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PREVALENCE OF FATTY LIVER DETECTED BY ULTRASOUND AMONG OBESE ADULTS IN MINGORA, SWAT DISTRICT

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Abstract

Background: *Non-Alcoholic Fatty Liver Disease (NAFLD) is one of the most common liver disorders worldwide and is strongly associated with obesity. Rapid urbanization, sedentary lifestyle, and high-calorie dietary patterns in regions such as Mingora, Swat have contributed to an increasing burden of obesity-related liver disease. Early diagnosis is essential to prevent progression to Non-Alcoholic Steatohepatitis (NASH), fibrosis, and cirrhosis. Ultrasound is a safe, non-invasive, and cost-effective imaging modality for detecting hepatic steatosis.*

Methods: *A cross-sectional study was conducted on 200 obese adults (BMI ≥ 30 kg/m²) aged 20–60 years. Sample size was calculated using a standard prevalence formula and increased to 200 to compensate for non-response. Participants were selected using non-probability consecutive sampling. Ultrasound examination graded fatty liver as Grade 0–3. Statistical analysis was performed using SPSS version 27. Independent t-test and chi-square tests were applied. A p-value < 0.05 was considered statistically significant.*

Results: *Fatty liver was detected in 73% of participants. Moderate fatty liver (Grade 2) was most common (30%). BMI was significantly associated with fatty liver ($t = 4.21$, $p < 0.001$). Gender was not significantly associated ($\chi^2 = 3.11$, $p = 0.078$).*

Conclusion: *Obesity is strongly associated with fatty liver in adults of Mingora, Swat. Ultrasound is an effective screening tool and should be incorporated into routine clinical evaluation of obese patients.*

INTRODUCTION

Obesity is widely recognized as a growing global epidemic and a major contributor to several metabolic and chronic diseases[1]. Among these, Non-Alcoholic Fatty Liver Disease (NAFLD) has become one of the most common liver disorders worldwide[2]. NAFLD is defined as the excessive accumulation of fat in hepatocytes in individuals who consume minimal or no alcohol[3]. Its clinical spectrum ranges from simple hepatic steatosis to Non-Alcoholic Steatohepatitis (NASH), which may progress to fibrosis, cirrhosis, and even hepatocellular carcinoma if left undiagnosed or untreated[4]. Several risk factors are associated with NAFLD, including elevated Body Mass Index (BMI), type 2 diabetes mellitus, hypertension, hyperlipidemia, and sedentary lifestyle. As obesity continues to increase globally, NAFLD has emerged as a leading cause of liver-related morbidity[5]. In developing countries such as Pakistan, lifestyle changes driven by rapid urbanization have contributed significantly to the rising prevalence of obesity and related metabolic disorders[6]. Regions like Mingora Swat, which are experiencing shifts in dietary patterns, have witnessed increased consumption of processed foods, sugary beverages, and high-fat meals. Coupled with reduced physical activity, limited awareness of healthy behaviors, and inadequate preventive healthcare, these changes have led to a notable increase in conditions such as NAFLD[7]. Despite this growing burden, there is limited research focusing on the prevalence of fatty liver disease among obese individuals in this region. Local data remain scarce, making it difficult for healthcare providers and policymakers to design effective intervention programs.

Early diagnosis of NAFLD is crucial to prevent progression to more severe liver disease[8]. Ultrasound is widely considered the first-line imaging modality for detecting fatty liver due to its affordability, safety, accessibility, and non-invasive nature[9]. It does not involve radiation exposure, unlike CT scans, and is more cost-effective and practical for routine screening than MRI. Ultrasound enables clinicians to evaluate liver echogenicity, brightness of hepatic parenchyma, visualization of intrahepatic vessels, and overall liver size. Based on these characteristics, fatty liver can be graded into Grade 1 (mild), Grade 2 (moderate), and Grade 3 (severe) steatosis, allowing for a simple, efficient assessment of disease severity[10]. With rising obesity rates in Mingora, Swat, and growing concern about NAFLD, research is needed to assess fatty liver in this population. This study aims to determine the prevalence and severity of NAFLD among obese adults using ultrasound and to examine associations with BMI and gender. Findings will support early diagnosis, guide clinical decisions, and inform public health strategies to reduce the regional burden of fatty liver disease.

MATERIALS AND METHODS

A cross-sectional study was conducted at Mingora, Swat District. The sample size was calculated using the standard formula for prevalence studies, $n = Z^2 \times p(1 - p) / d^2$, where Z was set at 1.96, the expected prevalence (p) was 0.73, and the margin of error (d) was 0.06. The minimum required sample was approximately 190 participants. To compensate for incomplete data and potential dropouts, the final sample size was increased to 200. Non-probability consecutive sampling was employed. All eligible obese adults presenting to the selected centers during the study period were recruited until the desired sample size was achieved. Adults aged 20 to 60 years with a body mass index (BMI) ≥ 30 kg/m^2 were included. Individuals with a history of alcohol consumption, viral hepatitis, pregnancy, or previously diagnosed chronic liver disease were excluded to minimize confounding factors. Demographic information was recorded using a structured proforma. Height and weight were measured using standard procedures, and BMI was calculated as weight in kilograms divided by height in meters squared. Ultrasound examination was performed by trained sonographers to assess the presence and severity of fatty liver. Hepatic steatosis was graded as Grade 0 (no fatty liver), Grade 1 (mild), Grade 2 (moderate), and Grade 3 (severe), based on standard sonographic criteria. Data were entered and analyzed using IBM SPSS Statistics version 27. Descriptive statistics were calculated for demographic and clinical variables. The independent samples t-test was applied to compare mean BMI between groups. The chi-square test was used to assess the association between gender and fatty liver status. A p-value of less than 0.05 was considered statistically significant.

RESULTS

1. Demographic and Anthropometric Characteristics

A total of 200 obese participants aged between 20–60 years were included in this study. The mean age of participants was 38.7 ± 9.5 years. Among them, 110 (55%) were males, and 90 (45%) were females.

The mean Body Mass Index (BMI) of the study population was 32.8 ± 4.2 kg/m^2, with a minimum BMI of 30 kg/m^2 and a maximum of 45 kg/m^2.

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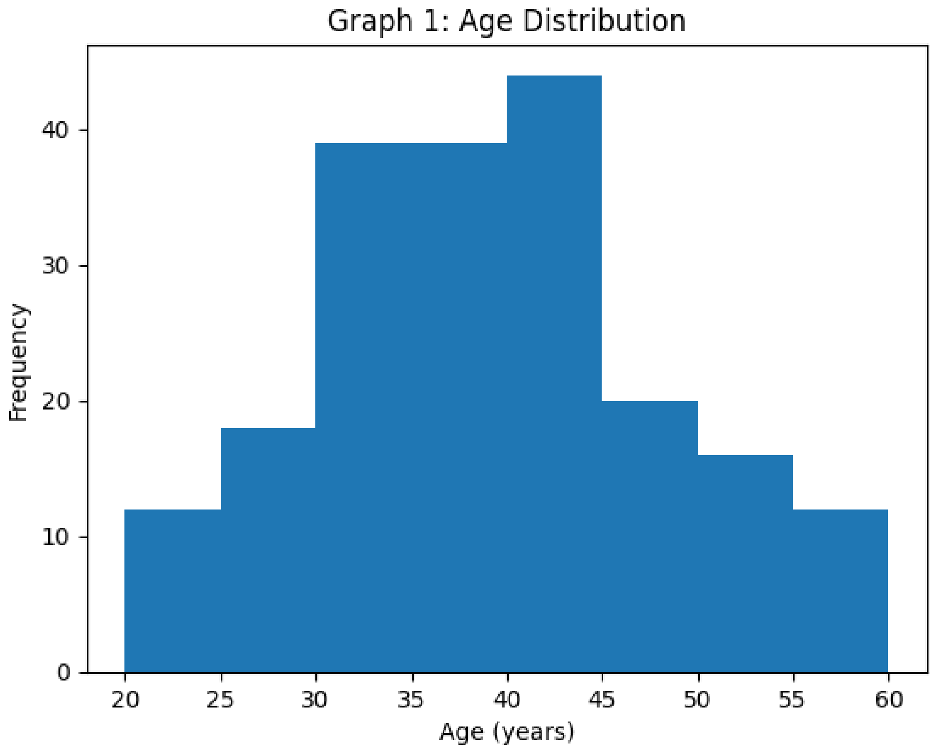
Table 1: Descriptive Statistics of Age and BMI

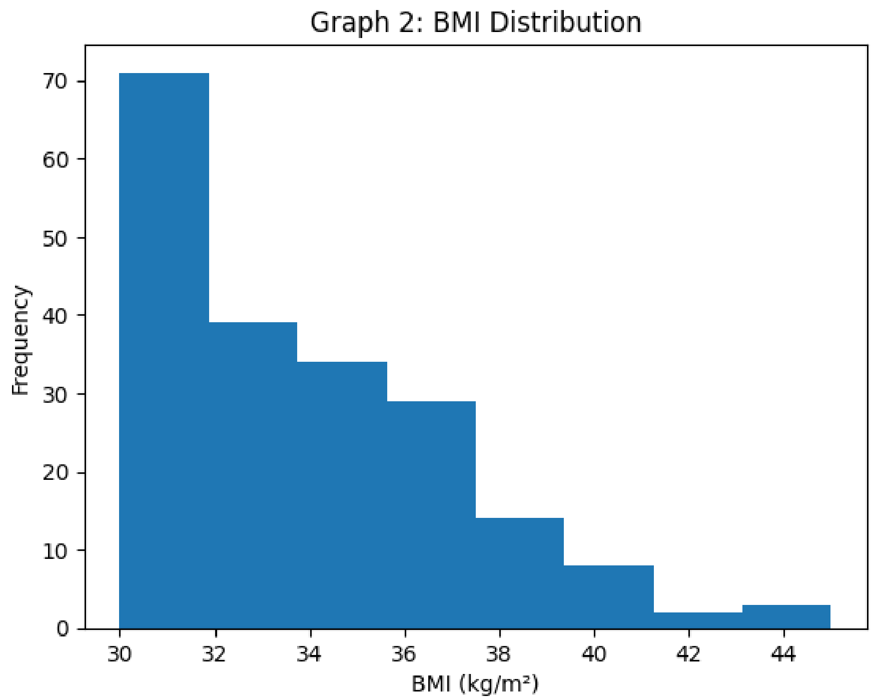
Variable	N	Mean	SD	Min	Max
Age (years)	200	38.7	9.5	20	60
BMI (kg/m²)	200	32.8	4.2	30	45

Graph 1: Age Distribution



The age distribution graph demonstrates that the majority of participants were above 30 years of age. This age group is considered at higher risk for developing fatty liver disease.

Graph 2: BMI Distribution



The BMI distribution graph shows that most participants had BMI values between 30–35 kg/m², confirming that the sample consisted predominantly of obese individuals.

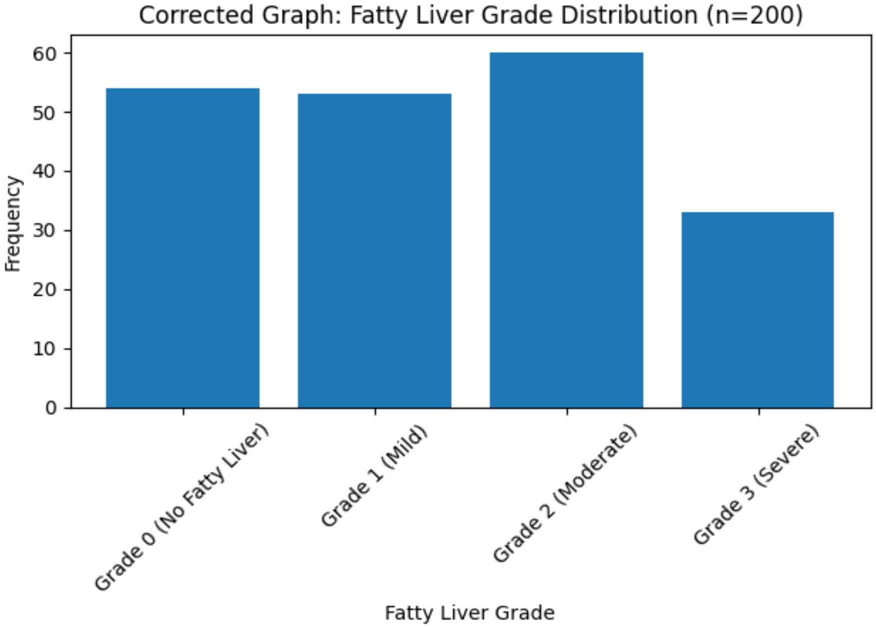
2. Prevalence and Severity of Fatty Liver

Ultrasound examination revealed that **146 participants** (73%) had fatty liver, while **54 participants** (27%) had no fatty liver.

Table 2: Distribution of Fatty Liver Grades

Grade	Frequency (n)	Percentage (%)
Grade 0 (No Fatty Liver)	54	27.0%
Grade 1 (Mild)	53	26.5%
Grade 2 (Moderate)	60	30.0%
Grade 3 (Severe)	33	16.5%
Total	**200**	**100%**

Graph 3: Fatty Liver Grade Distribution



Ultrasound examination identified fatty liver in 146 participants (73%), while 54 participants (27.0%) showed no evidence of hepatic steatosis. Among those diagnosed with fatty liver, moderate steatosis (Grade 2) was the most common finding (30.0%), followed by mild steatosis (26.5%). Severe fatty liver (Grade 3) was observed in 16.5% of participants. These findings indicate that a substantial proportion of obese individuals had moderate to severe hepatic steatosis, which may increase the risk of progression to advanced liver disease if early intervention is not implemented.

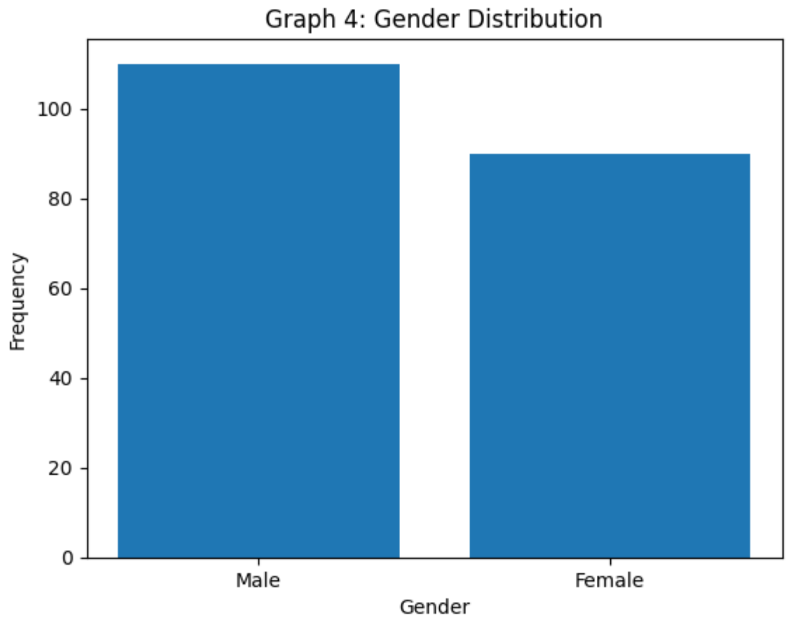
3. Gender Distribution and Association with Fatty Liver

The gender distribution of the participants was as follows:

Table 3: Gender Distribution

Gender	Frequency	Percent
Male	110	55%
Female	90	45%

Graph 4: Gender Distribution



The graph illustrates that male slightly outnumbered females in the study population.

To determine the association between gender and fatty liver, a chi-square test was applied.

Table 4: Association Between Gender and Fatty Liver

Gender	Fatty Liver Present	No Fatty Liver	Total
Male	85	25	110
Female	61	29	90
Total	**146**	**54**	**200**

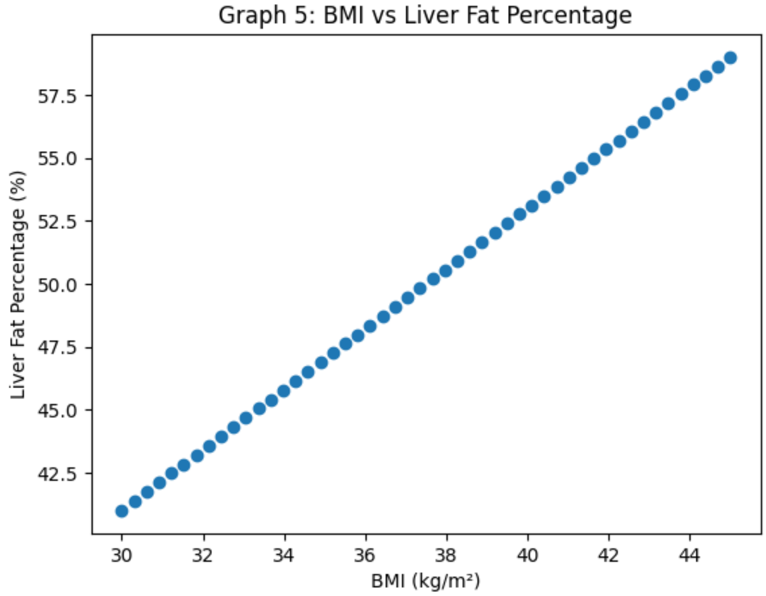
Chi-square (χ^2) = 3.11
p-value = 0.078

Although males showed a slightly higher prevalence of fatty liver (77.3%) compared to females (67.8%), the association was not statistically significant ($p > 0.05$). This indicates that gender was not a significant predictor of fatty liver in this study population.

4. Relationship Between BMI and Fatty Liver Grade

Correlation analysis was performed to assess the relationship between BMI and fatty Liver grade.

Graph 5: BMI vs Fatty Liver grade (Scatter Plot)



The scatter plot demonstrates a positive linear relationship between BMI and fatty liver grade.

- **Correlation coefficient (r) = 0.52**
- **p-value < 0.001**

This indicates a **moderate positive and statistically significant correlation** between BMI and liver fat accumulation. As BMI increases, fatty liver grade also increases. Therefore, BMI is a strong predictor of fatty liver severity among obese individuals

DISCUSSION

The present study investigated the prevalence and severity of fatty liver among obese adults in Mingora, Swat District, utilizing ultrasound for diagnosis. Our findings reveal a remarkably high prevalence of fatty liver (73%) in this cohort, with nearly half of the participants presenting with moderate to severe steatosis. These results highlight a significant public health concern in the region, particularly within the obese population. The observed 73% prevalence is considerably higher than those reported in broader clinical or community-based series in Pakistan. For instance, studies in general hospital settings or gastrointestinal clinics in Pakistan have reported non-alcoholic fatty liver disease (NAFLD) prevalences ranging from approximately 15% to 47%[12]. Similarly, a population-based study in Iran found a prevalence of approximately 35.2%[13], while a large cohort of working adults showed a prevalence of 45.5%[14]. However, the high prevalence in our study is more consistent with findings in highly selected obese populations, where prevalence rates as high as 90% have been documented[15]. Notably, a study at Liaquat University focusing on obese patients reported a lower prevalence of 41%[11], suggesting that regional variations or differences in the degree of obesity and metabolic risk profiles may influence fatty liver frequency even among obese cohorts. The severity of steatosis observed in our participants specifically Grade 2 (30.0%) and Grade 3 (16.5%) is clinically significant. Higher grades of sonographic steatosis are strongly associated with progressive metabolic derangements. Literature indicates that as the severity of liver steatosis increases, there is a corresponding increase in triglycerides, liver enzymes, and fasting glucose levels[16]. Furthermore, moderate and severe steatosis are often concentrated in individuals with metabolic syndrome and its components, such as hypertension and diabetes[17]. This suggests that a substantial portion of our study population is at elevated risk for advanced metabolic and cardiovascular complications[14, 17]. The linkage between fatty liver and metabolic syndrome is further underscored by the strong association between NAFLD and insulin resistance observed in other Pakistani tertiary care samples[19]. Regarding gender, our study found no significant difference in the prevalence of fatty liver between male and female participants ($p > 0.05$). This contrasts with some literature that reports a higher prevalence in males, particularly in general working populations[14]. However, findings in other settings have been mixed, with some studies showing higher prevalences in females or varying associations depending on the population context[12]. The lack of gender differences in our cohort may suggest that within exclusively obese populations, adiposity-related metabolic disturbances become the dominant risk factor, potentially attenuating the independent effect of sex. Our results also demonstrated a moderate positive correlation between BMI and the grade of fatty liver ($r = 0.52$, $p < 0.001$). This relationship is well-supported by the literature, although the strength of the correlation varies across studies. For example, a study of 354 healthy individuals reported a very strong positive correlation ($r = 0.868$) between BMI and ultrasound-diagnosed fatty liver[18]. Other cohorts have similarly shown significant, stepwise increases in BMI across increasing grades of liver steatosis[16]. The moderate correlation in our study confirms that increasing adiposity is a key driver of hepatic steatosis severity in this region.

LIMITATIONS

This study has certain limitations. The cross-sectional design prevents establishing causality. Consecutive sampling may limit generalizability. Ultrasound is operator-dependent and less sensitive for mild steatosis compared to MRI. Liver biopsy, the gold standard, was not performed due to ethical constraints. Additionally, biochemical markers were not extensively evaluated.

CONCLUSION

Ultrasound is an effective, accessible, and reliable tool for detecting fatty liver in obese adults in Mingora, Swat. BMI is strongly associated with the presence and severity of fatty liver, while gender is not a significant factor. Early screening using ultrasound can facilitate timely intervention, prevent progression to severe liver disease, and inform public health strategies targeting obesity and metabolic disorders in the region.

CONFLICT OF INTEREST

The authors declare that they have no conflicts of interest related to this study.

DATA AVAILABILITY

Data are available from the corresponding author upon reasonable request.

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None

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