total number of 100 patients with Type-2 DM were enrolled as per the inclusion/exclusion criteria. Proper written informed consent were taken from each patient. Detailed history and clinical findings were recorded in a case record form.

All necessary investigations was done. Abdominal USG was performed in all patients, those who were detected to have fatty liver were graded into grade-1, grade-2 and grade-3 as per the grading system of fatty liver on USG.

Those who were not detected to have Fatty Liver was considered as grade-0 and served as a control. The obtained data were analyzed by appropriate statistical test, using statistical software.

**Statistical Analysis:** Data were entered into Excel and analyzed using SPSS and GraphPad Prism. Numerical variables were summarized using means and standard deviations, while categorical variables were described with counts and percentages. Two-sample t-tests were used to compare independent groups, while paired t-tests accounted for

correlations in paired data. Chi-square tests (including Fisher's exact test for small sample sizes) were used for categorical data comparisons.

P-values  $\leq 0.05$  were considered statistically significant.

### Result

**Table 1: Association between Fatty Liver Grade with NAFLD and NO-NAFLD Group**

Group					
Fatty Liver Grade	NAFLD	NO NAFLD	Total	Chi-square value	p-value
0	0	40(100%)	40(40.0%)	100.0000	<0.0001
1	9(15.0%)	0	9(9.0%)		
2	29(48.3%)	0	29(29.0%)		
3	22(36.7%)	0	22(22.0%)		
Total	60(100.0%)	40(100.0%)	100(100.0%)		

**Table 2: Association of NAFLD & NO-NAFLD Group with Fatty Liver (FL) Grade**

Fatty Liver Grade						Chi-square value	p-value
Group	0	1	2	3	Total		
NAFLD	0	9(100.0%)	29(100.0%)	22(100.0%)	60(60.0%)	100.0000	<0.0001
NO NAFLD	40(100.0%)	0	0	0	40(40.0%)		
TOTAL	40(100.0%)	9(100.0%)	29(100.0%)	22(100.0%)	100(100.0%)		

**Table 3: Distribution of mean Fatty Liver (FL) Grade with NAFLD and NO-NAFLD Group**

	Group	Number	Mean	SD	Minimum	Maximum	Median	p-value
FL Grade	NAFLD	60	2.2167	0.6911	1.0000	3.0000	2.0000	<0.0001
	NO NAFLD	40	0.0000	0.0000	0.0000	0.0000	0.0000	

**Table 4: Distribution of mean FL Grade with NAFLD and NO-NAFLD Group**

	Group	Number	Mean	SD	Minimum	Maximum	Median	p-value
FL Grade	NAFLD	60	2.2167	0.6911	1.0000	3.0000	2.0000	<0.0001
	NO NAFLD	40	0.0000	0.0000	0.0000	0.0000	0.0000	

**Table 5: Distribution of mean FT4, FT3 with NAFLD and NO-NAFLD Group**

	Group	Number	Mean	SD	Minimum	Maximum	Median	p-value
FT4	NAFLD	60	1.4633	0.7883	0.4000	3.6000	1.4000	<0.0001
	NO NAFLD	40	6.1475	0.6288	5.0000	7.0000	6.2500	
FT3	NAFLD	60	1.1250	0.3286	0.5000	2.0000	1.1500	<0.0001
	NO NAFLD	40	2.9800	0.4751	2.1000	3.8000	2.9500	

**Table 6: Distribution of mean FT4, FT3 with Fatty Liver (FL) Grade**

	FL Grade	Number	Mean	SD	Minimum	Maximum	Median	p-value
FT4	0	40	6.1475	0.6288	5	7	6.25	<0.0001
	1	9	2.9333	0.4528	2.1	3.6	2.9	
	2	29	1.5828	0.2592	1.2	2	1.6	
	3	22	0.7045	0.1704	0.4	0.9	0.75	
FT3	0	40	2.98	0.4751	2.1	3.8	2.95	<0.0001
	1	9	1.5889	0.2667	1.2	2	1.6	
	2	29	1.2414	0.1524	1	1.5	1.2	
	3	22	0.7818	0.1053	0.5	0.9	0.8	

In NAFLD Group, 9 (15.0%) patients were of FL Grade 1, 29 (48.3%) patients were of FL Grade 2 and 22 (36.7%) patients were of FL Grade 3. In without NAFLD Group, all patients [40 (100.0%)]

were of FL Grade 0. Association of Fatty Liver Grade with Group was statistically significant ( $p < 0.0001$ ). In FL Grade 0, all patients [40 (100.0%)] were in without NAFLD Group. In FL

Grade 1, all patients [9 (100.0%)] were in NAFLD Group. In FL Grade 2, all patients [29 (100.0%)] were in NAFLD Group. In FL Grade 3, all patients [22 (100.0%)] were in NAFLD Group. Association of Group with Fatty Liver Grade was statistically significant ( $p < 0.0001$ ). In NAFLD Group, the mean FL grade (mean  $\pm$  s.d.) of patients was  $2.2167 \pm .6911$ . In without NAFLD Group, the mean FL grade (mean  $\pm$  s.d.) of patients was  $0.0000 \pm 0.0000$ . Distribution of mean FL Grade with Group was statistically significant ( $p < 0.0001$ ). In NAFLD Group, the mean FL Grade (mean  $\pm$  s.d.) of patients was  $2.2167 \pm 0.6911$ . In without NAFLD Group, the mean FL Grade (mean  $\pm$  s.d.) of patients was  $0.0000 \pm 0.0000$ . Distribution of mean FL Grade with Group was statistically significant ( $p < 0.0001$ ). In NAFLD Group, the mean FT4 (mean  $\pm$  s.d.) of patients was  $1.4633 \pm 0.7883$ . In without NAFLD Group, the mean FT4 (mean  $\pm$  s.d.) of patients was  $6.1475 \pm 0.6288$ .

Distribution of mean FT4 with Group was statistically significant ( $p < 0.0001$ ). In NAFLD

Group, the mean FT3 (mean  $\pm$  s.d.) of patients was  $1.1250 \pm 0.3286$ . In without NAFLD Group, the mean FT3 (mean  $\pm$  s.d.) of patients was  $2.9800 \pm 0.4751$ . Distribution of mean FT3 with Group was statistically significant ( $p < 0.0001$ ). In FL Grade 0, the mean FT4 (mean  $\pm$  s.d.) of patients was  $6.1475 \pm 0.6288$ . In FL Grade 1, the mean FT4 (mean  $\pm$  s.d.) of patients was  $2.9333 \pm 0.4528$ . In FL Grade 2, the mean FT4 (mean  $\pm$  s.d.) of patients was  $1.5828 \pm 0.2592$ . In FL Grade 3, the mean FT4 (mean  $\pm$  s.d.) of patients was  $0.7045 \pm 0.1704$ . Distribution of mean FT4 with FL Grade was statistically significant ( $p < 0.0001$ ). In FL Grade 0, the mean FT3 (mean  $\pm$  s.d.) of patients was  $2.9800 \pm 0.4751$ . In FL Grade 1, the mean FT3 (mean  $\pm$  s.d.) of patients was  $1.5889 \pm 0.2667$ . In FL Grade 2, the mean FT3 (mean  $\pm$  s.d.) of patients was  $1.2414 \pm 0.1524$ . In FL Grade 3, the mean FT3 (mean  $\pm$  s.d.) of patients was  $0.7818 \pm 0.1053$ . Distribution of mean FT3 with FL Grade was statistically significant ( $p < 0.0001$ ).

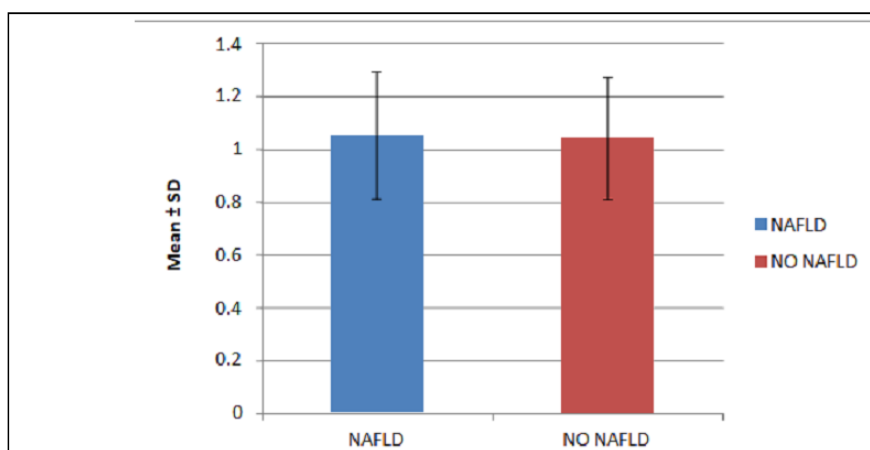


Figure 1: Distribution of mean Total bilirubin with NAFLD and NO-NAFLD Group

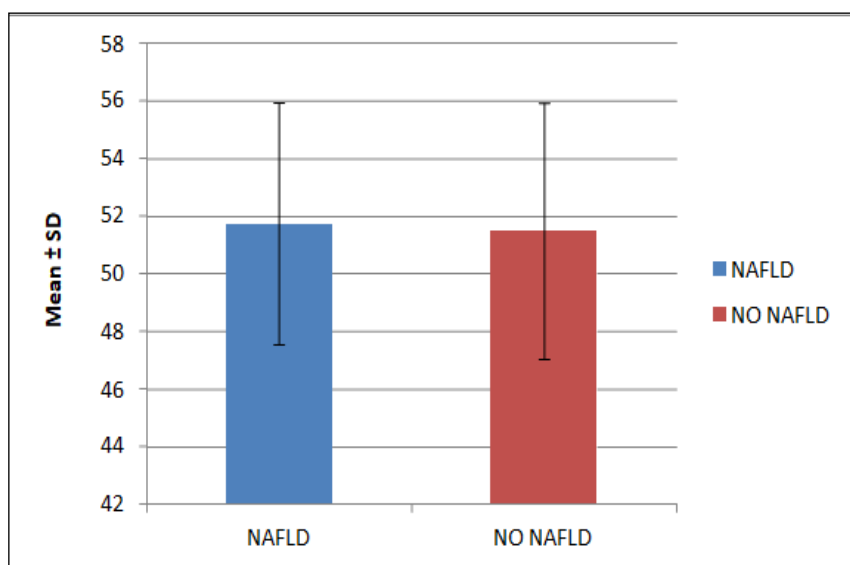


Figure 2: Distribution of mean HDL with NAFLD and NO-NAFLD Group

## Discussion

This Cross Sectional Observational Study was conducted in General Medicine Department of IPGME & R and SSKM Hospital from April 2020 to October 2021. Non Alcoholic Type-2 Diabetic Patients without any primary Liver disease were included in this study. Total 100 patients were present in this study.

Data of our study showed that, in NAFLD Group, 33 (55.0%) patients were Female and 27 (45.0%) patients were Male and in without NAFLD Group, 24 (60.0%) patients were Female and 16 (40.0%) patients were Male which was not statistically significant ( $p=0.6207$ ).

We observed that, in NAFLD Group, 9 (15.0%) patients were FL Grade 1, 29 (48.3%) patients were FL Grade 2 and 22 (36.7%) patients were FL Grade 3 and in without NAFLD Group, all patients [40 (100.0%)] were FL Grade 0 which was statistically significant ( $p<0.0001$ ).

Present study showed that, in FL Grade 0, all patients [40 (100.0%)] were in without NAFLD Group and in FL Grade 1, all patients [9 (100.0%)] were in NAFLD Group, in FL Grade 2, all patients [29 (100.0%)] were in NAFLD Group and in FL Grade 3, all patients [22 (100.0%)] were in NAFLD Group which was statistically significant ( $p<0.0001$ ). We examined that, in NAFLD Group, the mean FL Grade of patients was  $2.2167 \pm 0.6911$  and in without NAFLD Group, the mean FL Grade of patients was  $0.0000 \pm 0.0000$  which was statistically significant ( $p<0.0001$ ).

Our study showed that, in NAFLD Group, the mean FBS (mg/dl) of patients was  $227.9167 \pm 51.3936$  and in without NAFLD Group, the mean FBS (mg/dl) of patients was  $134.5250 \pm 2.7079$  which was statistically significant ( $p<0.0001$ ). We observed that, in NAFLD Group, the mean PPBS of patients were  $333.7500 \pm 39.1605$  and in without NAFLD Group, the mean PPBS of patients were  $230.3000 \pm 14.3012$  which was statistically significant ( $p<0.0001$ ).

Data of our study showed that, in NAFLD Group, the mean HbA1C% of patients was  $7.9067 \pm 0.3905$  and in without NAFLD Group, the mean HbA1C% of patients was  $6.6625 \pm 0.1213$  which was statistically significant ( $p<0.0001$ ).

We observed that, in NAFLD Group, the mean Duration of diabetes (yr) of patients was  $9.4333 \pm 2.3961$  and in without NAFLD Group, the mean Duration of diabetes (yr) of patients was  $4.3000 \pm 1.2850$  which was statistically significant ( $p<0.0001$ ).

Present study showed that, in NAFLD Group, the mean TG of patients was  $286.4167 \pm 30.4159$  and in without NAFLD Group, the mean TG of patients

was  $170.1250 \pm 8.4100$  which was statistically significant ( $p<0.0001$ ). We examined that, in NAFLD Group, the mean TC of patients was  $215.9500 \pm 24.8258$  and in without NAFLD Group, the mean TC of patients was  $134.4750 \pm 2.6017$  which was statistically significant ( $p<0.0001$ ).

Data of our study showed that, in NAFLD Group, the mean LDL of patients was  $238.8667 \pm 39.2340$  and in without NAFLD Group, the mean LDL of patients was  $133.6000 \pm 2.3512$  which was statistically significant ( $p<0.0001$ ). We observed that, in NAFLD Group, the mean HDL of patients was  $51.7333 \pm 4.1817$  and in without NAFLD Group, the mean HDL of patients was  $51.4750 \pm 4.4375$  which was not statistically significant ( $p=0.7684$ ).

Amarapurkar D et al [10](2007) found that prevalence of NAFLD based on the ultrasound above 20 years of age was 18.9%. NAFLD was more prevalent in male than female (24.6% vs 13.6%,  $p<0.001$ ). Risk factors associated with NAFLD were age more than 40 years, male gender, central obesity, high BMR  $>25$ , elevated fasting blood sugar, raised AST and ALT. Prevalence of NAFLD in Indian population is comparable to the west.

Present study showed that, in NAFLD Group, the mean AST of patients was  $50.6833 \pm 4.9007$  and in without NAFLD Group, the mean AST of patients was  $50.9500 \pm 4.8461$  which was not statistically significant ( $p=0.7894$ ). We examined that, in NAFLD Group, the mean ALT of patients was  $54.5833 \pm 7.7750$  and in without NAFLD Group, the mean ALT of patients was  $50.9500 \pm 4.8461$  which was statistically significant ( $p=0.0099$ ).

Younossi ZM et al [11](2004) found that markers of hepatic dysfunction (low albumin level, high total bilirubin level, and prolonged prothrombin time) were the only independent predictors of increased mortality. Patients with NAFLD and DM are at risk for the development of an aggressive outcome, such as cirrhosis and mortality. This study supports the potential role of insulin resistance in the development of poor clinical outcomes in patients with NAFLD.

Our study showed that, in NAFLD Group, the mean Total bilirubin of patients was  $1.0533 \pm 0.2411$  and in without NAFLD Group, the mean Total bilirubin of patients was  $1.0425 \pm 0.2319$  which was not statistically significant ( $p=0.8236$ ).

We observed that, in NAFLD Group, the mean ALP of patients was  $106.4833 \pm 8.0790$  and in without NAFLD Group, the mean ALP of patients was  $107.0500 \pm 8.2864$  which was not statistically significant ( $p=0.7345$ ). Data of our study showed that, in NAFLD Group, the mean Albumin of patients was  $5.1867 \pm 0.5193$  and in without

NAFLD Group, the mean Albumin of patients was  $5.2000 \pm 0.5028$  which was not statistically significant ( $p=0.8989$ ).

We examined that, in NAFLD Group, the mean Globulin of patients was  $2.3983 \pm 0.2771$  and in without NAFLD Group, the mean Globulin of patients was  $2.3725 \pm 0.2792$  which was not statistically significant ( $p=0.8989$ ).

Present study showed that, in NAFLD Group, the mean Urea of patients was  $35.2833 \pm 2.9521$  and in without NAFLD Group, the mean Urea of patients was  $35.2000 \pm 2.8483$  which was not statistically significant ( $p=0.8888$ ). We observed that, in NAFLD Group, the mean Creatinine of patients was  $1.0567 \pm 0.2389$  and in without NAFLD Group, the mean Creatinine of patients was  $1.0450 \pm 0.2320$  which was not statistically significant ( $p=0.8093$ ).

Our study showed that, in NAFLD Group, the mean FL Grade of patients was  $2.2167 \pm 0.6911$  and in without NAFLD Group, the mean FLG Grade of patients was  $0.0000 \pm 0.0000$  which was statistically significant ( $p<0.0001$ ).

Deshmukh V et al [12](2013) found that the thyroid function tests were as follows: Mean values were: T3:  $1.79 \pm 0.42$  ng/mL, T4:  $10.23 \pm 2.25$   $\mu$ g/dL, FT3:  $1.88 \pm 0.19$  pg/mL, FT4:  $1.12 \pm 0.21$  ng/dL, S.TSH:  $2.22 \pm 1.06$   $\mu$ lu/mL. 10.2% of euthyroid subjects had antimicrosomal antibodies (AMA) +ve (mean titer 1:918) and 23.6% were anti-thyroid peroxidase autoantibody (anti-TPO) +ve (mean titer 15.06 Au/mL).

We examined that, in NAFLD Group, the mean TSH of patients was  $6.3067 \pm 0.5135$  and in without NAFLD Group, the mean TSH of patients was  $3.0375 \pm 0.4845$  which was statistically significant ( $p<0.0001$ ). Data of our study showed that, in NAFLD Group, the mean FT4 of patients was  $1.4633 \pm 0.7883$  and in without NAFLD Group, the mean FT4 of patients was  $6.1475 \pm 0.6288$  which was statistically significant ( $p<0.0001$ ). Present study showed that, in NAFLD Group, the mean FT3 of patients was  $1.1250 \pm 0.3286$  and in without NAFLD Group, the mean FT3 of patients was  $2.9800 \pm 0.4751$  which was statistically significant ( $p<0.0001$ ).

We examined that, in NAFLD Group, the mean SBP of patients was  $134.7000 \pm 7.9219$  and in without NAFLD Group, the mean SBP of patients was  $134.0000 \pm 7.5922$  which was not statistically significant ( $p=0.6608$ ). Our study showed that, in NAFLD Group, the mean DBP of patients was  $89.7000 \pm 5.7851$  and in without NAFLD Group, the mean DBP of patients was  $89.2000 \pm 5.3359$  which was not statistically significant ( $p=0.6634$ ).

We observed that, in FL Grade 0, the mean Age (yr) of patients was  $44.8750 \pm 6.9621$ , in FL Grade 1, the mean Age (yr) of patients was  $47.0000 \pm 7.6811$ , in FL Grade 2, the mean Age (yr) of patients was  $48.7586 \pm 4.3643$  and in FL Grade 3, the mean Age (yr) of patients was  $48.2273 \pm 2.7243$  which was statistically significant ( $p=0.0276$ ).

Data of our study showed that, in FL Grade 0, the mean BMI of patients was  $24.7750 \pm 2.8260$ , in FL Grade 1, the mean BMI of patients was  $23.6000 \pm 1.4866$ , in FL Grade 2, the mean BMI of patients was  $27.5207 \pm 1.9586$ , in FL Grade 3, the mean BMI of patients was  $32.5227 \pm 2.2520$  which was statistically significant ( $p<0.0001$ ).

We examined that, in FL Grade 0, the mean FBS (mg/dl) of patients was  $134.5250 \pm 2.7079$ , in FL Grade 1, the mean FBS (mg/dl) of patients was  $155.2222 \pm 12.2145$ , in FL Grade 2, the mean FBS (mg/dl) of patients was  $211.1724 \pm 34.2711$  and in FL Grade 3, the mean FBS (mg/dl) of patients was  $279.7273 \pm 18.2709$  which was statistically significant ( $p<0.0001$ ). Present study showed that, in FL Grade 0, the mean PPBS of patients was  $230.3000 \pm 14.3012$ , in FL Grade 1, the mean PPBS of patients was  $269.2222 \pm 12.5775$ , in FL Grade 2, the mean PPBS of patients was  $322.0690 \pm 11.6770$  and in FL Grade 3, the mean PPBS of patients was  $375.5455 \pm 16.2326$  which was statistically significant ( $p<0.0001$ ).

We observed that, in FL Grade 0, the mean HBA1C% of patients was  $6.6625 \pm 0.1213$ , in FL Grade 1, the mean HBA1C% of patients was  $7.2444 \pm 0.1667$ , in FL Grade 2, the mean HBA1C% of patients was  $7.8172 \pm 0.1338$  and in FL Grade 3, the mean HBA1C% of patients was  $8.2955 \pm 0.1914$  which was statistically significant ( $p<0.0001$ ).

Data of our study showed that, in FL Grade 0, the mean Duration of diabetes (yr) of patients was  $4.3000 \pm 1.2850$ , in FL Grade 1, the mean Duration of diabetes (yr) of patients was  $6.6667 \pm 1.4142$ , in FL Grade 2, the mean Duration of diabetes (yr) of patients was  $8.6552 \pm 1.4947$  and in FL Grade 3, the mean Duration of diabetes (yr) of patients was  $11.5909 \pm 1.8429$  which was statistically significant ( $p<0.0001$ ).

We examined that, in FL Grade 0, the mean TG of patients was  $170.1250 \pm 8.4100$ , in FL Grade 1, the mean TG of patients was  $243.4444 \pm 6.1667$ , in FL Grade 2, the mean TG of patients was  $273.3793 \pm 10.1925$ , in FL Grade 3, the mean TG of patients was  $321.1818 \pm 12.4044$  which was statistically significant ( $p<0.0001$ ). We examined that, in FL Grade 0, the mean TC of patients was  $134.4750 \pm 2.6017$ , in FL Grade 1, the mean TC of patients was  $164.7778 \pm 3.6324$ , in FL Grade 2, the mean TC of patients was  $215.3793 \pm 7.7617$  and in FL

Grade 3, the mean TC of patients was  $237.6364 \pm 5.5510$  which was statistically significant ( $p < 0.0001$ ).

Data of our study showed that, in FL Grade 0, the mean LDL of patients was  $133.6000 \pm 2.3512$ , in FL Grade 1, the mean LDL of patients was  $167.1111 \pm 14.5297$ , in FL Grade 2, the mean LDL of patients was  $230.9655 \pm 11.1659$  and in FL Grade 3, the mean LDL of patients was  $278.6364 \pm 11.3244$  which was statistically significant ( $p < 0.0001$ ). We observed that, in FL Grade 0, the mean HDL of patients was  $51.4750 \pm 4.4375$ , in FL Grade 1, the mean HDL of patients was  $53.0000 \pm 2.7386$ , in FL Grade 2, the mean HDL of patients was  $51.5172 \pm 4.4290$  and in FL Grade 3, the mean HDL of patients was  $51.5000 \pm 4.3943$  which was not statistically significant ( $p = 0.8009$ ).

Present study showed that, in FL Grade 0, the mean AST of patients was  $50.9500 \pm 4.8461$ , in FL Grade 1, the mean AST of patients was  $47.4444 \pm 5.0028$ , in FL Grade 2, the mean AST of patients was  $51.8276 \pm 4.4164$  and in FL Grade 3, the mean AST of patients was  $50.5000 \pm 5.0592$  which was not statistically significant ( $p = 0.1244$ ). We examined that, in FL Grade 0, the mean ALT of patients was  $50.9500 \pm 4.8461$ , in FL Grade 1, the mean ALT of patients was  $49.3333 \pm 5.3385$ , in FL Grade 2, the mean ALT of patients was  $53.0690 \pm 7.8737$  and in FL Grade 3, the mean ALT of patients was  $58.7273 \pm 6.5841$  which was statistically significant ( $p < 0.0001$ ).

Data of our study showed that, in FL Grade 0, the mean Total bilirubin of patients was  $1.0425 \pm 0.2319$ , in FL Grade 1, the mean Total bilirubin of patients was  $1.0778 \pm 0.2438$ , in FL Grade 2, the mean Total bilirubin of patients was  $1.0586 \pm 0.2457$  and in FL Grade 3, the mean Total bilirubin of patients was  $1.0364 \pm 0.2441$  which was not statistically significant ( $p = 0.9659$ ).

We observed that, in FL Grade 0, the mean ALP of patients was  $107.0500 \pm 8.2864$ , in FL Grade 1, the mean ALP of patients was  $105.5556 \pm 9.9135$ , in FL Grade 2, the mean ALP of patients was  $107.2414 \pm 7.6609$  and in FL Grade 3, the mean ALP of patients was  $105.8636 \pm 8.1316$  which was not statistically significant ( $p = 0.8963$ ).

Present study showed that, in FL Grade 0, the mean Albumin of patients was  $5.2000 \pm 0.5028$ , in FL Grade 1, the mean Albumin of patients was  $5.1222 \pm 0.5761$ , in FL Grade 2, the mean Albumin of patients was  $5.2000 \pm 0.5106$  and in FL Grade 3, the mean Albumin of patients was  $5.1955 \pm 0.5305$  which was not statistically significant ( $p = 0.9805$ ). We examined that, in FL Grade 0, the mean Globulin of patients was  $2.3725 \pm 0.2792$ , in FL Grade 1, the mean Globulin of patients was

$2.4444 \pm 0.2789$ , in FL Grade 2, the mean Globulin of patients was  $2.4000 \pm 0.2891$  and in FL Grade 3, the mean Globulin of patients was  $2.3773 \pm 0.2707$  which was not statistically significant ( $p = 0.9023$ ).

We found that, in FL Grade 0, the mean Urea of patients was  $35.2000 \pm 2.8483$ , in FL Grade 1, the mean Urea of patients was  $34.3333 \pm 3.2787$ , in FL Grade 2, the mean Urea of patients was  $35.3793 \pm 2.9570$  and in FL Grade 3, the mean Urea of patients was  $35.5455 \pm 2.8740$  which was not statistically significant ( $p = 0.7586$ ). We observed that, in FL Grade 0, the mean Creatinine of patients was  $1.0450 \pm 0.2320$ , in FL Grade 1, the mean Creatinine of patients was  $1.0778 \pm 0.2635$ , in FL Grade 2, the mean Creatinine of patients was  $1.0655 \pm 0.2349$  and in FL Grade 3, the mean Creatinine of patients was  $1.0364 \pm 0.2441$  which was not statistically significant ( $p = 0.9545$ ).

Present study showed that, in FL Grade 0, the mean TSH of patients was  $3.0375 \pm 0.4845$ , in FL Grade 1, the mean TSH of patients was  $5.3778 \pm 0.4295$ , in FL Grade 2, the mean TSH of patients was  $6.2552 \pm 0.1920$  and in FL Grade 3, the mean TSH of patients was  $6.7545 \pm 0.1945$  which was statistically significant ( $p < 0.0001$ ). We observed that, in FL Grade 0, the mean FT4 of patients was  $6.1475 \pm 0.6288$ , in FL Grade 1, the mean FT4 of patients was  $2.9333 \pm 0.4528$ , in FL Grade 2, the mean FT4 of patients was  $1.5828 \pm 0.2592$  and in FL Grade 3, the mean FT4 of patients was  $0.7045 \pm 0.1704$  which was statistically significant ( $p < 0.0001$ ). Data of our study showed that, in FL Grade 0, the mean FT3 of patients was  $2.9800 \pm 0.4751$ , in FL Grade 1, the mean FT3 of patients was  $1.5889 \pm 0.2667$ , in FL Grade 2, the mean FT3 of patients was  $1.2414 \pm 0.1524$  and in FL Grade 3, the mean FT3 of patients was  $0.7818 \pm 0.1053$  which was statistically significant ( $p < 0.0001$ ).

We found that, in FL Grade 0, the mean SBP of patients was  $134.0000 \pm 7.5922$ , in FL Grade 1, the mean SBP of patients was  $135.7778 \pm 9.5627$ , in FL Grade 2, the mean SBP of patients was  $134.8276 \pm 8.1682$  and in FL Grade 3, the mean SBP of patients was  $134.0909 \pm 7.1840$  which was not statistically significant ( $p = 0.9188$ ). Present study showed that, in FL Grade 0, the mean DBP of patients was  $89.2000 \pm 5.3359$ , in FL Grade 1, the mean DBP of patients was  $91.5556 \pm 5.5478$ , in FL Grade 2, the mean DBP of patients was  $89.1724 \pm 5.7945$  and in FL Grade 3, the mean DBP of patients was  $89.6364 \pm 5.9725$  which was not statistically significant ( $p = 0.7009$ ).

## Conclusion

We concluded that patients with Type-2 Diabetes Mellitus, Hyperlipidemia, Obesity and Hypothyroidism are at risk for the development of NAFLD. In our study there was strong positive co-

relation between the severity of NAFLD with the severity and duration of Type-2 Diabetes Mellitus. Our study indicates that, patients with older age, high BMI, elevated lipid profile and TSH level should be taken seriously as a predictor of severity of NAFLD. Therefore, it is necessary to follow-up patients with Type-2 DM to ensure early diagnosis and timely management of NAFLD.

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