VER
Vascular & Endovascular Review

Correlation of fatty liver by CT scan, Ultrasound and lipid profile

Ahmad Mustafa Mekaail*[1] and Aska Faruq Jamal[2]

[1]Candidate of Radiology and medical imaging program at Kurdistan higher council of medical specialties, Erbil, Iraq
[2]Department of surgery (radiology branch), college of medicine, Hawler medical university, Erbil, Iraq.
*Corresponding author: ahmad76argoshy@gmail.com

ABSTRACT

Background: Fatty liver disease also known as non-alcoholic fatty liver disease (NAFLD), is a growing health concern strongly associated with dyslipidemia and metabolic syndrome. Imaging modalities such as ultrasound (U.S.) and computed tomography (CT) are commonly used for non-invasive detection, alongside lipid profile evaluation. Patients and Methods: A cross-sectional study was conducted involving 50 patients clinically suspected of having fatty liver disease and 50 healthy cases. All subjects underwent abdominal ultrasound and non-contrast CT scanning. Concurrently, fasting blood samples were collected to assess serum lipid profile, including total cholesterol, LDL, HDL, and triglyceride levels. Imaging findings were graded for severity and compared with lipid parameters. Results: Abnormal HV Doppler waveforms (biphasic and monophasic) were found in 40% (20/50) and 12% (6/50) of cases, respectively, with a significantly higher prevalence in patients with fatty liver disease compared to healthy individuals ($P < 0.001$). No significant association was found between age or gender and fatty liver severity. The highest rate of monophasic waveform was observed in grade III (41.67%), while the highest biphasic pattern was seen in grade II (24%). A statistically significant correlation was found between fatty liver grade and Doppler waveform pattern ($P < 0.0001$). The highest triglyceride and cholesterol levels were recorded in grade III (249.8±56.41 mg/dL and 230.2±19.01 mg/dL, respectively). HDL was highest in grade III (49.5±2.16 mg/dL), while LDL was highest in grade I (142.8±9.63 mg/dL). Conclusion: Abnormal hepatic vein Doppler waveforms are significantly associated with the presence and severity of fatty liver disease. Doppler ultrasound, combined with lipid profiling, can serve as a useful non-invasive tool in assessing the progression of fatty liver disease.

KEYWORDS: fatty liver disease, Computed tomography, ultrasonography, Lipid profile.

How to Cite: Ahmad Mustafa Mekaail, Aska Faruq Jamal, (2025) Correlation of fatty liver by CT scan, Ultrasound and lipid profile, Vascular and Endovascular Review, Vol.8, No.5s, 204-209.

INTRODUCTION

The liver is said to be "fatty" if the hepatocytes contain more than 5% triglycerides. The diagnosis of fatty liver is confirmed by liver biopsy, which can differentiate between mild (5% - 33%), moderate (>33% and <66%) and severe (>66%) (1).

Fatty liver is a relatively common incidental finding on imaging studies. Although generally a benign condition, fat in the liver can be troubling for clinicians because it can cause persistently elevated liver enzyme levels (2). Imaging studies assist in the diagnosis of NAFLD through identifying fatty infiltrate in the liver. Therefore, ultrasonography (US) has been widely used as primary imaging modality for the evaluation of liver disease due to availability and low cost compared to magnetic resonance based or computed tomography techniques (3). Evaluation of hepatic steatosis using US is based on the echo change in hepatic parenchyma. As intracellular accumulation of fat vacuoles reflects the US beam, hepatic steatosis appears as a diffuse increased hepatic parenchymal echogenicity, or "bright liver" on US (4). High diagnostic accuracy can be achieved by the US when sonographic features unique to NAFLD are standardized and used to aid in diagnosis. Bright hepatic echoes, increased hepatorenal echogenicity ratio and vascular blurring of portal or hepatic vein (HV) have been classified as unique sonographic features of NAFLD. US of the liver has a sensitivity of 82 to 89% and a specificity of 93% for identifying fatty liver infiltrate (5). On the other hand, hepatic steatosis often recognized incidentally during the course of evaluation of other abdominal pathology. Multiple diagnostic criteria for hepatic steatosis have been described in the literature, including for noncontrast-enhanced and contrast-enhanced CT examinations. Although relationships have been shown between abnormal lipid profiles and hepatic steatosis, no quantitative correlation has been established between the incidental CT diagnosis of hepatic steatosis and lipid values (6). Furthermore, lipid profile is a blood test that measures levels of total cholesterol, triglycerides, HDL cholesterol, and LDL cholesterol. Abnormality of one of the lipid profiles in plasma is called dyslipidemia. Many studies have shown that nonalcoholic fatty liver disease (NAFLD) is closely r1elated to metabolic diseases, such as obesity, type 2 diabetes and dyslipidemia (1). The aim of the study is to finding the role of ultrasonographic and C.T. along with a significantly elevated fasting lipid profile and an accurate, available diagnostic tool for fatty liver disease.

MATERIAL AND METHODS

The current study was conducted in the ultrasound unit at Rizgary teaching hospital and Hawler teaching hospital in Erbil-Iraq, through the period of one year from February 2024, to January 2025. The studied population were fifty patients with fatty liver disease that confirmed based on the amount of liver fat infiltration and categorized according to the related changes in the liver echogenicity and a control group (fifty cases) was selected from healthy volunteers after an evaluation, with no evidence of fatty liver by US/or CT scan cases with known cardiac and chronic liver diseases excluded from the control group.

Clinical data collection: Demographic and clinical data were collected, which include the patient's gender and age. All the patients with fatty liver had blood samples drawn within 2 days following US and CT scan examination for serum lipid profile. The blood samples included total cholesterol (TC), triglycerides (TG), high-density lipoprotein cholesterol (HDL-C) and low-density lipoprotein cholesterol (LDL-C). Patients with a history of alcohol consumption, hepatitis, hepatotoxic drug intake, other chronic liver disease risk factors, or those with incomplete data were excluded.

Ultrasound examinations were performed by a system Philips Machine and Mindray Console Ultrasound Machine, at 3.5 MHz convex transducer, a liver grey scale and a vascular Doppler US performed by the researcher at entry. Report grades of fatty liver and HV waveform patterns. US B-mode imaging allows for a subjective estimate of the degree of fatty infiltration in the liver. The grading of liver steatosis is usually obtained using some US features that include liver brightness, contrast between the liver and the kidney, the appearance of the intrahepatic vessels, liver parenchyma and diaphragm (1). The sonography of fatty infiltration can vary depending on the amount of fat and whether deposits are diffuse or focal. Furthermore, the study included individuals over 18 years old, who had the result of abdominal CT scan without contrast and lipid profile. The CT Scanning without contrast was performed using standard protocol 16-slice MDCT Scanner (GE Bright Speed 16) and CT Philips Ingenuity Core 128. Four criteria proposed previously in the literature were applied to evaluate for fatty liver, and the diffuse fatty liver pattern was chosen since it is the most common pattern. Fatty liver attenuation was evaluated by the researcher and one radiologist at Rizgary teaching hospital and Hawler teaching hospital (Akbar et al., 2023).

Statistical analysis: Microsoft Excel 2020 was used to tabulate and analyze the collected data and statistical analysis was performed using statistical package for scatter plot software (GraphPad Prism v.7, CA, USA). Using a chi-square independence test, frequency data were evaluated. A significant p-value is ≤ 0.05.

RESULT

A total of 100 cases, 50 normal healthy adults who served as a control group and 50 cases with fatty liver diseases underwent HV Doppler ultrasonography and C.T scan. Table 1 shows the frequency of Triphasic, Biphasic and Monophasic waveforms in the control group were 96 % (48/50), 4% (2/50) and 0, respectively. While, in the second group were 48% (24/50), 40% (20/50) and 12% (6/50), respectively. The rate of triphasic waveform in control group was significantly higher as compared with triphasic waveform patients with fatty liver diseases (P<0.0001).

Table 1: Frequency of Fatty liver disease Pattern in Study Groups

Hepatic Vein Waveform Pattern	Control (n=50)	(%)	Case study (n = 50)	(%)	P Value
Triphasic	48	96	24	48	<0.0001
Biphasic	2	4	20	40	
Monophasic	0	0	6	12	

Table 2 shows the relation between the severity of fatty liver disease with gender. The highest rate of total grade II of fatty liver disease patients was found in males and females, which was 30% (15/50), 26% (13/50) versus Grade III 8% (4/50), 4% (2/50), respectively. On the other hand, the highest rate was recorded in Grade I in males 22% (11/50) than females 10% (5/50). Statistically these differences were non-significant between both sexes in fatty liver patients (P=0.5759).

Table 2: Severity of Fatty Liver Disease in Relation to Gender

Gender	Severity of fatty liver disease							P value
	Grade I	(%)	Grade II	(%)	Grade III	(%)	Total	
Male	11	22	15	30	4	8	30	0.5759
Female	5	10	13	26	2	4	20	
Total	16	32	28	56	6	12	50	

The age range of patients was 24–79 years. The study population was divided into five age groups as shown in Table 3. The maximum number of patients are in the age group 41-50 years with a maximum percentage of 22% (11/50) and the minimum number of patients was found in all age groups which was 1 (2%) except 51-60 years which was 4%(2/50). Furthermore, the highest rate of fatty liver disease was found in grade II, which was 56% (28/50), and the lowest rates were recorded in grade III, which was 12% (6/50). Statistically, there are no significant differences found between ages with fatty liver disease (P=0.647).

Table 3: Frequency of Fatty Liver Disease in Relation to Age

Age\years	Severity of nonalcoholic fatty liver disease						P value
	Grade I	(%)	Grade II	(%)	Grade III	(%)	
≤30	1	2	3	6	1	2	0.9448

31-40	3	6	5	10	1	2	
41-50	4	8	11	22	1	2	
51-60	6	12	6	12	2	4	
≥61	2	4	3	6	1	2	
Total	16	32	28	56	6	12	

Table 4 shows that 24 patients (48%), 20 patients (40%), and 6 patients (12%) had grade triphasic, biphasic, and monophasic fatty liver disease, respectively, based on their Doppler waveform pattern in the right HV. and CT scan pattern. The highest rate of triphasic waveform was found in grade I, which was 28% (14/50), and the lowest rate was found in grade III, 2% (1/50). Furthermore, the highest rate of monophasic waveform was found in grade III, 41.67% (3/50), and the lowest rate was found in grade I, which was 2% (1/50). As well as, the highest rate of biphasic pattern was found in grade II 24% (12/50), and the lowest rate was revealed in grade III 4% (2/50). Statistically, a significant difference was found between the severity of NAFLD and the HV waveform pattern (P<0.0001).

Table 4: Severity of Fatty liver Disease in Relation to Hepatic Vein Doppler Waveform Pattern

Hepatic vein waveform pattern	Severity of nonalcoholic fatty liver disease								P value
	Grade I (16)	(%)	Grade II (28)	(%)	Grade III (6)	(%)	Total	(%)	
Triphasic	9	18	14	28	1	2	24	48	0.0433
Biphasic	6	12	12	24	2	4	20	40	
Monophasic	1	2	2	4	3	6	6	12	

Table 5 shows the result of the current study, that the highest rate of TG was found in grade III (249.8±56.41), and the lowest rate was found in grade I, which was (261.7±18.43). While for the cholesterol, the highest rate was found in grade III (230.2±19.01) and the lowest rate was reported in grade I (222.1±10.93). Regarding HDL the highest rate was found in grade III (49.5±2.16), while in LDL was found in grade I (142.8±9.63) and the lowest rate was found in grade II (45.32±3.61) and (140.2±9.03), respectively.

Table 5: Severity of Fatty liver Disease in Relation of biochemical parameters

Lipid profile	Severity of fatty liver disease			Control (40) Mean± SD
	Grade I Mean± SD	Grade II Mean± SD	Grade III Mean± SD	
TG (mg/dl)	261.7±18.43	274.9±30.94	249.8±56.41	122.9±11.19
Cholesterol (mg\dL)	222.1±10.93	230.5±11.23	230.2±19.01	190.9±15.76
HDL-C (mg/dl)	46±2.19	45.32±3.61	49.5±2.16	51.85±3.57
LDL-C (mg/dl)	142.8±9.63	140.2±9.03	140.3±10.31	112.4±20.61

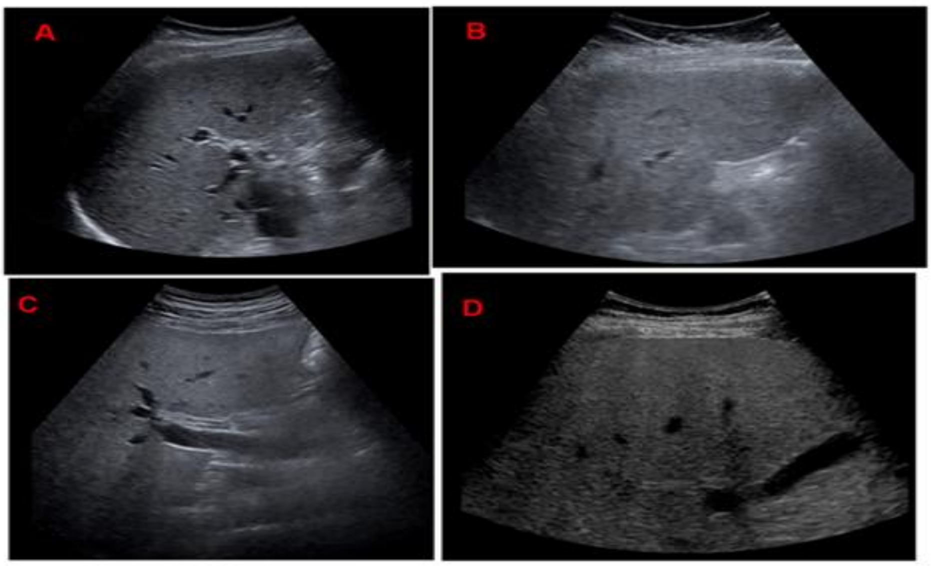

Figure 1: B-mode ultrasound transverse images of the liver are shown for four patients. The increased liver parenchyma echogenicity and decreased definition of intrahepatic structures such as vessel walls

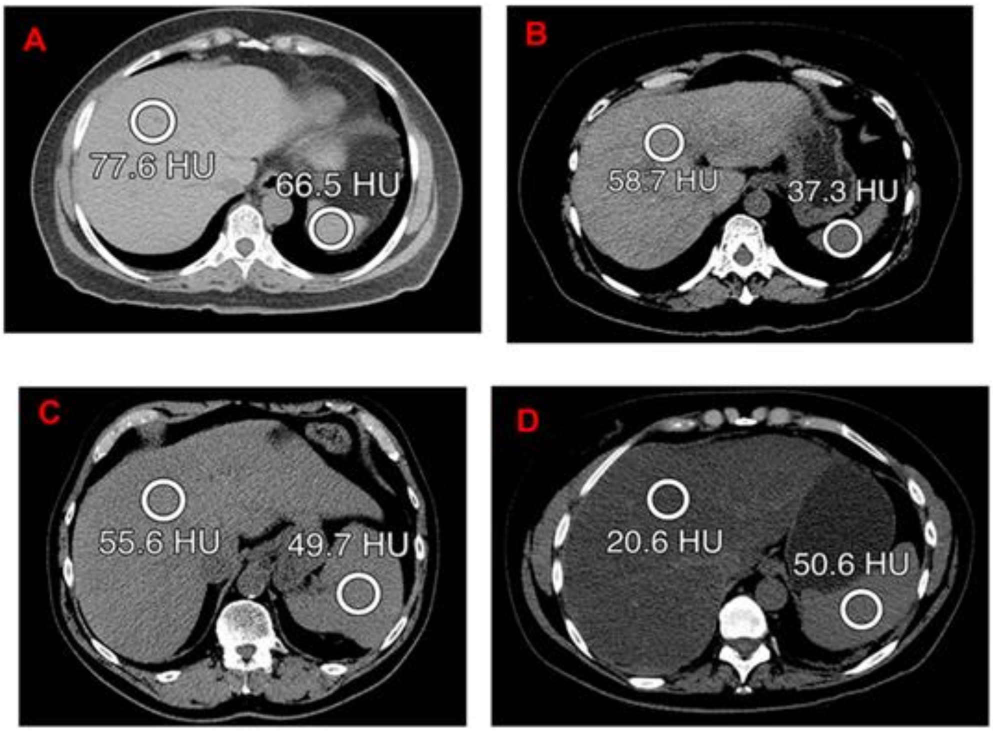

Figure 2: CT images of the liver at the level of the spleen, liver density on CT in Hounsfield Units decreases though spleen density in Hounsfield Units is variable

DISCUSSION

Ultrasonography is the imaging method most frequently indicated in the diagnosis and evaluation of hepatic steatosis, considering its noninvasiveness, wide availability and low cost. It has been described that the hepatic veins present a decrease in pulsatility in cases of fat infiltration, from the triphasic pulsatile pattern to a biphasic pattern and eventually to a monophasic flow where no oscillation in the flow velocity waveform is identified at pulsatile Doppler (7). This finding matches with the study by Rangankar et al., (8) which revealed that, abnormal hepatic vein waveform pattern was seen in 52 (65.8%) out of 79 patients of fatty liver disease. Also, the result matches with the study by Tunçyürek O et al., who reported abnormal HV Doppler waveform in 119 (65%) of 181 cases of diffuse fatty liver and reported correlation between fatty liver grade and HV Doppler waveforms (p=0.03) (9).

There was no significant difference in gender (P = 0.575) with severity of fatty liver disease; thus, they did not influence the study results and agreed with Tang et al., which revealed that, the prevalence of fatty liver and health risks was higher among male workers who also had several unhealthy lifestyle habits compared to females (10). The gender difference is apparent in pre-puberty and narrows in late puberty. For girls, estradiol and PRL were inversely associated with the prevalence of NAFLD, while in boys, estradiol was positively related to NAFLD prevalence, whereas LH and testosterone had a negative correlation. Principal component analysis identified three important components representing the potential impact of markers of sex hormones and fat distribution, lipid metabolism, and glucose metabolism. Logistic regression analysis reveals the importance of sex hormones and fat distribution as factors associated with the prevalence of fatty liver in both sexes, and puberty may increase the risk of fatty liver (11). Regarding the age, the maximum number of patients are in the age group 41-50 years with a maximum percentage of 22% (11/50) and the minimum number of patients was found in all age groups which was 1 (2%) except 51-60 years which was 4% (2/50). The result agreed with Lin et al., which revealed that, the age-standardized incidence rate (ASIR) rapidly increased as age increased for those younger than 45–49 years, decreased for those aged 45–49 years to 65–69 years, and increased for those aged over 65–69 years (12) .The ASIR of Central Latin America was highest (6.88 per 100,000 persons) around the world, while most of the people were white race in Central Latin America. The ASIR of East Asia was 2.10 per 100,000 persons(13). Furthermore, a study reported that in a longitudinal cohort of 6513 Israelite persons, the incidence rate of fatty liver disease in the people aged < 45 years old and ≥ 45 years old were 5.8 per 100 person-years and 10.3 per 100 person-years, respectively (14). A large-scale epidemiological study in China reported that weight gain in adults increased with age, and this increase was highest at age 45–50 years old then decreased thereafter (15).

Statistically, a significant difference was found between the severity of NAFLD and the HV waveform pattern (P<0.0001). The result agreed with Mohammadinia et al., (16) 2010 and Solhjoo et al., 2019 (17) which showed that, the severity of fatty liver disease can be assessed using hepatic vein doppler waveform patterns, as the disease progresses. Specifically, more severe fatty infiltration correlates with abnormal waveforms, such as a shift from triphasic to biphasic or even monophasic patterns. This change in waveform pattern reflects a decrease in vascular compliance within the liver due to the fatty infiltration. Also, Tarzamni et al., presented that, as the fatty liver disease progresses, the severity of fatty infiltration can be graded (e.g., mild, moderate, severe) based on ultrasound characteristics. The severity of fatty infiltration correlates with changes in the hepatic vein Doppler waveform pattern (18).

Fatty liver disease or metabolic dysfunction-associated steatotic liver disease (MASLD), is often associated with several abnormal biochemical parameters along with reduced high-density lipoprotein (HDL), are common findings. These biochemical abnormalities can be indicators of liver damage and metabolic dysfunction linked to fatty liver. The result agreed with Rousch et al. (19), Martínez et al. (20)and Cabrerizo et al. (21) which revealed that, the most characteristic lipid alterations were the significant elevation of triglyceride levels (85%) and cholesterol (82.5%), biochemical parameters that exhibited a significant difference when compared between study groups. This finding leads to the assumption that lipid regulation, synthesis, and metabolism are altered in this group of patients. This abnormality may be due to an adjustment to the rise of protein binding to the sterol regulatory element SREP1c, a transcription factor of some genes involved in the de novo synthesis of fatty acids; this element inhibits the oxidation of free fatty acids and the stimulation of the fat content in the liver (22, 23). Similarly, the sterol regulatory element SREBP-2 and low-density lipoprotein (LDL) receptors are regulated downwards in subjects with NAFLD, thus inhibiting cholesterol absorption and the synthesis of very high-density lipoprotein (VLDL) in hepatocytes and resulting in a high triglyceride content in the liver (24, 25). Radiologic tools for evaluation of NAFLD provide a promising noninvasive method for assessment of liver steatosis and fibrosis. Providers can use a combination of noninvasive serum tests, imaging results and endoscopic findings to arrive at a personalized diagnosis and risk stratification avoiding unnecessary liver biopsies (26).

CONCLUSION

The findings of this study demonstrate a significant association between abnormal hepatic vein (HV) Doppler waveforms and the severity of fatty liver disease. Biphasic and monophasic waveforms were notably more frequent in patients with fatty liver, particularly in advanced grades, indicating that hepatic vein waveform alteration may reflect disease progression. A statistically significant correlation was observed between HV waveform patterns and fatty liver grades ($P < 0.0001$), with the highest incidence of monophasic waveforms in grade III and biphasic patterns in grade II. No significant correlation was found between fatty liver and patient age or gender. In addition, lipid profile abnormalities—including elevated triglycerides and cholesterol levels—were more pronounced in higher grades of fatty liver, supporting the metabolic involvement in disease progression.

Informed consent: Written informed consent was obtained from all participants prior to their inclusion in the study
Funding: This research received no specific grant from any funding agency.
Conflict of interest: The authors declare no conflicts of interest.
Availability of data: The corresponding author can provide the datasets used and/or analyzed during the current study upon reasonable request.

REFERENCES

1. Akbar FN, Daulay ER, Sungkar T. Correlation of Fatty Liver Imaging on Abdominal CT-Scan with Dyslipidemia in Haji Adam Malik General Hospital in 2020. Journal of Society Medicine. 2023;2(5):170-5.
2. Khare T, Liu K, Chilambe LO, Khare S. NAFLD and NAFLD related HCC: emerging treatments and clinical trials. International Journal of Molecular Sciences. 2025;26(1):306.
3. Erdogmus B, Tamer A, Buyukkaya R, Yazici B, Buyukkaya A, Korkut E, et al. Portal vein hemodynamics in patients with non-alcoholic fatty liver disease. The Tohoku journal of experimental medicine. 2008;215(1):89-93.
4. Lu S, Archard R, Mcleod L, Banh A, Con D, Ardalan Z, et al. Portal Venous Pulsatility Index as a predictor of fibrosis in patients with non-alcoholic fatty liver disease. Australasian Journal of Ultrasound in Medicine. 2022;25(1):36-41.
5. Bayard M, Holt J, Boroughs E. Nonalcoholic fatty liver disease. American family physician. 2006;73(11):1961-8.
6. El-Nakeep S, Foda E, Sheha AS, Abdelazeem SM, Mohamed GA. Magnetic resonance spectroscopy as a diagnostic model for assessment of liver steatosis in metabolic dysfunction-associated steatotic liver disease in non-diabetic patients. Egyptian Journal of Radiology and Nuclear Medicine. 2024;55(1):189.
7. Diniz ALD, Cotrim HP, Rocha HLOG, Salomão FC. Hepatic vein Doppler flowmetry in patients with nonalcoholic steatosis. Radiologia Brasileira. 2011;44:1-6.
8. Rangankar VP, Bhole PR, Gosavi SS, Patil PP. Ultrasound of Hepatic Vessels in Fatty Liver Disease. Journal of Anatomy, Radiology and Surgery. 2018;7(3):31-6.
9. Tuncyurek O, Akin S, Aydin ST, Tuncyurek P, Erpek H. Hepatic Vein Doppler Waveform Changes in Nonalcoholic Fatty Liver Disease with Hepatomegaly Hepatomegali ile Birlikte Seyreden Alkolik Olmayan Hepatosteatozda Hepatic Ven Akım Formu Değişiklikleri.
10. Tang F-C, Li R-H, Huang J-H. Unraveling the connection between fatty liver severity with gender, lifestyle, and health risks among workers. Nutrients. 2023;15(22):4765.
11. Jin B, Wu Z, Wang S, Yu Z, Ullah R, Liang X, et al. Gender differences in non-alcoholic fatty liver disease in obese children and adolescents: a large cross-sectional study. Hepatology International. 2024;18(1):179-87.
12. Lin Y, Feng X, Cao X, Miao R, Sun Y, Li R, et al. Age patterns of nonalcoholic fatty liver disease incidence: heterogeneous associations with metabolic changes. Diabetology & Metabolic Syndrome. 2022;14(1):181.
13. Wu W, Feng A, Ma W, Li D, Zheng S, Xu F, et al. Worldwide long-term trends in the incidence of nonalcoholic fatty liver disease during 1990–2019: a joinpoint and age-period-cohort analysis. Frontiers in Cardiovascular Medicine. 2022;9:891963.
14. Aneni EC, Saeed GJ, Bittencourt MS, Cainzos-Achirica M, Osondu CU, Budoff M, et al. Cardiometabolic disorders, inflammation and the incidence of non-alcoholic fatty liver disease: A longitudinal study comparing lean and non-lean individuals. PloS one. 2022;17(4):e0266505.

15. Zhou M, Zhu N, Yu C, Du H, Lyu J, Guo Y, et al. Analysis on adulthood weight change in adults in China. Chinese Journal of Epidemiology. 2019;40(5).
16. Mohammadinia AR, Bakhtavar K, Ebrahimi-Daryani N, Habibollahi P, Keramati MR, Fereshtehnejad SM, et al. Correlation of hepatic vein Doppler waveform and hepatic artery resistance index with the severity of nonalcoholic fatty liver disease. Journal of Clinical Ultrasound. 2010;38(7):346-52.
17. Solhjoo E, Mansour-Ghanaei F, Moulaei-Langorudi R, Joukar F. Comparison of portal vein doppler indices and hepatic vein doppler waveform in patients with nonalcoholic fatty liver disease with healthy control. Hepatitis Monthly. 2011;11(9):740.
18. Tarzamni MK, Khoshbaten M, Sadrarhami S, Daneshpajouhnejad P, Jalili J, Gholamian M, et al. Hepatic artery and portal vein doppler indexes in non-alcoholic fatty liver disease before and after treatment to prevent unnecessary health care costs. International Journal of Preventive Medicine. 2014;5(4):472.
19. Roesch-Dietlen F, Dorantes-Cuéllar A, Carrillo-Toledo MG, Martínez-Sibaja C, Rojas-Carrera S, Bonilla-Rojas S, et al. Frecuencia del hígado graso no alcohólico en un grupo de pacientes con síndrome metabólico estudiado en la Ciudad de Veracruz. Revista de Gastroenterología de México. 2006;71(4):446-52.
20. López EM, Rosales JAD, Nazara ZHH, Cerda AP. Esteatohepatitis no alcohólica. Investigación en Salud. 2005;7(1):40-7.
21. Cabrerizo L, Rubio MÁ, Ballesteros MD, Moreno Lopera C. Complicaciones asociadas a la obesidad. Rev esp nutr comunitaria. 2008:156-62.
22. Severova M, Saginova E, Gallyamov M, Ermakov N, Rodina A, Fomin V, et al. Clinicopathogenetic characteristics of cardiorenal syndrome in non-alcoholic fatty disease of the liver. Terapevticheskii arkhiv. 2012;84(6):15-20.
23. Lee JM, Choudhury RP. Atherosclerosis regression and high-density lipoproteins. Expert Review of Cardiovascular Therapy. 2010;8(9):1325-34.
24. Nakamuta M, Fujino T, Yada R, Yada M, Yasutake K, Yoshimoto T, et al. Impact of cholesterol metabolism and the LXRα-SREBP-1c pathway on nonalcoholic fatty liver disease. International journal of molecular medicine. 2009;23(5):603-8.
25. Lopez-Amador N, Nolasco-Hipolito C, Rojas-Jimeno M, Carvajal-Zarrabal O. Liver enzymes in patients diagnosed with non-alcoholic fatty liver disease (NAFLD) in Veracruz: a comparative analysis with the literature. Clinical Investigation. 2017;7(1):25-32.
26. EL-Eraky AM, Elalfy H, Amer T, Farag R, Arafa M. Radiologic evaluation of nonalcoholic fatty liver Disease. Medical Journal of Viral Hepatitis. 2021;6(1):10-6