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EVALUATING THE ROLE OF ULTRASOUND FOR THE DIAGNOSIS OF FATTY LIVER DISEASE IN ASYMPTOMATIC PATIENTS AT TERTIARY CARE HOSPITALS OF D-I-KHAN

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Abstract

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Background: Fatty liver disease (FLD) is one of the most common chronic liver disorders worldwide and is increasingly detected among asymptomatic individuals. Early diagnosis is important to prevent disease progression to fibrosis, cirrhosis, and hepatocellular carcinoma. Ultrasound is widely used as a non-invasive, safe, and cost-effective imaging modality for the detection of fatty liver disease.

Objective: To evaluate the role of ultrasound in the diagnosis of fatty liver disease among asymptomatic adult patients (18–65 years) attending tertiary care hospitals of Dera Ismail Khan.

Methodology: A cross-sectional study was conducted in the Radiology Department of DHQ Hospital, Dera Ismail Khan. A total of 102 asymptomatic adult patients aged 18–65 years were included using a non-probability convenient sampling technique. Data were collected through a structured performa and analyzed using SPSS version 22. Ultrasound examination was performed to identify and grade fatty liver disease.

Results: Among the 102 participants, 61 (59.8%) were diagnosed with fatty liver disease, while 41 (40.2%) had normal liver findings. Grade 1 (mild) fatty liver was the most common finding and was observed in 51 (50.0%) participants. Grade 2 (moderate) fatty liver was detected in 7 (6.9%) participants, whereas Grade 3 (severe) fatty liver was identified in 3 (2.9%) participants. The prevalence and severity of fatty liver disease increased with age. Male participants constituted 54.9% of the study population, while females accounted for 45.1%.

Conclusion: Ultrasound proved to be an effective, non-invasive, safe, and economical imaging modality for the detection and grading of fatty liver disease in asymptomatic adults. The findings support the use of ultrasound as

a first-line screening tool for early diagnosis and management of fatty liver disease.

Keywords: Ultrasound, Fatty Liver Disease, Hepatic Steatosis, Asymptomatic Adults, Non-Alcoholic Fatty Liver Disease (NAFLD), Liver Ultrasound, Dera Ismail Khan.

INTRODUCTION

The liver is the largest internal organ and the largest gland of human body which is a critical part of physiological balance and metabolic homeostasis. It is an organ that is very specialized and carries out many biochemical, synthetic, detoxifying and regulatory functions necessary for life. Anatomically the liver is located on the right hypochondrium and the epigastric region of the abdomen, directly under the diaphragm. In adults, it makes up about 1.4 - 1.6 kg and about 2 - 2.5% of the total body weight. The liver is divided structurally into two lobes: right and left, and is enclosed by a thin fibrous capsule called Glisson's capsule. It gets a dual blood supply from the hepatic artery (oxygenated blood) and portal vein (nutrient-rich venous blood from the gastrointestinal tract and spleen). The portal vein accounts for about 75% of hepatic blood flow and the hepatic artery accounts for the other 25%. This 'double circulation' allows the liver to process nutrients it has absorbed, to break down drugs, to detoxify harmful substances and to control the metabolism of the rest of the body [1].

The liver is microscopically made up of functional units called hepatic lobules, composed of hepatocytes grouped together in plates around a central vein. Hepatocytes are the most metabolically active cells in the liver and perform most of the functions of the liver. Hepatic sinuses are present in the liver, connecting the portal vein and hepatic artery to each other and provide direct access between hepatocytes and circulating blood for metabolic exchange.

Special macrophages called kupffer cells are located inside the sinusoids and serve a noteworthy function in immune-defense, by phagocytosing bacterial, toxins and other cellular debris.

Liver has over 500 physiological functions which are essential for maintenance of normal body homeostasis. It is primarily involved in the metabolism of carbohydrates, controlling blood glucose level by glycogenesis, glycogenolysis and gluconeogenesis. Excessive glucose is converted to glycogen and stored in the hepatocytes after eating while, in fasting conditions, glycogen is broken down to keep blood glucose levels in check. The liver is also actively involved in lipid metabolism: It synthesizes cholesterol, triglycerides, phospholipids and lipoproteins. It burns fat for energy and turns excess carbohydrate and protein into fat and stores it [2].

The liver also serves as a storage organ for glycogen, iron, copper, and the vitamins A, D, B12 and folic acid. It plays an important role in the immune function by means of Kupffer cells and immune mediator production. Moreover, the liver is responsible for endocrine regulation through the metabolism of such hormones as insulin, glucagon, thyroid hormones, and steroid hormones [3].

The condition of fatty liver disease (FLD), hepatic steatosis, is defined by the presence of high levels of triglycerides and other lipids in the liver cells (hepatocytes). Small amounts of fat are normally found in the liver healthy people, as part of normal metabolic functions. If the amount of fat in the liver exceeds around 5% of the weight of the individual liver, it is considered "fatty liver disease. FLD is a spectrum of liver disease that can involve simple fatty liver disease, as well as complicated inflammation and fibrosis of the liver and lead to cirrhosis, liver failure and hepatocellular carcinoma.

The accumulation of fat in hepatocytes is caused by imbalance in the liver between acquiring lipids and eliminating lipids. Liver fat is caused by increased

uptake of free fatty acids, greater hepatic lipogenesis, decreased fatty acid oxidation, and decreased export of triglycerides. In fact, fat deposition might not cause notable liver damage, but chronic deposition can lead to oxidative stress, mitochondrial dysfunction, inflammatory reactions and hepatocellular damage [4].

A number of factors are closely linked to NAFLD, such as obesity, insulin resistance, type 2 diabetes mellitus, dyslipidemia, hypertension, and sedentary lifestyle. Obesity, especially visceral obesity, is considered one of the most important risk factors of NAFLD due to the increased release of free fatty acids in the bloodstream which then promotes the deposition of fat in the liver. Insulin resistance is a key factor in the pathogenesis of disease and is responsible for the indirect effects of insulin on fat, namely lipolysis in fat tissue and increase of hepatic TG synthesis. Hyperinsulinemia also triggers an increase in the generation of lipids from nonlipid precursors (de novo lipogenesis) in hepatocytes [5].

Simple Hepatic Steatosis:

This is the most subclinical form of disease in which fat deposits are found in the hepatocytes but there is little inflammation or fibrosis. The majority of people do not get symptoms and it is often picked up on scans or lab tests [6].

Non-Alcoholic Steatohepatitis (NASH):

NASH is a more serious condition associated with hepatic steatosis and hepatocellular inflammation, ballooning degeneration and various stages of fibrosis. Ongoing inflammation can lead to ongoing liver damage and chronic liver failure.

Hepatic Fibrosis:

Chronic inflammation leads to the activation of HSCs, leading to increased deposition of extracellular matrix proteins and scarring in the liver

parenchyma. Over time, fibrosis can cause changes to the liver's architecture and blood flow.

Liver Cirrhosis:

This ultimately results in advanced fibrosis, cirrhosis, with extensive fibrous scarring, nodular liver regeneration and loss of liver architecture. Complications of cirrhosis include portal hypertension, liver insufficiency, ascites, variceal bleeding and hepatic encephalopathy [7].

Obesity

Obesity is thought to be the most important and most prevalent risk factor for non-alcoholic fatty liver disease. Increased adiposity in general and visceral obesity in particular leads to higher levels of free fatty acid in the blood and contributes to higher rates of triglyceride uptake and storage in the liver cells. Hepatic steatosis is especially strongly associated with central obesity, defined by an increase in waist circumference and waist-to-hip ratio.

Diabetes Mellitus

Fatty liver disease is a very important risk factor in type 2 diabetes mellitus. Because of insulin resistance, type 2 diabetes involves higher levels of lipolysis in adipose tissue and higher delivery of free fatty acids to the liver. Hyperinsulinemia promotes hepatic lipogenesis and inhibits lipid oxidation as well, thereby favoring the accumulation of fat in hepatocytes.

Dyslipidemia

Another significant risk factor for fatty liver disease is dyslipidaemia, which involves high levels of triglyceride, low levels of high-density lipoprotein (HDL) and high levels of low-density lipoprotein (LDL) cholesterol in the bloodstream. Excessive accumulation of triglycerides within hepatocytes is caused by abnormal lipid metabolism and is a contributing factor to hepatic steatosis.

Sedentary Lifestyle

Low levels of physical activity and sedentary time are highly associated with the pathogenesis of fatty liver disease. Without regular exercise, energy expenditure is decreased and weight gain, obesity, insulin resistance, and liver lipid accumulation occur.

Inactivity is linked to less oxidation of fatty acids, decreased insulin sensitivity and greater visceral fat. On the other hand, regular physical activity increases insulin sensitivity, induces weight loss, decreases hepatic fat content and decreases inflammatory mediators. Hence, lifestyle modification with the addition of exercise is regarded as one of the corner stones in the prevention and management of NAFLD.

Aging

Fatty liver is a separate risk factor of aging. With ageing comes a number of metabolic and physiological changes such as decrease in mitochondrial function, dysfunction of lipid metabolism, increased oxidative stress, chronic low-grade inflammation and decreased hepatocyte regeneration.

Liver function test (LFT)

Liver function tests are used routinely as the first laboratory test performed in patients who are suspected to have fatty liver disease. The blood tests done include alanine aminotransferase (ALT), aspartate aminotransferase (AST), alkaline phosphatase (ALP), gamma-glutamyl transferase (GGT), bilirubin, albumin and prothrombin time.

Liver Biopsy

Liver biopsy is used as the gold standard for diagnosis and staging of fatty liver disease as it allows a direct histopathological assessment of liver tissue. It can be used to accurately assess steatosis, inflammation, hepatocellular ballooning, fibrosis and cirrhosis.

Liver biopsy is a procedure that involves removing a small piece of liver tissue through a needle guided by imaging to the abdomen. Histological

examination will help distinguish between simple steatosis and non-alcoholic steatohepatitis (NASH) to help guide disease severity and prognosis.

Computed Tomography (CT)

Another imaging option used in assessment of hepatic steatosis is computed tomography. Fatty infiltration is detected with CT by a decrease in the attenuation of liver tissue relative to spleen. On CT scans, healthy people's liver is hypodense due to the presence of fat, which decreases the liver's density, while the density of the spleen is relatively high.

CT can detect moderate to severe hepatic steatosis with reasonable accuracy and also may detect the presence of hepatic abnormalities like hepatomegaly, cirrhosis and focal lesions. Measurement of liver attenuation values can be used quantitatively to assess the degree of fat infiltration.

Magnetic Resonance Imaging (MRI)

Magnetic resonance imaging is a very accurate imaging modality for the detection and quantification of hepatic fat content without using X-rays, ultra-sounds or computed tomography. MRI is an imaging technique that uses magnetic fields and radiofrequency waves to give detailed images in cross sections, without exposing patients to ionizing radiation.

Ultrasound

The most common imaging method for diagnosis and assessment of fatty liver disease is currently ultrasound. It is deemed as the first line of investigation due to its safety, non-invasiiveness, low cost, no radiation, portability and availability in most health care practices.

Methodology:

The study was carried out at Department of Medical Imaging Technology, FAHS Gomal University DI khan.

Research design:

This is a cross sectional study aimed to explore the role of ultrasound for the diagnosis of fatty liver disease in asymptomatic elderly patients at tertiary care hospitals of D-I-Khan.

Study Setting:

This study was conducted in DHQ hospital DIK.

Study Duration:

The duration of the study was 6 months.

Sample Size:

The sample size is calculated by raosoft calculator with population size anticipated as 9.6% (in patients with fatty liver disease) who perform abdominal scan, absolute precision desired as 7% and confidence level as 5% then n = 102 patients.

Sampling Technique:

The types of sampling method which will be applied in this research study are non-probability convenient sampling.

Data Collection Tool and procedure:

All patients coming with fatty liver, will be recruited through abdominal scan and radiology department of District Headquater hospital of Dera Ismail Khan through current study. Permission will be sought from the hospitals ethical and research committee at the time of admission, and from the written informed patients.

Questionnaire will be used to collect the data.

- Informed consent will be taken prior to data collection.

Name and gender of the patient will be recorded.

- All the performed procedures including ultrasound will be recorded.

Data Collection analysis:

Detailed description of types of analysis plan according to type of variables and study design, statistical tests (if required), stratification of confounders/effect modifiers, presentation of results must be clearly mentioned. Data will be presented and analysed using SPSS 22. The quantitive data (numbers, percentage) will be presented in form of mean and for qualitive data (cause) will also be analyzed and drawn bar charts or pie charts. The data will be analysed using SPSS version 22. Data will be displayed graphically and tabulary.

Inclusive Criteria:

All gender patients who had abdominal scans are included.

- All patient will be included with disease fatty liver (asymptomatic).

All male and female patients aged 18-65 years will be included.

Exclusion Criteria:

- All patients other than abdominal scans are excluded.
- Patients who have any known chronic liver disease (probably malignancy or cirrhosis).

Demographic Characteristics of the Study Population

A total of 102 asymptomatic adult patients aged 18–65 years who underwent abdominal ultrasound examination were included in this study.

4.1.1 Age-wise Distribution of Patients

Table 4.1: Age-wise Distribution of Patients (n=102)

Age Group (Years)| Frequency (n)| Percentage (%)

18–30	45	44.1
31–45	40	39.2
46–65	17	16.7
Total	102	100.0

Interpretation

The majority of participants 45 (44.1%) belonged to the 18–30 years age group, followed by 40 (39.2%) participants in the 31–45 years age group and 17 (16.7%) participants in the 46–65 years age group.

Figure 4.1: Age-wise Distribution of Patients

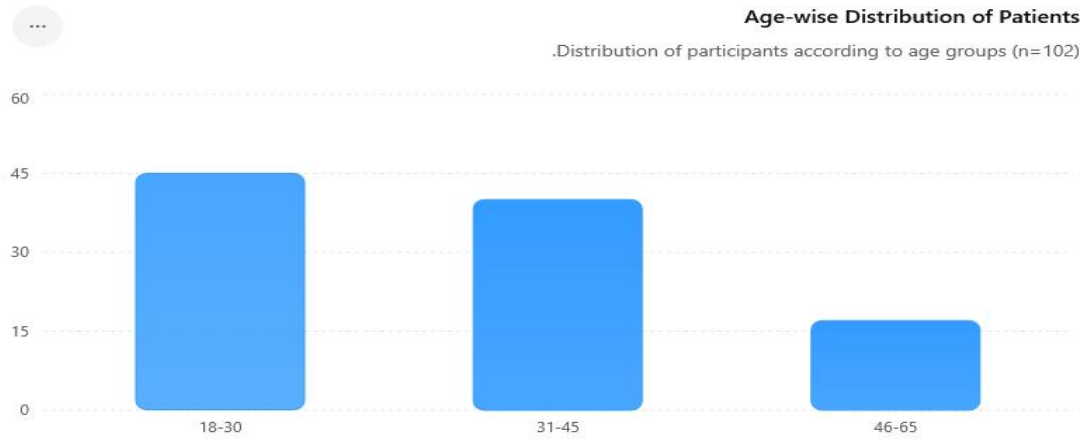

Figure 4.1 shows that the majority of participants belonged to the 18–30 years age group.

Figure Interpretation

The bar chart demonstrates that the highest number of participants belonged to the 18–30 years age group, while the lowest number belonged to the 46–65 years age group.

4.1.2 Gender-wise Distribution of Patients

Table 4.2: Gender-wise Distribution of Patients (n=102)

Gender	Frequency (n)	Percentage (%)
Male	56	54.9
Female	46	45.1
Total	102	100.0

Interpretation

Out of 102 participants, 56 (54.9%) were males and 46 (45.1%) were females.

Figure 4.2: Gender-wise Distribution

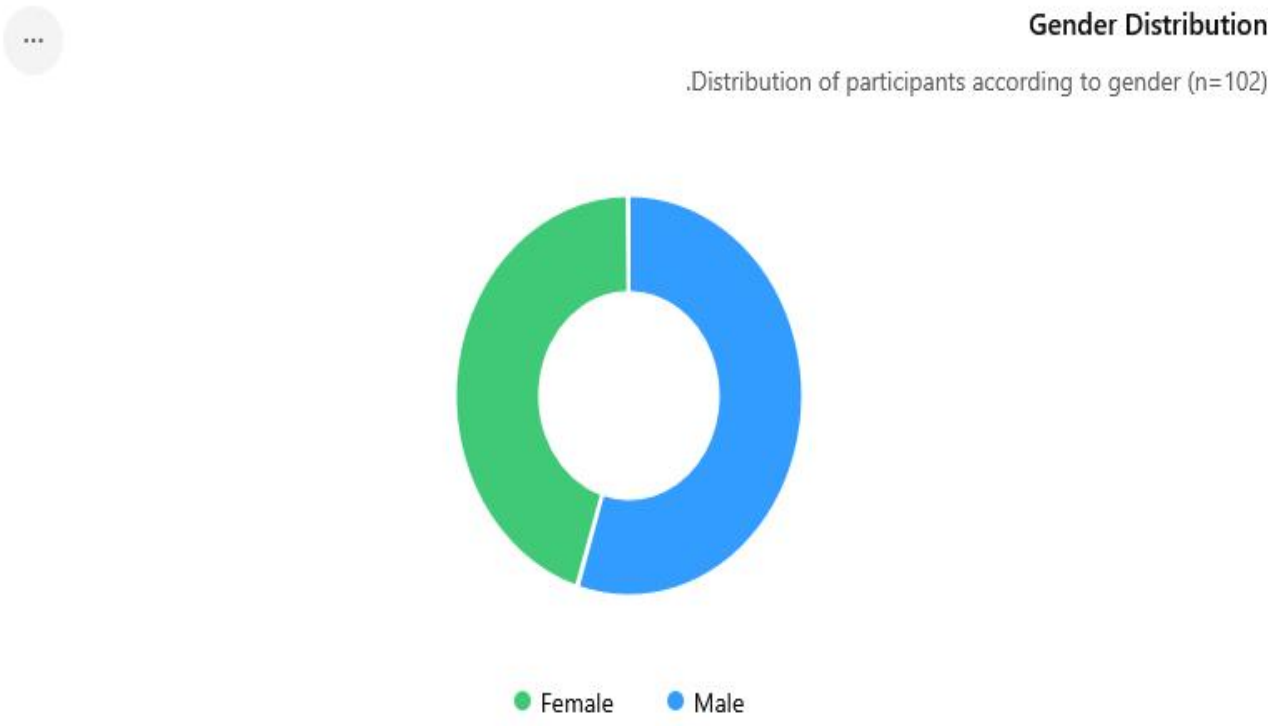

Figure 4.2 illustrates that male participants (54.9%) were slightly higher than female participants (45.1%).

Figure Interpretation

The pie chart illustrates that male participants were slightly more prevalent than female participants.

Table 4.3: Frequency of Normal and Fatty Liver Findings (n=102)

Finding	Frequency (n)	Percentage (%)
Normal Liver	41	40.2
Fatty Liver Disease	61	59.8
Total	102	100.0

Interpretation

Among 102 participants, 61 (59.8%) patients were diagnosed with fatty liver disease, while 41 (40.2%) participants had normal liver findings on ultrasound examination.

Figure 4.3: Distribution of Normal and Fatty Liver Findings

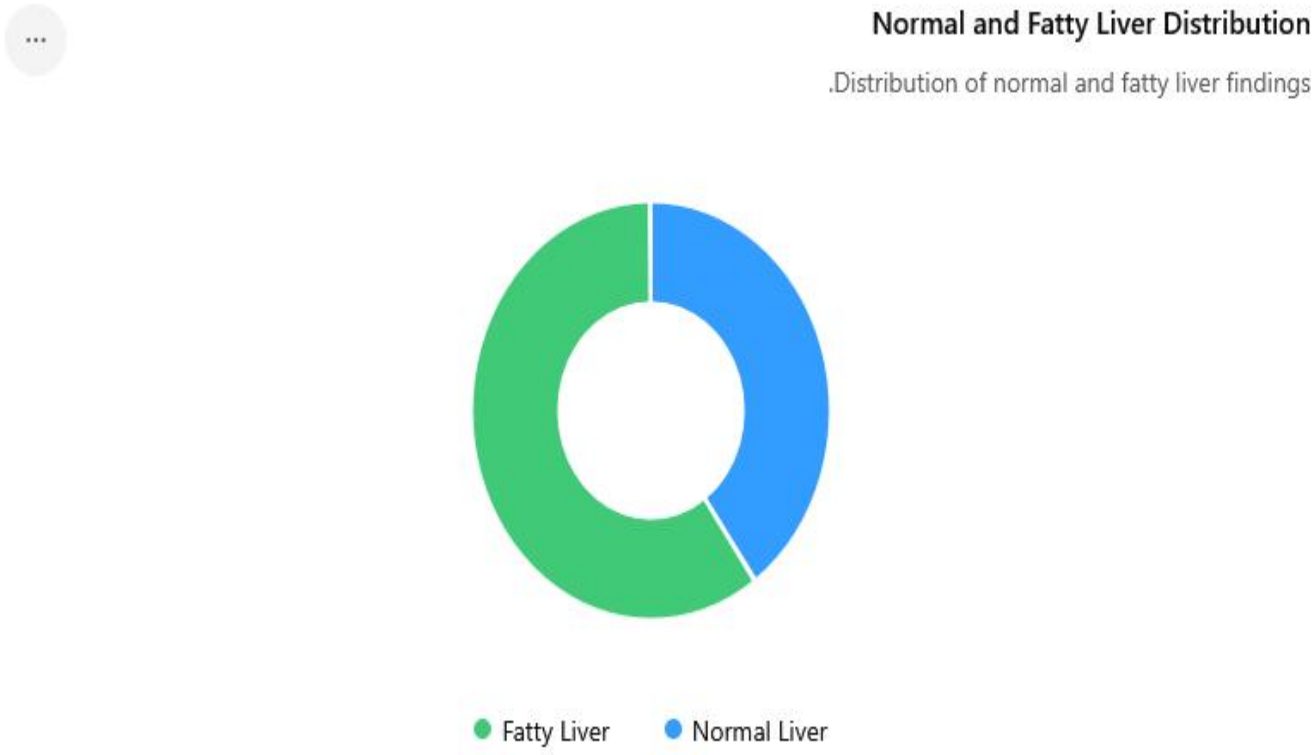

Figure Interpretation

The pie chart demonstrates that fatty liver disease was present in more than half of the study population.

Table 4.4: Grade-wise Distribution of Fatty Liver Disease (n=102)

Grade| Frequency (n)| Percentage (%)

Normal (Grade 0)| 41| 40.2

Grade 1 (Mild)| 51| 50.0

Grade 2 (Moderate)| 7| 6.9

Grade 3 (Severe)| 3| 2.9

Total| 102| 100.0

Interpretation: Grade 1 fatty liver was the most common finding and was observed in 51 (50.0%) participants. Grade 2 fatty liver was present in 7 (6.9%) participants, while Grade 3 fatty liver was observed in 3 (2.9%) participants.

Figure 4.4: Grade-wise Distribution of Fatty Liver Disease

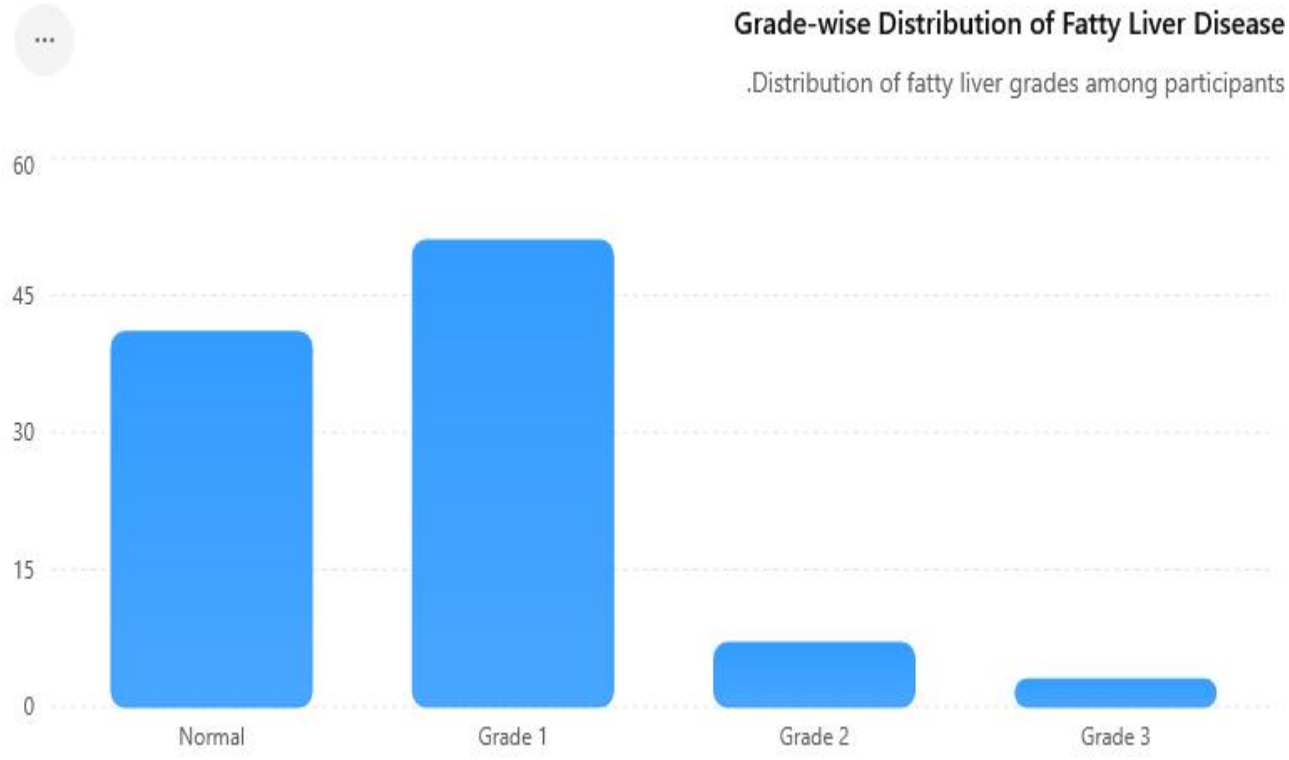

Figure Interpretation

The bar chart demonstrates that Grade 1 fatty liver was the most frequently observed grade, whereas Grade 3 fatty liver was the least common finding.

Table 4.5: Age Distribution Across Fatty Liver Grades

Age Group (Years)| Normal| Grade 1| Grade 2| Grade 3| Total

18–30| 30| 15| 0| 0| 45

31–45| 6| 30| 4| 0| 40

46–65| 5| 6| 3| 3| 17

Total| 41| 51| 7| 3| 102

Interpretation

Normal liver findings were more common among younger participants, while moderate and severe grades of fatty liver disease were predominantly observed in older age groups.

Table 4.6: Gender Distribution Across Fatty Liver Grades

Grade| Male| Female| Total

Normal| 22| 19| 41

Grade 1| 28| 23| 51

Grade 2| 4| 3| 7

Grade 3| 2| 1| 3

Total| 56| 46| 102

Interpretation

The distribution of fatty liver grades was relatively similar between male and female participants, with a slightly higher prevalence among males.

Summary of Results

The present study included 102 asymptomatic adult patients who underwent abdominal ultrasound examination.

Key findings of the study were:

- Male participants constituted 54.9% of the study population, while females accounted for 45.1%.
- The majority of participants (44.1%) belonged to the 18–30 years age group.
- Fatty liver disease was detected in 61 (59.8%) participants.
- Normal liver findings were observed in 41 (40.2%) participants.
- Grade 1 fatty liver was the most common grade, accounting for 50.0% of participants.
- Grade 2 and Grade 3 fatty liver were observed in 6.9% and 2.9% of participants, respectively.
- Moderate and severe fatty liver grades were more commonly observed among older participants.
- A positive relationship was observed between increasing age and severity of fatty liver disease.

Discussion

Fatty liver disease has emerged as one of the most common chronic liver disorders worldwide and is increasingly being detected among asymptomatic individuals. Early diagnosis is important because untreated fatty liver disease may progress to steatohepatitis, fibrosis, cirrhosis, and hepatocellular carcinoma. Ultrasound is widely used as a first-line imaging modality because it is non-invasive, safe, affordable, and readily available.

The present study was conducted to evaluate the role of ultrasound in the diagnosis of fatty liver disease among asymptomatic adult patients aged 18–65 years attending DHQ Hospital, Dera Ismail Khan. A total of 102 participants were included in the study.

The findings of the study revealed that fatty liver disease was detected in 61 (59.8%) participants, while 41 (40.2%) participants had normal liver findings. These findings indicate that fatty liver disease is common among asymptomatic adults and can be detected effectively through routine ultrasound examination.

Overall, the results of the present study indicate that ultrasound is an effective, non-invasive, and practical imaging modality for identifying fatty liver disease in asymptomatic adults. Routine ultrasound screening may contribute to earlier diagnosis and timely intervention, thereby reducing the risk of disease progression and long-term liver-related complications.

Comparison with Previous Studies

Study	Population	Prevalence	Main Findings
Present Study (2026)	Asymptomatic adults, D.I. Khan	59.8%	Ultrasound effectively detected fatty liver disease
Hernaez et al. (2011)	Meta-analysis	Variable	Ultrasound sensitivity 84.8%, specificity 93.6%
Yip et al. (2023)	Global population	25–30%	Significant geographical variation in prevalence
Francque &	Obese population	High	Strong association with

Study	Population	Prevalence	Main Findings
Dirinck (2023)		prevalence	obesity and metabolic syndrome
Han et al. (2020)	Multi-ethnic population	Variable	Ethnic and lifestyle factors influence prevalence

The findings of the present study are generally consistent with previously published literature and further support the utility of ultrasound in the diagnosis and grading of fatty liver disease.

Limitations of the Study

The present study had several limitations:

1. The study was conducted at a single center, which may limit the generalizability of the findings.
2. Liver biopsy, the gold standard for diagnosing fatty liver disease, was not performed.
3. The study was cross-sectional in nature; therefore, long-term follow-up of patients was not possible.
4. Metabolic parameters such as body mass index (BMI), blood glucose level, lipid profile, and liver function tests were not evaluated.
5. Ultrasound findings are operator-dependent and may vary according to examiner experience.

Strengths of the Study

1. The study focused on asymptomatic adults, a population in which fatty liver disease often remains undiagnosed.

2. Ultrasound was used as a safe, non-invasive, and readily available diagnostic tool.
3. The study provides local data regarding the prevalence and grading of fatty liver disease in Dera Ismail Khan.
4. The findings may contribute to increased awareness regarding early detection of fatty liver disease.

Summary of Discussion

The present study demonstrated that fatty liver disease is common among asymptomatic adults and that ultrasound is an effective modality for its detection and grading. Mild fatty liver disease was the most common finding, while moderate and severe grades were less frequent. Increasing age was associated with greater disease severity. The results support the use of ultrasound as a first-line screening tool for early detection of fatty liver disease.

Conclusion

The present study was conducted to evaluate the role of ultrasound in the diagnosis of fatty liver disease among asymptomatic adult patients aged 18–65 years attending DHQ Hospital, Dera Ismail Khan.

A total of 102 participants were included in the study. The findings revealed that fatty liver disease was present in 61 (59.8%) participants, while 41 (40.2%) participants had normal liver findings on ultrasound examination.

Among the diagnosed cases, Grade 1 (mild) fatty liver was the most common finding and was observed in 51 (50.0%) participants. Grade 2 (moderate) fatty liver was detected in 7 (6.9%) participants, whereas Grade 3 (severe) fatty liver was identified in only 3 (2.9%) participants.

The study further demonstrated that the severity of fatty liver disease increased with age. Moderate and severe grades were more commonly observed among older participants, while normal liver findings were more frequent among younger individuals.

Ultrasound successfully identified and differentiated various grades of fatty liver disease through characteristic sonographic features such as increased hepatic echogenicity, reduced visualization of intrahepatic vessels, impaired diaphragm visibility, and posterior beam attenuation.

Based on the findings of the present study, it can be concluded that ultrasound is an effective, non-invasive, safe, economical, and readily available imaging modality for the detection and grading of fatty liver disease in asymptomatic adults.

The study supports the use of ultrasound as a first-line screening and diagnostic tool for early detection of fatty liver disease, particularly in populations at risk of metabolic disorders.

Recommendations

Based on the findings of the present study, the following recommendations are proposed:

1. Routine Ultrasound Screening

Routine abdominal ultrasound screening should be encouraged for adults, especially those with risk factors such as obesity, diabetes mellitus, dyslipidemia, and sedentary lifestyle.

2. Early Detection Programs

Healthcare institutions should implement early detection and screening programs to identify fatty liver disease before the development of advanced liver complications.

3. Public Awareness

Awareness campaigns should be organized to educate the general population regarding the risk factors, prevention, and consequences of fatty liver disease.

4. Lifestyle Modification

Patients diagnosed with fatty liver disease should be advised regarding healthy dietary habits, weight reduction, regular physical activity, and avoidance of risk factors that contribute to disease progression.

5. Further Clinical Evaluation

Patients with moderate and severe fatty liver disease should undergo further evaluation, including liver function tests, lipid profile assessment, blood glucose monitoring, and specialist consultation when required.

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