



ST. PAUL'S HOSPITAL MILLENNIUM MEDICAL COLLEGE

DEPARTMENT OF RADIOLOGY AND

MEDICAL RADIOLOGY TECHNOLOGY

CORRELATION BETWEEN SONOGRAPHIC GRADES OF NONALCOHOLIC
FATTY LIVER DISEASE AND LIPID PROFILE

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Acronyms and Abbreviations

CT- Computed Tomography

CVD- Cardiovascular disease

DM – Diabetes mellitus

EMR- Electronic Medical Record

HDL-C -High Density Lipoprotein Cholesterol

HTN - Hypertension

LDL-C - Low Density Lipoprotein Cholesterol

LFT-Liver Function Test

MDCT-Multi detector Computed Tomography

MOH-Ministry of Health

MRI-Magnetic Resonance Imaging

NAFLD- Non-Alcoholic Fatty Liver Disease

NASH- Non-Alcoholic steatohepatitis

RIS-Radiology Information System

SPHMMC- Saint Paul's Hospital Millennium Medical College

T2DM- Type 2 Diabetes mellitus

TG- Triglycerides

TC-Total Cholesterol

USG-Ultrasonography

VLDL-Very low density lipoprotein

WHO –World Health Organization

Abstract

Introduction: Non-alcoholic fatty liver disease (NAFLD) is a form of metabolic liver disease in which fat changes (steatosis) are associated with lobular inflammation, hepatocyte injury, polymorphs, or liver fibrosis. Most patients with NAFLD have no symptoms or signs of liver disease at the time of diagnosis. However, many patients report fatigue or malaise and a sensation of fullness or discomfort on the right side of the upper abdomen. Hepatomegaly is the only physical finding in most patients.

Objective: To evaluate the correlation between sonographic grades of nonalcoholic fatty liver disease and lipid profile at St. Paul's hospital millennium medical college, Addis Ababa, Ethiopia, 2024.

Methods: Institutional based retrospective chart review was conducted at St. Paul's Hospital Millennium Medical College from June 2024 to July 2024. The USG findings were accessed from radiology information system (RIS). The collected data was entered into Epi Data version 7.2.1 and exported to SPSS version 25 for analysis. For descriptive statistics tables, graphs showing the frequency mean and standard deviation were used. The degree and direction of the ordinal relationship between the nonalcoholic fatty liver disease and lipid profile were measured using the spearman correlation coefficient.

Result: There were 426 patients in all who had been identified with nonalcoholic fatty liver disease on ultrasound, the majority of whom had grade 1 nonalcoholic fatty liver 56.6%, (95%CI: 51.7%-61.3%). Median age of 48 years (IQR: 38-58) were included in this study. The majority 234 (54.6%) of the participants were females and 140 (59.8%) of them found in grade 1 nonalcoholic fatty liver disease. According to spearman's analysis, the grade of nonalcoholic fatty liver disease had weak correlation with triglyceride ($r < 0.3$, $p < 0.001$) and total cholesterol ($r < 0.3$, $p < 0.05$).

Conclusion and recommendation: In conclusion, regarding this study, TG and TC had a statistically significant weak correlation with nonalcoholic fatty liver disease. This emphasizes how crucial it is to use blood-based markers to evaluate the degree and metabolic effects of non-alcoholic fatty liver disease. More multicenter longitudinal studies are required to confirm these findings and provide insight into the underlying processes causing these relationships.

Key words: Sonographic, Non-alcoholic fatty liver disease, Lipid profile

1. Introduction

1.1. Background

Non-alcoholic fatty liver disease (NAFLD) is a form of metabolic liver disease in which fat changes (steatosis) are associated with lobular inflammation, hepatocyte injury, polymorphs, or liver fibrosis.(1). A NAFLD histologic classification system (grade 1 to grade 3) has been proposed that correlates certain histologic features with the long-term prognosis. In this classification system: Grade I constitute simple steatosis. Grade II is steatosis with lobular inflammation and ballooned hepatocytes. Grade III is steatosis, lobular inflammation, ballooned hepatocytes and Mallory hyaline or fibrosis(2, 3) .

This histologic grading gives an indirect estimation of the quantification of fat deposition in the liver. It should also be remembered that NAFLD is a spectrum with the most severe forms consists of liver fibrosis and cirrhosis. Hence, higher the grade of fatty liver, more the chances of progressing to fibrosis and then cirrhosis(4-6).

Fatty liver can be easily diagnosed by imaging. Although Liver biopsy is thought of as the gold standard for assessment of NAFLD, it has been limited by its invasiveness and unsuitability for screening purposes. Fortunately, it can be diagnosed by ultrasound, computed tomography (CT), and magnetic resonance imaging (MRI). In ultrasonography (USG), the echogenicity of normal liver equals or minimally exceeds that of the renal cortex or spleen, with intrahepatic vessels sharply demarcated and posterior aspects of liver well depicted. Fatty liver in USG can be diagnosed if the liver echogenicity exceeds that of the renal cortex and spleen and there is attenuation of ultrasound wave, loss of definition of the diaphragm, and poor delineation of the intrahepatic architecture (7-10)

Biopsy can detect the liver fatty infiltration, also it is a painful procedure with dangerous complication like bleeding(11).The ultrasound has moderate accuracy and is widely available so it is the primary tool to diagnose NAFLD in routine practice(12).

Most patients with NAFLD have no symptoms or signs of liver disease at the time of diagnosis. However, many patients report fatigue or malaise and a sensation of fullness or discomfort on the right side of the upper abdomen. Hepatomegaly is the only physical finding in most patients(13).NAFLD is linked with raised values of VLDL, TG, and LDL with decreased values of serum HDL which can lead to cardiovascular diseases (CVD) morbidity and mortality(14).

Ultrasound can detect the liver fatty infiltration but cannot differentiate between NAFLD and NASH. This differentiation needs a liver biopsy and is essential because of the much higher risk of liver fibrosis and cirrhosis with NASH. Liver biopsy is clinically impractical because of the large numbers of patients with NAFLD and that most patients are asymptomatic and its high cost and sampling errors(15) . Also it is a painful procedure with dangerous complication like bleeding(16). The ultrasound has moderate accuracy and is widely available so it is the primary tool to diagnose NAFLD in routine practice (17) .

This correlation study between sonographic grade of non-alcoholic fatty liver disease and lipid profile will help in early protective management and prevention of complications due NAFLD through prompt specific measures to decrease the burden of disease and outcome in terms of disability and death.

1.2. Statement of problem

Fatty liver is a common problem worldwide. Its prevalence has been estimated to be 20%–30% in general population in Western countries(18). Earlier reports indicated that most cases of NAFLD are relatively mild and have a benign course. However, now it has been documented that a number of these cases can progress to fibrosis, cirrhosis, liver failure and hepatocellular carcinoma and thus contributes to liver-related mortality and morbidity(19, 20).

Most NAFLD cases have a benign course without symptoms or signs of liver disease but some cases can be progressive and develop fibrosis and cirrhosis or even liver failure and hepatocellular carcinoma(21). Most patients with NAFLD have no symptoms or signs of liver disease at the time of diagnosis. However, many patients report fatigue or malaise and a sensation of fullness or discomfort on the right side of the upper abdomen. Hepatomegaly is the only physical finding in most patients(22). It was thought to be a benign condition but is now increasingly recognized as a major cause of liver-related morbidity and mortality. Studies introduced that nonalcoholic fatty liver disease (NAFLD) may progress to cirrhosis, liver failure, and hepatocellular carcinoma(23, 24).

1.3. Rationale of the Study

Ultrasound is clinically easy-to-use and low-cost as a diagnostic tool to detect NAFLD, which usually shows no symptoms in patients. Some parameters of ultrasonography findings have been used to grade the severity of NAFLD. There is limited information on the cause of non-alcoholic fatty liver disease and its correlation with abnormal lipid profile. NAFLD is a poorly researched area in our country. There are only a few studies done in Ethiopia on NAFLD. The studies only described NAFLD and its correlation with Lipid profile in patients with diabetes. In Saint Paul's Hospital Millennium Medical College, there is no known study done at all on this area to the best of my knowledge. So, the study aims to evaluate grades of NAFLD in all patients regardless of DM; where there is no known study done to date in Ethiopia.

The knowledge generated from this study helps the Addis Ababa health bureau and hospitals under it decide where to focus their efforts to know the correlation between non-alcoholic fatty liver disease and lipid profile. So, the information generated from this study can be used as input by stakeholders to help in prevention of complications due to NAFLD, fibrosis, cirrhosis, liver failure, and hepatocellular carcinoma and thus contribute to prevention of liver-related mortality and morbidity. This study can also be used as baseline data and a reference for other researchers who want to conduct further studies on related topics.

2. Literature review

2.1. Prevalence of NAFLD

Study conducted in H. Adam Malik Medan hospital showed distribution of NAFLD to be Grade 1: 32 (40%), Grade II: 29 (36%), and Grade III: 19 (23%) patients. There is a significant correlation between NAFLD grade with TC and LDL-C (25).

A cross-sectional study done in Indonesia in all patients with T2DM, consisted of Grade 1: 32 (40%), Grade II: 29 (36%), and Grade III: 19 (23%) patients. There was a significant difference between TC, TG, and LDL-C ($p < 0.01$) in the three grades of NAFLD.(26).

The prospective, analytical observational study done in India in 122 patients , results showed that out of the 122 selected participants, 51 subjects were categorized as grade I, 63 as grade II and 8 as grade III fatty liver(27) and also other study done in India Bharati medical college and hospital during June 2018 to May 2019 NAFLD study results showed that of 384 patients, 352 (91.7%), 30 (7.8%), and 2 (0.5%) had grade I, II, and III fatty liver, respectively (28)

A hospital-based cross-sectional study from June 2018 to May 2019 conducted in the KVG Medical College and Hospital, revealed that among 100 patients, 52% have grade I, 30% have grade II, and 18% have grade III NAFLD (29).

A comparative analytical study was conducted at General Hospital Lahore and Sheikh Zayed Hospital from July 2019 to October 2019 on 138 patients affected with fatty liver disease. The study revealed the total number of patients having grade 1 fatty liver was 84 (60.9%), patients having grade 2 fatty liver was 52 (37.7%) and patients having grade 3 fatty liver was 2 (1.4%) (30).

Study conducted in Islamabad, results revealed Out of the total 79 patients, grade I, II, and III NAFLD was diagnosed in 56.6%, 45.5%, and 3.9% respectively (31).

In Africa Cairo Egypt a cross sectional study on the grades of NAFLD, out of 100 subjects included in the study 51% were grade I, 42% were grade II and 7% were grade III. Out of 100 subjects included in the study 38% were asymptomatic(32) .other Study done at Sinai Hospitals in the Ashanti region of Ghana , Africa Ghana revealed The prevalence of NAFLD among Ghanaian participants was 51.4% (112/218), of whom 11.6% had significant liver fibrosis(33).

A cross-sectional study was undertaken among rural and urban Kenyans of different ethnic origin. Overall, 118 individuals (15.9%) had NAFLD, of whom 94.1% had mild steatosis. Age >40 years was significantly associated with having NAFLD compared with no difference found in NAFLD between ethnic groups(42).

The results showed in the study done at Dessie Comprehensive Specialized Hospital , Ethiopia that the prevalence of non-alcoholic fatty liver disease was elevated among patients with type 2 diabetes mellitus who had higher levels of body mass index, waist circumference, triglycerides, glycated hemoglobin, and gamma-glutamyl transferase(34)

A cross-sectional study done at Jimma University Specialized Hospital, Jimma. in Ninety-six (96) type 2 diabetic patients on non-alcoholic fatty liver disease prevalence was , 35.4%, 31.3% and 6.3% exhibited mild, moderate and severe fatty liver diseases, respectively(35).

2.2. Lipid profile

The descriptive cross-sectional study was conducted at HBS General Hospital, Islamabad, over a period of six months, from January 2018 to June 2018. A fasting blood sample of all the subjects was analyzed for total cholesterol (TC), triglycerides (TG), low-density lipoprotein cholesterol (LDL-C), and high-density lipoprotein cholesterol (HDL-C). A comparison of lipid abnormalities between different grades of NAFLD was done using statistical significance to develop NAFLD(36). By these results revealed total cholesterol (TC), triglycerides (TG), low density lipoprotein cholesterol (LDL-C) were raised in 28 (35.4%), 43 (54.4%) and 43 (54.4%) patients respectively. Low serum high-density lipoprotein cholesterol (HDL-C) levels were seen in 74 (93.6%) of patients. Statistical analysis showed a significant increase in frequency as well as mean values in all serum lipid profile parameters with the severity of NAFLD grades except total cholesterol (TC)(37) .

The prospective, analytical observational study done in India on 122 patients Statistical analyses were carried out to determine the correlation between the grades of fatty liver and alterations in lipid profile and liver enzymes. There was statistically significant variation in AST, ALT, and GGT among different grades (P value < 0.05) (38). Other study a cross-sectional study revealed that in India patients with NAFLD, their serum lipids and liver parameters were analyzed. Results revealed that TC, triglyceride (TG), low-density lipoprotein (LDL), and very low-density lipoprotein (VLDL) levels were increased in 54%, 68%, 42%, and 38% of NAFLD patients, respectively (39)

In the cross-sectional study design conducted in Indonesia, all patients have T2DM. There was a significant difference between TC, TG, and LDL-C ($p < 0.01$) in the three grades of NAFLD, and there is a significant correlation between NAFLD grade and TC and LDL-C(25).

Results showed that in Nepal in 2017, out of a total 100 cases Triglycerides, total cholesterol, and low-density lipoprotein levels were raised in 59, 53, and 72% of the cases, respectively, and high-density lipoprotein levels were decreased in 57% of participants. There was a significant positive correlation between the presence of non-alcoholic fatty liver disease and increasing levels of serum total cholesterol(40).

The analytical cross-sectional study revealed results in Iran, in which 950 data points were conducted the lipid profile (triglyceride [TG], total cholesterol [TC], high density lipoprotein [HDL], LDL-C/HDL-C (ratio), TC/HDL-C (ratio), and fasting blood sugar [FBS], correlated with NAFLD (41).

In Africa Cairo Egypt a cross sectional prospective study as the grade of NAFLD increased, there was associated significant increase in levels of serum total cholesterol, TG ,LDL and VLDL and associated significant decrease in HDL(32).

3. Objectives

3.1. General objective

To evaluate the correlation between sonographic grades of nonalcoholic fatty liver disease and lipid profile at St. Paul's hospital millennium medical college, Addis Ababa, Ethiopia, from June 4 2024 to July 4 2024.

3.2. Specific objective

- To assess the proportion of sonographic grades of nonalcoholic fatty liver at St. Paul's Hospital Millennium Medical College, Addis Ababa, Ethiopia from June 4 2024 to July 4 2024.
- To assess the correlation between sonographic grades of non-alcoholic fatty liver disease and lipid profile at St. Paul's Hospital Millennium Medical College, Addis Ababa, Ethiopia from June 4 2024 to July 4 2024.

4. Methods

4.1. Study Setting

The study was conducted at St. Paul's Hospital Millennium Medical College, St Paul's Hospital Millennium Medical College is one of the largest Hospitals and medical schools in Ethiopia, found in the capital city, Addis Ababa, Gulelle sub-city near Swaziland Street. It was established in 1969G.C by Emperor Haile Selassie.

The college is governed by a board under the Federal Ministry of Health. It has more than 2800 clinical, academic and administrative and support staffs that provide medical specialty services to patients who are referred from all over the country, teaching medicine and nursing students and doing basic and applied researches. While the inpatient capacity is more than 700 beds, The College sees an average of 1200 emergency and outpatient clients daily.

The Radiology Department is one of the biggest departments in the nation providing diagnostic and interventional radiology services. The department is equipped with a working 1.5T MRI, MDCT, mammography, fluoroscopy, several x-ray and ultrasound machines. The residency program had begun 9 years ago. A fellowship program in neuroradiology, cardiothoracic, musculoskeletal, body, and interventional radiology, as well as a master's degree for medical radiology technologists, have recently begun.

4.2. Study period

This study was conducted from June 4 2024 to July 4 2024.

4.3. Study Design

Retrospective chart review study was employed.

4.4. Source Population

The source of population was all outpatient sonographic diagnosis of NAFLD within RIS at St. Paul's Hospital Millennium Medical College

4.5. Study Population

All selected sonographic result of NAFLD within the nearest 6 months were the study population at St. Paul's Hospital Millennium Medical College

4.6. Inclusion and Exclusion criteria:

Inclusion criteria: Patients of either sex, ageing 18 years or above, diagnosed with fatty liver disease by sonographic abdomen and are not known alcoholics were included in the present study.

Exclusion criteria: Patients under the use of corticosteroids, tamoxifen, methotrexate, or high-dose estrogen. Patients with jejunoileal bypass or extensive bowel resection, Patients with liver cirrhosis.

4.7. Sample size determination

The sample of this study was all selected sonographic diagnosis of NAFLD who met the inclusion criteria within the nearest 6 months which were 426.

4.8. Sampling Procedure

All eligible patients diagnosed with non-alcoholic fatty liver disease (NAFLD) on ultrasonography within 6 months. The data was collected by using non-probability consecutive sampling.

4.9. Study variables

Dependent variables:

- Non-alcoholic fatty liver disease (Grade 1, Grade 2, Grade 3)

Independent variables:

- Age
- Sex
- Chronic illness (DM, HTN, others)
- Lipid profile (TG, TC, LDL-C, HDL-C)

4.10. Data collection method

The data was collected by using a structured questionnaire which is adopted from different study literature. Four GPs were recruited as data collectors and one supervisor was assigned. Prior to data collection period one-day training was given for, data collectors and supervisors on proper review of patient clinical data and sonographic diagnosis of fatty liver which was accessed from RIS, patient's chart and Electronic medical record. The training was based on objective, relevance of the study and the guide that were developed for clarifying the questionnaires. Besides, they were trained on overall procedures of data collection. The completeness, accuracy and consistency of data were assured by daily supervision and correction was made immediately by supervisors and investigator.

4.11 Operational definition

Grade 1 – Minimal diffuse increase in the fine echoes. Liver appears bright compared to the cortex of the kidney. Normal visualization of the diaphragm and intrahepatic vessel borders (43)

Grade 2 – Moderate diffuse increase in the fine echoes. Slightly impaired visualization of the intrahepatic vessels and diaphragm(43)

Grade 3 – Marked increase in fine echoes Poor or no visualization of intrahepatic vessels and diaphragm and poor penetration of the posterior segment of the right lobe of the liver(43)

LDL-C;- level is considered normal if the level < 100 milligram (mg)/ deciliter (dl) and high if the level >100 mg/ dl (43).

HDL-C :- level is considered normal if the level >50 mg/ dl for males and >40 mg/ dl for females and HDL low if the level < 50 mg/ dl for males and < 40 mg/ dl for females(43).

Triglyceride: - is considered normal level if < 150 mg/ dl and high if level is >150 mg/ dl

4.12 Data quality control

The quality of data was assured by proper coding of the structured questionnaire. The structured questionnaire was evaluated by the research advisor. One-day training was given to a data collector to be familiar to the questionnaire and how to collect the data. To keep the reliability of the data, the collected data was reviewed by supervisor and principal investigator to check mistakes, completeness and consistency of the data and incomplete data was reviewed on daily level.

4.13 Data processing and analysis

The data was checked for completeness and inconsistencies then cleaned, coded and entered using Epi-Info version 7.2.1 and exported and analyzed in SPSS version 25. Descriptive and summary statistics was employed. Figures and tables were used to present the findings. As for finding correlations between lipid profiles and NAFLD using spearman tests was used. The results of the analysis are significant if the value of p-value < 0.05.

4.14 Ethical considerations

Ethical clearance was obtained from St. Paul Hospital Millennium Medical College. A formal letter of cooperation will be written from the University St. Paul Hospital Millennium Medical College. Confidentiality was maintained by omitting their name and other personal identification. Permission was requested from St. Paul Hospital Millennium Medical College. To maintain confidentiality, all collected data was coded and locked in a separate place, and it was used only for research purposes. The ethical considerations were taken into account throughout the study.

4.15 Dissemination and utilization of result

The results of the study will be presented to St. Paul Hospital Millennium Medical College. Health Sciences, department of radiology and imaging, as part of the thesis, and it will also be shared with the Addis Ababa regional health bureau. Efforts will be made to present the results at scientific conferences, and peer-reviewed journal publications will be considered.

5. Results

5.1. Characteristics of the participants

A total of 426 study participants were enrolled. More than half (54.6%) of the participants were females. The median value of age of the study participants was 48 with an Interquartile range (IQR) of 38-58 years. More than half (59.8%) of the study participants were found in mild nonalcoholic fatty liver (**Table 1**).

5.2. Chronic medical illness and sonographic grades of nonalcoholic fatty liver

Almost one-sixth (15.5%) of participants were living with both hypertension and diabetes mellites, more than one-tenth (12.7%) of them were living with diabetes mellites, and 16 (3.8%) of them living with more than two chronic illnesses (**Figure 1**).

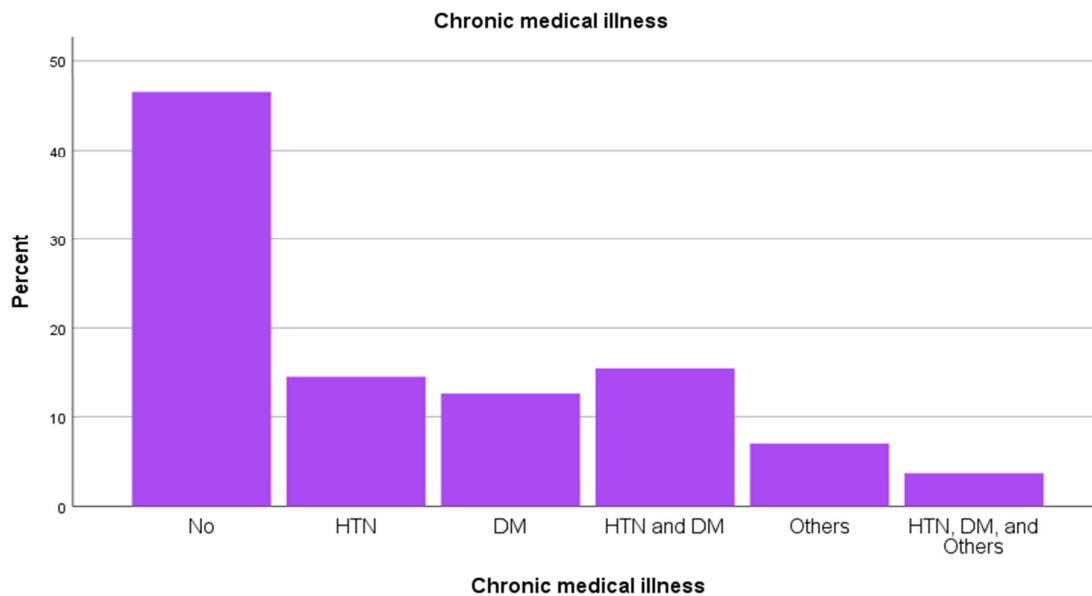


Figure 1 Chronic medical illness among patients who were sonographically diagnosed with NAFLD within the RIS at St. Paul's Hospital Millennium Medical College (n=426)

5.3. Proportion of sonographic grades of nonalcoholic fatty liver

As shown in Table 1, more than half (56.6%, 95%CI: 51.7%-61.3%) of the patients found in sonographic Grade 1(mild) of nonalcoholic fatty liver, about 38.0%, (95% CI: 32.4%, 42.8%) of patients found in Grade 2 (moderate), and the rest 5.4%, (95%CI: 3.5%-8.0%) of patients had Grade 3(sever) nonalcoholic fatty liver (**Table 1**). Approximately half (15(48.4%)) aged 20 to 29 patients had grade 2 nonalcoholic fatty liver.

Table 1 Grade of Nonalcoholic fatty liver across demographic characteristics among patients who were sonographically diagnosed with NAFLD within the RIS at St. Paul's Hospital Millennium Medical College (n=426)

Nonalcoholic fatty liver,		Grade 1, 240(56.6%)	Grade 2, 162(38%)	Grade 3, 22(5.4%)
		56.6%, (95%CI: 51.7%-61.3%)	38.0%, (95%CI: 32.4%, 42.8%)	5.4%, (95%CI: 3.5%-8.0%)
Sex	Female	140 (59.8%)	84 (35.9%)	10 (4.3%)
	Male	100 (52.6%)	78 (41.1%)	12(6.3%)
Age	20-29	16 (51.6%)	15(48.4%)	0 (0%)
	30-39	55 (61.8%)	29 (32.6%)	5 (5.6%)
	40-49	62 (59.6%)	36 (34.6%)	6 (5.8%)
	50-59	52 (50.0%)	46 (44.2%)	6 (5.8%)
	>=60	56 (57.1%)	36 (36.7%)	6 (6.1%)

5.4. Mean values of lipid profile across non-alcoholic fatty liver grades

The mean of HDL is 40.92 with a standard deviation (SD) of 12.97, the mean LDL 114.12 with SD of 50.43, and the mean of TC is 180.96 with SD of 48.57 (**Table 2**).

Table 2 Mean values of lipid profile across non-alcoholic fatty liver grades

Lipid profile	Mean	Std. Deviation
HDL	40.92	12.97
LDL	114.12	50.43
TC	180.96	48.57
TG	197.53	109.21

5.5. Correlation analysis between sonographic grades of non-alcoholic fatty liver grades and lipid profile

The 163 patients who had lipid profiles were the subjects of the correlation analysis. TG had a weak correlation ($r_s < 0.3$, $p < 0.001$) with non-alcoholic fatty liver disease. A very weak correlation ($r_s < 0.2$, $p < 0.05$) was observed between grades of non-alcoholic fatty liver disease and TC (**Table 3**). Since the $p\text{-value} > 0.05$, LDL and HDL didn't show a significant correlation with non-alcoholic fatty liver grades.

Table 3 Correlation analysis between sonographic grades of non-alcoholic fatty liver grades and lipid profile among patients who were sonographically diagnosed with NAFLD within the RIS at St. Paul's Hospital Millennium Medical College (n=163)

Lipid profile	Spearman correlation (r_s)	p-value
TC	0.137	0.045
LDL	0.050	0.524
HDL	-0.120	0.127
TG	0.264	<0.001

6. Discussion

Non-alcoholic fatty liver disease (NAFLD) is a form of metabolic liver disease in which fat changes (steatosis) are associated with lobular inflammation, hepatocyte injury, polymorphs, or liver fibrosis.(1). The histologic grading of NAFLD gives an indirect estimation of the quantification of fat deposition in the liver. It should also be remembered that NAFLD is a spectrum with the most severe forms consists of liver fibrosis and cirrhosis. Hence, higher the grade of fatty liver, more the chances of progressing to fibrosis and then cirrhosis(4-6). The finding of the present study adds to our knowledge of NAFLD and its therapeutic consequences by shedding light on the link between the severity of NAFLD and serum lipid profile.

In this study the prevalence of Grade 1 NAFLD was 56.6% (95%CI: 51.7%-61.3%) which is higher than study conducted in Indonesia 40% (26), KVG medical collage 52% (29), and H. Adam Malik Medan hospital showed distribution of NAFLD to be Grade 1: 32 (40%) (25), however it is lower than a study conducted in India Bharati medical collage 91.7% (28), and the result was similar with a study conducted in Islamabad 56.6% (31). Similarly our study reveals the prevalence of Grade 2 NAFLD to be 38.0%, (95%CI: 32.4%, 42.8%) which is higher than study done in India Bharati medical college and hospital 7.8% (28), KVG Medical College and Hospital 30% (29) and Jimma University Specialized Hospital 31.3% (35). however it is lower than Study conducted in Islamabad 45.5% (31), and In Africa Cairo Egypt 42% (32) and the result was comparative with a study conducted at General Hospital Lahore and Sheikh Zayed Hospital 37.7 % (30), and Indonesia 36% (26). This discrepancy may be due to the sample size difference, the method used to analyze NAFLD or the area of interest for the principal investigator, or maybe because of a real difference in the prevalence of the problem.

The study we conducted demonstrates statically significant correlation between sonographic grades of NAFLD and serum level of TG and TC ($P < 0.05$). This aligns with previous research highlighting the interplay between NAFLD and this lipid profile (36, 37, 39, 41). In contrast since the $P\text{-value} > 0.05$, LDL and HDL didn't show a statistically significant correlation with non-alcoholic fatty liver grades which differs from research's that highlights the interplay between NAFLD and this lipid profiles (36-39, 41). The differences in study results on the relationship between NAFLD grades and lipid profiles are due to differences in ultrasonography techniques for NAFLD imaging, differences in study population, difference in the prevalence of the problem or other confounding factors.

Limitation and strength of the study

Limitation

1. The ultrasound of the liver is done by different radiologists with different educational level which makes the result prone for inter observer difference
2. The USG and the serum lipid profile tests are not done simultaneously
3. Some of the patients are on follow up for chronic medical illnesses and are taking atorvastatin (lipid modifying agent)

Strength

1. To the best of my knowledge, It is primary research in the studied area.
2. Standard diagnostic protocol was used for sonographic diagnosis of fatty liver

7. Conclusion and recommendation

7.1 conclusion

In conclusion, regarding this study, TG and TC had a weak correlation with NAFLD. This study highlights the correlation between lipid profile and NAFLD grade. This emphasizes how crucial it is to use blood-based markers to evaluate the degree and metabolic effects of non-alcoholic fatty liver disease.

7.2 recommendation

The present investigation offers proof of a relationship between blood parameters like TG, and TC, with NAFLD grades as determined by ultrasound. These results highlight the potential clinical utility of blood-based markers in assessing the severity of NAFLD and its associated metabolic aspects. More multicenter longitudinal studies are required to confirm these findings and provide insight into the underlying processes causing these relationships. Research along these lines may lead to better risk stratification, early diagnosis, and targeted management strategies for people with NAFLD.

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Assurance of Principal Investigator

I the undersigned agree to accept all responsibilities for the scientific and ethical conduct of the research project. I will provide timely progress report to my advisor and seek the necessary advice and approval from my primary advisors in the course of the research. I will communicate timely to my advisors all stakeholders involved in the study including any source of funding for this research.

Name of the student: _____

Signature: _____

Date: _____

Approval of the Primary Advisor

Name of the primary advisor: _____

Signature: _____

Date: _____

Approval of the Co-Advisor

Name of the primary advisor: _____

Signature: _____

Date: _____

Annexes

Questioner

Observation of demographic, USG and lipid parameters of patients

S.N			
	Gender	F. M	
	Age group		
	History of chronic illness	DM HTN Others	
	Fatty liver grade	1. Grade 1 2. Grade 2 3. Grade 3	
	Lipid Profile	TC(mg/dl) TG(mg/dl) HDL-C(mg/dl) LDL-C(mg/dl)	