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Prevalence of Nonalcoholic Fatty Liver Disease among Obese Patients Presented in Liaquat University Hospital Hyderabad/Jamshoro

Yasra Memon[1*], Ghulam Fareed[2], Tariq Zaffar Shaikh[1], Kamran Ali Qureshi[1], Imran Karim[1] and Zaheer Hussain Memon[3]

[1]Department of Medicine, Liaquat University of Medical and Health Sciences, Jamshoro, Pakistan
[2]Department of Medicine, Isra University Hospital, Hyderabad, Pakistan
[3]Department of Medicine, Suleman Roshan Medical College Tando Adam, Pakistan

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***Corresponding Author:**
Yasra Memon
Department of Medicine, Liaquat University of Medical and Health Sciences, Jamshoro, Pakistan
dr.yasramemon@gmail.com

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ABSTRACT

Non-Alcoholic Fatty Liver Disease (NAFLD) is a common liver disorder strongly linked to obesity and metabolic syndromes. Its identification in obese patients is critical for early management and prevention of complications. **Objective:** To evaluate the prevalence of NAFLD in obese patients presenting to a tertiary care hospital in Hyderabad, Pakistan. **Methods:** A prospective cross-sectional study was conducted in Liaquat University Hospital Hyderabad and Jamshoro, over six months. Initially, 78 obese patients (BMI>30) were included through convenience sampling but after weight adjustment (IPW) it became 500 Patients. Demographic, anthropometric, and clinical data were collected. NAFLD diagnosis was based on ultrasound findings. Data were analyzed using SPSS version 22.0. **Results:** The prevalence of NAFLD was 41% in obese patients presented to hospital. In the adjusted model, BMI was the strongest predictor of NAFLD (OR = 1.205, 95% CI: 1.165–1.246, p<0.001), with each unit increase in BMI increasing the odds of NAFLD by 20.5%. Male had significantly lower odds of NAFLD compared to female (OR = 0.644, 95% CI: 0.540–0.767, p<0.001). Waist circumference (OR = 0.981, p=0.017p) and weight (OR = 0.969, p<0.001) were negatively associated with NAFLD, likely reflecting residual effects after adjusting for BMI. **Conclusions:** NAFLD is prevalent among obese patients in Pakistan, with Body Mass Index as the primary risk factor. Adjusting for sampling biases via IPW provided more accurate and generalizable findings. Routine screening for NAFLD and targeted interventions for weight management, particularly in female, are essential to mitigate disease progression.

INTRODUCTION

Non-Alcoholic Fatty Liver Disease (NAFLD) is rapidly emerging as one of the most significant public health challenges worldwide, particularly in developing countries such as Pakistan [1]. NAFLD encompasses a spectrum of liver abnormalities, ranging from simple hepatic steatosis to non-alcoholic steatohepatitis (NASH), fibrosis, cirrhosis, and even hepatocellular carcinoma [2]. Unlike liver damage caused by excessive alcohol consumption, NAFLD occurs in individuals with little to no history of alcohol intake and is strongly associated with metabolic risk factors, including obesity, type 2 diabetes mellitus (T2DM), dyslipidemia, and hypertension [3]. The global prevalence of NAFLD has been estimated to be around 25%, with significant variation between regions more in China and lowest in Japan, driven by the prevalence of obesity and metabolic syndrome in different populations [4, 5]. Obesity is a significant contributor to the prevalence of Non-Alcoholic Fatty Liver Disease (NAFLD) in Pakistan. According to the Global Nutrition Report, 13.4% of adult women and 7.5% of adult men in Pakistan are living with obesity [6]. This prevalence is influenced by factors such as poor dietary habits, sedentary lifestyles, and limited access to preventive healthcare services. The World Obesity Federation's Global Obesity Observatory assigns Pakistan a national obesity

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risk score of 6.5 out of 10, indicating a high risk based on obesity prevalence and related factors [7]. In Pakistan, the prevalence of NAFLD is becoming a critical health concern due to the rising rates of obesity and metabolic disorders [1]. Studies conducted in the region highlight that the pooled prevalence of NAFLD in the general population is approximately 29.82% (95% CI: 21.39–39.01%), with a disproportionately higher prevalence observed in specific high-risk groups [5]. The pooled NAFLD prevalence in the general population was 29.82% (95% CI 21.39–39.01%; prediction interval: 2.98–68.92%) based on 13 studies. In individuals with metabolic disorders, the prevalence of NAFLD in patients with diabetes, hypertension, and obesity, was 58.47% (95% CI 54.23–62.64%; prediction interval: 38.16–77.40%), 74.08% (95% CI 60.50–85.70%), and 47.43% (95% CI 30.49–64.66%), respectively. The role of tertiary care hospitals in addressing NAFLD is not addressed in above-described studies and most of the populations have associated metabolic syndrome, but this study will highlight the prevalence in obese without metabolic syndrome and presented toward tertiary care hospital. Understanding the prevalence of NAFLD in this high-risk group is crucial for several reasons. Firstly, it provides insights into the magnitude of the problem within a clinical setting, facilitating the allocation of resources for screening and management. Secondly, it highlights the need for multidisciplinary interventions involving hepatologists, endocrinologists, dietitians, and primary care physicians to address the underlying risk factors comprehensively.

Non-Alcoholic Fatty Liver Disease (NAFLD) is rapidly emerging as a critical public health challenge in Pakistan, where rising obesity rates driven by sedentary lifestyles, poor dietary habits, and limited preventive healthcare access are creating a growing burden of metabolic liver disease that risks progression to cirrhosis and hepatocellular carcinoma if left undetected. While the pooled NAFLD prevalence in Pakistan's general population has been estimated at approximately 29.82%, and substantially higher in metabolically compromised subgroups, data specifically characterizing NAFLD burden among obese patients without concurrent metabolic syndrome presenting to tertiary care hospitals remain scarce and methodologically limited. Existing studies predominantly examine populations with associated comorbidities such as diabetes and hypertension, leaving a significant evidence gap regarding the isolated contribution of obesity to NAFLD risk in clinically presenting Pakistani patients. This study therefore aimed to evaluate the prevalence of NAFLD among obese patients (BMI ≥30) presenting to Liaquat University Hospital, Hyderabad, using ultrasound-based diagnosis and inverse probability weighting to produce more representative and bias-adjusted prevalence estimates.

METHODS

This is the prospective cross-sectional study was conducted at the Department of Medicine, Liaquat University Hospital, Hyderabad, over a six-month period (March 2024 to August 2024). Convenience sampling was employed to recruit patients presenting to the outpatient and inpatient departments of Liaquat University Hospital. Convenience sampling was chosen due to logistical constraints and the limited timeframe of the study with efforts to enhance the representation of sample to some extent. The challenges with other sampling techniques include the lack of a comprehensive sampling frame of all eligible patients, resource constraints, and time limitations. The sample size was determined using OpenEpi, based on a Brazilian study reporting a 32.7% NAFLD prevalence in the obese population presenting to Tertiary care hospital [8]. Parameters included a 95% confidence level, 80% power, an odds ratio of 9, and a prevalence difference of 27%, yielding a required sample size of 78 (Fleiss with continuity correction). The study included 78 participants aged 18–65 years with a BMI ≥30 kg/m^2. Exclusion criteria were a history of alcohol consumption, pregnancy, prior liver transplant, or metabolic conditions like diabetes or hypertension. Approved by the Institutional Review Board of Liaquat University , the study obtained written informed consent from all participants. Data collection involved demographic, anthropometric, and clinical assessments, with BMI calculated as weight (kg)/height (m^2). NAFLD was diagnosed via abdominal ultrasound, conducted independently by two blinded radiologists based on hepatic steatosis findings. Analysis was performed using SPSS version 22.0. Descriptive statistics summarized continuous and categorical variables, while the Shapiro-Wilk test assessed data normality. Statistical tests included the t-test, Mann-Whitney U test, and chi-square test, with p-values and confidence intervals reported for precision. Logistic regression analysis was used to identify predictors of NAFLD, employing two models: an unadjusted model to estimate crude associations and an adjusted model using inverse probability weighting (IPW) with BMI as weighting variable to account for sampling biases. Predictors included BMI, weight, waist circumference, age, and gender, with odds ratios (ORs) and 95% confidence intervals (CIs) calculated for associations. Statistical significance was set at $p<0.05$. Multi-collinearity was ruled out (VIF <5), and model fit was confirmed with the Hosmer-Lemeshow test. Comparison of models showed the adjusted model to be more reliable and generalizable.

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RESULTS

The total patients in study were 78 in number out of them 35.9% (n=28) are male and 64.1% (n=50) were female (Figure 1). The mean age, and BMI of the patients was 49.38 ± 7.81 and 35.79 ± 2.50 respectively. The waist circumference of the patient was found to be 94.39 ± 5.24 and wight of the patients was 85.62 ± 6.95, and their distribution is evaluated using Shapiro-Wilk test for normality (table 1).

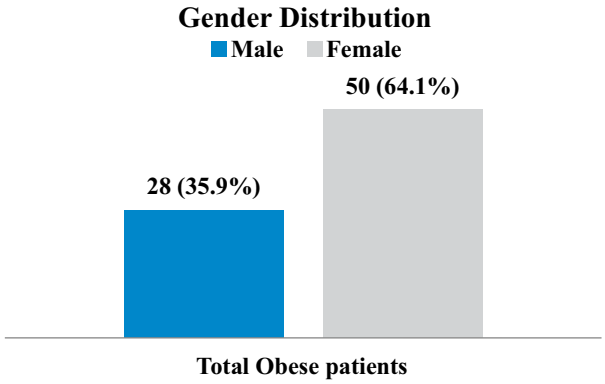


Figure 1: Gender Distribution

Table 1: Descriptive Analysis

Variables	Mean ± SD	Distribution
Age	49.38 ± 7.81	Non-parametric
BMI	35.79 ± 2.50	Parametric
Waist Circumference (cm)	94.3 ± 5.24	Parametric
Weight	85.62 ± 6.95	Non-Parametric

Total number of 32 (41%) obese patients has positive findings of non-alcoholic fatty liver disease (95% CI: 30.1%-51.9%) with mean age of 49.84 ± 1.13, the female (56.25%) were more, and the mean BMI, Waist Circumference and weight was 35.15 ± 1.04, 94.56 ± 0.81, 85.37 ± 1.04 respectively. For the comparison between the ultrasound negative patients see table 2. The data were not found to be significant in relation to comparison. For parametric data independent T test performed, for non-parametric data Mann Whitney U test performed and for categorical data; chi; square test was performed.

Table 2: Analysis of Obese Patients with or Without Ultrasound Findings of NAFLD

Variables		Ultrasound Positive	Ultrasound Negative	p-value
Age (Mean ± SD)		49.84 ± 1.13	49.05 ± 1.28	0.704[1]
Gender	Male	14 (43.75%)	14 (30.43%)	0.167[3]
	Female	18 (56.25%)	32 (69.6%)	
BMI (Mean ± SD)		35.15 ± 0.41	36.23 ± 0.37	0.060[2]
Waist Circumference (Mean ± SD)		94.56 ± 0.81	94.28 ± 0.84	0.81(4)9[2]
Weight		86.37 ± 1.04	85.01 ± 1.12	0.661[1]

1: Calculated Via Man Whitney U Test, 2: Independent T Test, 3: Chi Square Test

For adjustment of sampling biases and cofounding variables using inverse probability weighting (IPW) was applied which increases the sample size from 78 to 500 patients with similar distribution and then logistic regression applied which identified BMI as a significant predictor of NAFLD (OR = 1.205, 95% CI: 1.165-1.246, p<0.001). For every one unit increase in BMI, the odds of NAFLD increased by 20.5%. Gender also significantly influenced NAFLD prevalence with male having lower odds of NAFLD than female (OR = 0.644, 95% CI: 0.540-0.787, p<0.001). Additionally, waist Circumference (OR = 0.981, 95% CI: 0.966-0.997, p=0.017) and weight (OR = 0.969, 95% CI: 0.958- 0.980, p<0.001) were negatively associated with NAFLD, it could be due to reflection of dominance of BMI as an obesity related risk factor for NAFLD, with waist and weight showing residual effect in adjusted model. Age showed a minor but statistically significant association with each additional year decreasing the odds NAFLD by 1.5% (OR = 0.985, 95% CI: 0.974 -0.996, p= 0.007). On comparison to unadjusted results, the adjusted analysis showed a stronger association between BMI and NAFLD, while accounting for sampling biases. Adjusting for sampling biases revealed that gender and waist circumference were also significant predictors which were less evident in the unadjusted model. This method reduced the impact of sampling bias and provided a more representative estimate of the association between predictors and NAFLD prevalence (Table 3)

Table 3: Comparison of Unadjusted and Adjusted Logistic Regression Model for Association between Variables and NAFLD

Variables	Un adjusted Model (OR, 95% CI, p-value)*	Adjusted Model (OR, 95% CI, p-value)+
BMI	1.205 (0.985 – 1.473), p=0.069	1.205 (1.165 – 1-246), p=0.001
Waist circumference	0.973 (0.885 – 1.070), p=0.574	0.981 (0.966 – 0.997), p=0.17
Weight	0.971 (0.906 – 1.040), p=0.402	0.969 (0.958 – 0.980), p=0.001
Age	0.981 (0.919 – 1.047), p=0.563	0.985 (0.974 – 0.996), p=0.007
Gender (Male versus Female)	0.660 (0.232 – 1.883), p=0.438	0.644 (0.540 – 0.767), p=0.001

*Calculated via logistic regression analysis
+ Adjusted using inverse probability weighting to account for sampling biases and logistic regression analysis

The adjusted model provides more reliable estimates of the predictors of NAFLD. BMI emerged as the strongest risk factor, with a 20.5% increase in odds per unit increase. Gender, weight, waist circumference, and age also showed significant associations after adjustment, highlighting the importance of controlling for sampling biases and confounding variables in logistic regression analysis.

DISCUSSION

NAFLD prevalence among obese patients was 41%, consistent with global estimates (36–80%) but mostly with

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metabolic syndrome [1]. Obesity remains a critical factor for NAFLD, underscoring the need for heightened clinical focus in Pakistan, where sedentary lifestyles and dietary changes exacerbate obesity rates [9]. A higher prevalence in female (56.25%) vs. male (43.75%) may reflect sociocultural norms limiting female activity and hormonal/metabolic differences [5, 10-12]. Adjusted analysis showed that male had 35.6% lower odds of NAFLD (OR=0.644, p<0.001), suggesting gender-specific risk profiles influenced by local factors. Age significantly influences NAFLD prevalence and progression. In this study, the mean age among NAFLD-positive patients was 49.84 ± 6.44 years, aligning with global data showing increased NAFLD prevalence in middle-aged adults due to cumulative metabolic risk factors (e.g., obesity, insulin resistance and hypertension) [4]. Large-scale studies confirm the highest prevalence in the 40–59-year age group, reflecting the natural accumulation of metabolic derangements over time, Asia study found that individuals aged 40–59 years exhibited highest prevalence of NAFLD [13]. The mean BMI of NAFLD patients was 35.15 ± 1.04, with BMI emerging as the strongest independent predictor after adjustment (OR=1.205, p<0.001). Despite initially non-significant findings, each unit increase in BMI raised NAFLD odds by 20.5%. Central obesity, indicated by a mean waist circumference of 94.56 ± 0.81 cm, also played a role. However, after adjusting for BMI, weight (OR=0.96, p<0.001) and waist circumference (OR=0.98, p=0.017) showed inverse associations, highlighting BMI's overriding influence [14]. These results underscore the importance of targeted interventions focusing on weight reduction and visceral fat control [15]. However, the lean patient with metabolic syndrome is also a risk factor for developing NAFLD [16]. Ultrasound is a widely used as a non-invasive and cost-effective modality but its sensitivity and specificity vary depending on the degree of hepatic steatosis [17]. A total of 41% of obese patients found to have ultrasound positive findings for NAFLD, however in this study there is no significant differences in demographic and anthropometric variables. The mean age in ultrasound positive is slightly higher, this finding aligned with studies suggesting the older individuals are more likely to develop detectable liver changes [18]. Female are more in ultrasound positive group; it could be due to postmenopausal effect, due estrogen withdrawal and central fat distribution [19]. While BMI and waist circumferences are slightly lower in ultrasound positive group, which was not statistically significant. It could be suggestive of concurrence of higher BMI and central obesity could be associated with metabolic factors such as insulin resistance and lipid profiles changes, but these patients were excluded from study [20]. The prevalence of NAFLD in this cohort underscores significant public health challenges in Pakistan, where limited resources exacerbate the disease burden. NAFLD elevates the risk of liver-related morbidity and cardiovascular disease, a leading cause of death in the country [21]. Accordingly, routine screening for NAFLD should be integrated into healthcare for obese individuals. The hospital-based sampling may not fully represent the broader obese population, and ultrasound potentially underestimates mild hepatic steatosis. Moreover, the cross-sectional design precludes causal inferences, and confounding variables (e.g., diet, physical activity) were not examined. Negative associations for weight and waist circumference warrant further investigation for possible multi-collinearity or population-specific factors.

This study was constrained by its small initial sample of only 78 patients recruited through convenience sampling at a single tertiary care center, which limits the external validity of findings despite the use of inverse probability weighting to expand and adjust the effective sample to 500 patients. The cross-sectional design precludes causal inference, and the reliance on ultrasound for NAFLD diagnosis, while practical and non-invasive, may underestimate mild hepatic steatosis compared to magnetic resonance spectroscopy or liver biopsy as gold standard methods. Additionally, important confounding variables such as dietary patterns, physical activity levels, insulin resistance markers, and lipid profiles were not captured, limiting the completeness of the risk factor analysis. Future research should employ multicenter prospective cohort designs with larger, more representative samples across urban and rural settings in Sindh and beyond, incorporating advanced diagnostic modalities and comprehensive metabolic profiling. Longitudinal follow-up to assess NAFLD progression and the impact of weight management interventions would provide stronger evidence to guide the development of routine NAFLD screening protocols within Pakistan's public health infrastructure.

CONCLUSIONS

In conclusion this study reveals significant NAFLD burden among obese Pakistanis. The study also highlights BMI's role, IPW-adjusted model nuances, and the necessity of targeted screening and weight management programs for mitigating progression in resource-limited settings.

Authors' Contribution

Conceptualization: YM
Methodology: YM, IK
Formal analysis: TZS, KAQ
Writing and Drafting: GF, ZHM, TZS, KAQ
Review and Editing: GF, ZHM, TZS, KAQ

All authors approved the final manuscript and take responsibility for the integrity of the work

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Conflicts of Interest

The authors declare no conflict of interest.

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