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Original Article

CORRELATION OF INCIDENCE OF GALL BLADDER DISEASES AND NON ALCOHOLIC FATTY LIVER ON ULTRASONOGRAPHY IN TERTIARY CARE CENTRE- CENTRAL INDIA

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ABSTRACT

Background: Gallbladder diseases and non-alcoholic fatty liver disease (NAFLD) are increasingly prevalent conditions that share common metabolic risk factors, including obesity, dyslipidaemia, and insulin resistance. Ultrasonography (USG) is an effective, non-invasive imaging modality for diagnosing both conditions. This study aimed to evaluate the correlation between gallbladder diseases and NAFLD using ultrasonography in patients attending a tertiary care centre in Central India.
Methods: A hospital-based cross-sectional observational study was conducted in the Department of Radiodiagnosis at LN Medical College and JK Hospital over 18 months. A total of 210 patients with clinically suspected gallbladder disease underwent abdominal ultrasonography for the evaluation of gallbladder pathology and NAFLD. Demographic characteristics, body mass index (BMI), dietary habits, lipid profile, comorbidities, and ultrasonographic findings were recorded. Statistical analysis was performed using descriptive statistics, Chi-square test, and Student's t-test, with $p < 0.05$ considered statistically significant.
Results: NAFLD was detected in 71 (33.81%) of the 210 participants. Single gallstones were the most common gallbladder pathology (55.24%). Patients with NAFLD had significantly higher rates of obesity (42.3% vs. 36.0%, $p = 0.032$), non-vegetarian diet (77.5% vs. 40.3%, $p < 0.0001$), and dyslipidaemia (67.6% vs. 47.5%, $p = 0.006$). Single gallstones were significantly more frequent among patients with NAFLD (70.4%) than those without NAFLD (47.5%). No significant association was observed between NAFLD and age, gender, residence, or socioeconomic status.
Conclusion: NAFLD was highly prevalent among patients with gallbladder diseases and demonstrated significant associations with single gallstones, obesity, non-vegetarian dietary habits, and dyslipidaemia. These findings suggest that metabolic factors play a central role in the coexistence of gallbladder disease and NAFLD. Routine ultrasonographic screening for NAFLD in patients with gallbladder pathology may facilitate early diagnosis and timely management of associated metabolic disorders.

Keywords: *Non-alcoholic fatty liver disease, Gallbladder disease, Cholelithiasis, Ultrasonography, Obesity, Dyslipidaemia, Metabolic syndrome.*

INTRODUCTION

The relationship between gallbladder and liver pathologies is rooted in the anatomical, physiological, and embryological interconnections of the hepatobiliary system. Gallbladder and liver pathologies often share common risk factors, including obesity, metabolic syndrome, and certain genetic predispositions. Non-alcoholic fatty liver disease (NAFLD),

closely associated with obesity and metabolic syndrome, has been linked to an increased risk of gallstone disease due to shared metabolic derangements, such as insulin resistance, which affect both liver fat metabolism and bile composition, thereby promoting cholelithiasis.

Ultrasonography is a non-invasive imaging modality that provides real-time visualization of the liver and gallbladder, significantly impacting the diagnosis and management of abdominal pathologies. USG offers several diagnostic benefits in patients presenting with gallbladder symptoms, including the detection of gallstones, gallbladder wall thickening, and other signs of cholecystitis[8]. It can also assess liver abnormalities such as steatosis (fatty liver), cirrhosis, liver masses (benign and malignant), and signs of portal hypertension, which may contribute to or result from gallbladder disease[9–11]. It allows for the visualization of the common bile duct, which can be dilated in cases of obstruction due to gallstones or other causes.

Non-alcoholic fatty liver disease (NAFLD) is a spectrum of liver conditions characterized by the accumulation of fat in the liver cells of individuals who consume little to no alcohol. NAFLD is increasingly recognized as a leading cause of chronic liver disease worldwide, often associated with metabolic syndrome components such as obesity, type 2 diabetes, and dyslipidemia[12]. The disease can progress from simple steatosis (fatty liver) to more severe forms such as non-alcoholic steatohepatitis (NASH), which can further advance to fibrosis, cirrhosis, and even hepatocellular carcinoma[19]. The rising incidence of NAFLD parallels the global increase in obesity and metabolic syndrome, making it a significant public health concern.

In liver diseases, ultrasonography is used to assess liver size, texture, and the presence of masses or cirrhosis. It also significantly impacts treatment decisions and the management of abdominal pathologies by guiding minimally invasive procedures such as biopsies, drainages, and catheter placements. The study of the association between gallbladder pathology and non-alcoholic fatty liver disease (NAFLD) through abdominal ultrasonography (USG) is a burgeoning area of interest within gastroenterology and hepatology due to the increasing prevalence of these conditions globally, their potential for significant morbidity and mortality, and the interrelated pathophysiological mechanisms that link the liver and gallbladder[14]. Abdominal USG allows for the non-invasive assessment of these conditions, providing insights into their prevalence, severity, and potential interconnections[15]. Understanding this relationship can enhance diagnostic accuracy, enable early identification of patients at risk of developing more severe forms of disease, and offer prognostic value, as the presence of both conditions could indicate a higher risk of complications.

MATERIAL AND METHODS

Study Design: This study employed a cross-sectional observational design to investigate the association between gallbladder pathology and non-alcoholic fatty liver disease (NAFLD) in individuals, utilizing abdominal ultrasonography (USG) as a diagnostic tool.

Study Settings: The study was conducted in the Department of Radiology at LN Medical College and associated JK Hospital.

Ethical Clearance: Ethical clearance was granted by the Institute's Ethical Committee via protocol no. LNMC & RC/ Dean/2022/ Ethics/102 and date of approval 24/12/2022.

Study Duration: The total duration of the present study was 18 months: divided into the following three phases: i. Planning (3 months). Participant Recruitment & Data Collection (12 months). Data Analysis & Report Writing (3 months).

Study Participants: The participants for the present study included individuals who were referred to the radiology department for an abdominal USG for gallbladder related pathology and fulfilling the following criteria:

Inclusion Criteria: i. All patients clinically suspicious of all gall bladder pathologies.
ii. Patients of all age groups.
iii. Patients of both genders.

Exclusion Criteria: i. Patient not giving consent/unwilling for ultrasonographic examination
ii. Patients with incomplete test reports of LFT, RFT, LIPID PROFILE, RBS
iii. Patient with known liver disease or past history of liver disease.
iv. Patients having history of use of steatogenic medications within the past year.
v. Patient having history of liver malignancy.
vi. Patient having history of regular alcohol intake (>30 ml/day for male and >20ml/day for female)
vii. Positive serological markers for hepatitis B or C Virus.
viii. Patient who has undergone liver surgery.
ix. Patients having history of cholecystectomy.

RESULTS

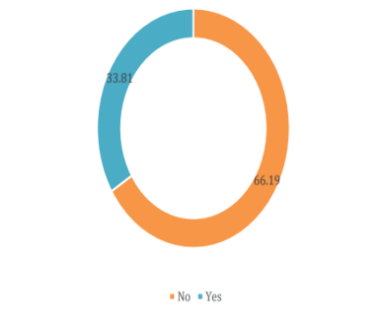
Descriptive statistics were computed to summarize the demographic and clinical characteristics of the study participants. Measures such as mean, median, standard deviation, and frequency distributions were calculated for relevant variables.

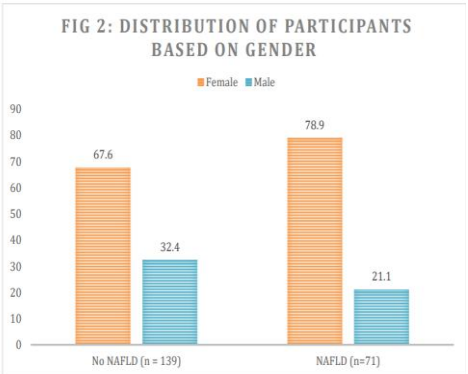
Chi-square tests and t-tests were performed to compare categorical and continuous variables between the groups with and without gallbladder pathology.

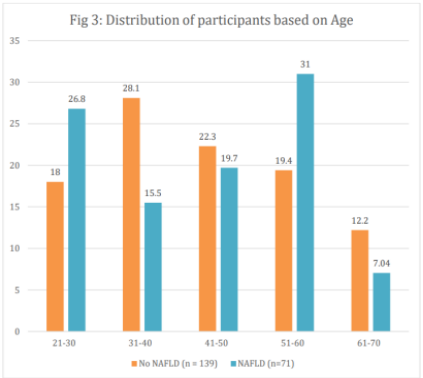
NAFLD	N	%		
No	139	66.19		
Yes	71	33.81		
Total	210	100.00		
	NO NAFLD	**NO NAFLD**	**NAFLD**	**NAFLD**
	N	**%**	**n**	**%**
Gender				
Female	94	67.6	56	78.9
Male	45	32.4	15	21.1
p value	0.668			
Age group				
21-30	25	18	19	26.8
31-40	39	28.1	11	15.5
41-50	31	22.3	14	19.7
51-60	27	19.4	22	31
61-70	17	12.2	5	7.04
Mean SD	42.9	12.1	43.8	13.2
p value	0.660			
Type of diet				
Veg	83	59.7	16	22.5
Non veg	56	40.3	55	77.5
p-value	< 0.0001			
BMI Category				
Normal	34	24.5	17	23.9
Overweight	55	39.6	24	33.8
Obese	50	36	30	42.3
Mean SD	24.6	2.4	28.7	3.5
p- value	0.032			
Lipid levels				
Low HDL	44	31.7	36	50.7
High HDL	43	30.9	29	40.8
Dyslipidemia	66	47.5	48	67.6
p-value	0.006			
Smoking	28	20.1	12	16.9
Tobacco chewing	10	7.19	5	7.04
Comorbidities				
Thyroid	12	8.63	13	18.3
CKD	7	5.04	12	16.9
CVD	16	11.5	10	14.1
Diabetes mellitus	18	12.9	21	29.6
Hypertension	22	15.8	24	33.8
Both DM+Hypertension	7	5.04	5	7.04
Residence				
Rural	67	48.2	38	53.5
Urban	72	51.8	33	46.5
p-value	0.0921			
Kuppuswamy SES class				
Lower	25	18	10	14.1

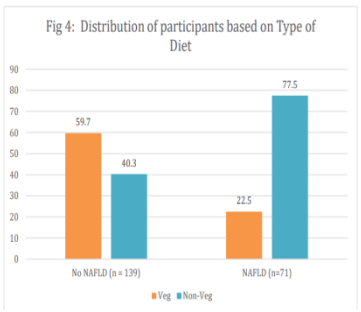
Upper Lower	34	24.5	15	21.1
Lower Middle	25	18	14	19.7
Upper Middle	54	38.8	27	38
Upper Class	1	0.719	5	7.04
p-value	0.120			
Type of GB diseases	**N**		**%**	
Single gallstone	116		55.24	
Multiple gallstone	52		24.76	
GB polyp	13		6.19	
Cholecystitis	11		5.24	
Adenomyomatosis	14		6.67	
Cholangiocarcinoma	4		1.90	
Volume of GB				
Contracted	48	34.5	31	43.7
Distended	52	37.4	25	35.2
Over distended	39	28.1	15	21.1
Single stone	66	47.5	50	70.4
Multiple stones	39	28.1	13	18.3
Sludge	34	24.5	8	11.3
GB Wall				
Normal	41	29.5	22	31
Thickening	98	70.5	49	69.1
Association of type of GB disease and NAFLD				
Type of GB diseases				
Single gallstone	66	47.5	50	70.4
Multiple gallstone	39	28.1	13	18.3
GB polyp	11	7.91	2	2.82
Cholecystitis	11	7.91	0	0
Adenocarcinoma	9	6.47	5	7.04
Cholangiocarcinoma	3	2.16	1	1.41

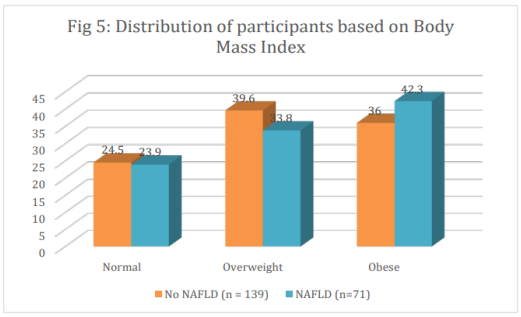
Fig 1: Prevalence of NAFLD among participants

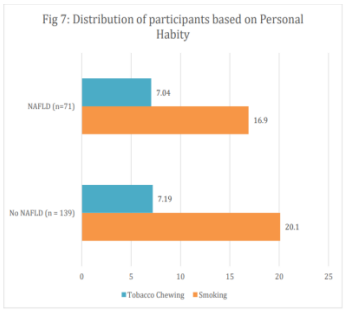


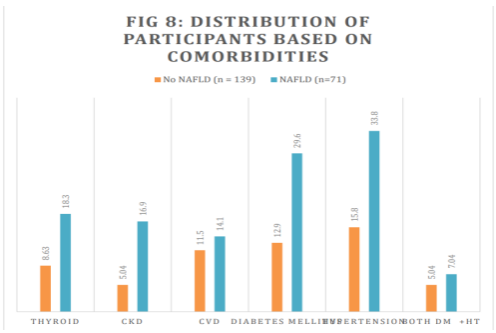


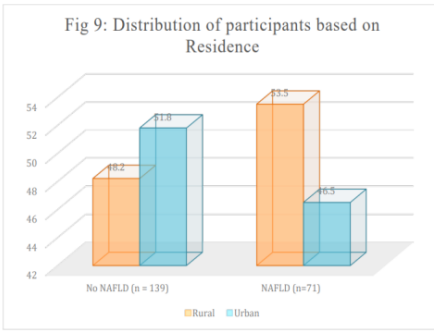


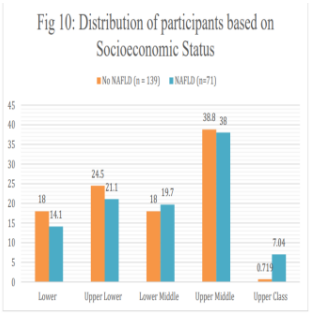


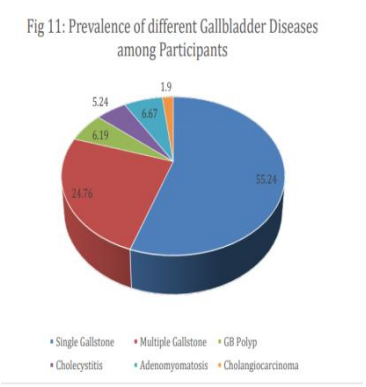


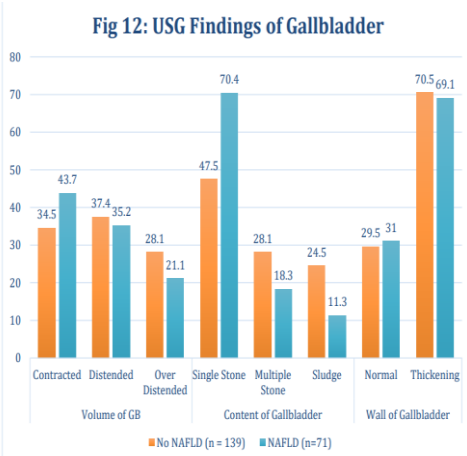


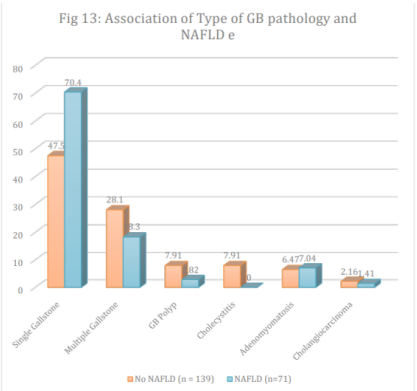












Using appropriate statistical methods; interpreted the results and assessed the association between gallbladder pathology and NAFLD; and compiled findings and prepared the final study report.

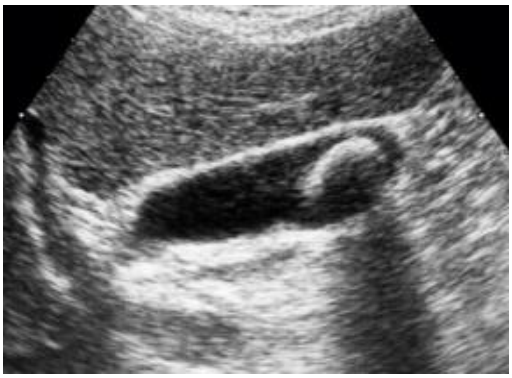


IMAGE 1- Image shows echogenic focus within gall bladder lumen in a patient with nonalcoholic fatty liver disease

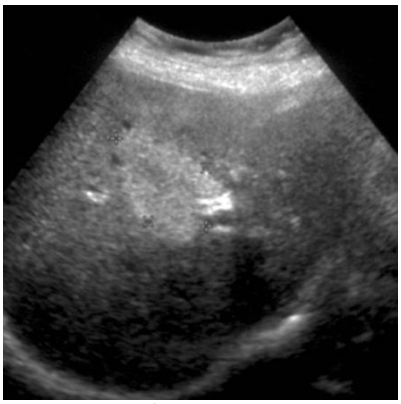


IMAGE 1 (a)- Above image shows focal increase of echogenecity in right lobe of liver S/o- Focal fatty Hepatic steatosis.

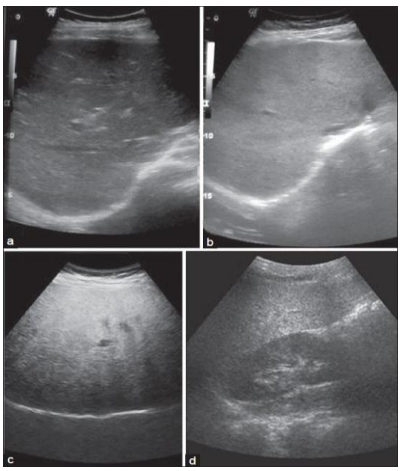


IMAGE 1(B). Above image shows increased echigenecity compared to right kidney s/o - Fatty liver.

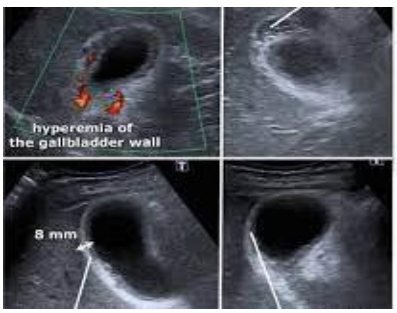


IMAGE 1 (C) . Above image shows gall bladder wall thickening and hyperemia with no calculous s/o acalculous cholecystitis.

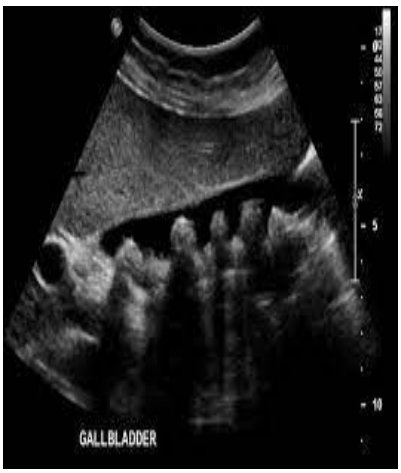
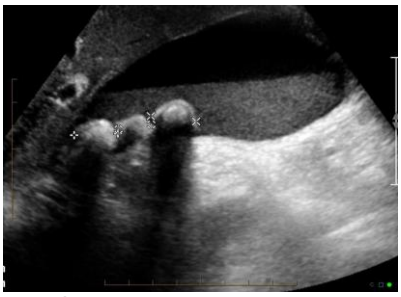


IMAGE 3 (A) Above image in patient shows evidence of multiple variable sized echogenic foci giving posterior acoustic shadowing seen in gall bladder lumen S/o -Cholelithiasis.–



5(a). Above image shows three echogenic foci with echogenicity on dependant part of gall bladder lumen S/o cholelithiasis with sludge.

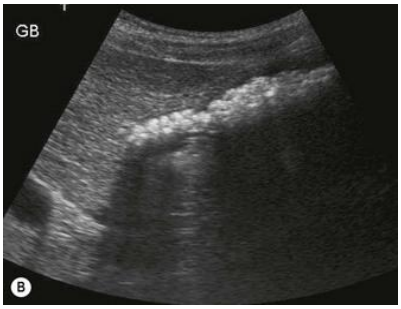


IMAGE 5(b). Above image showing multiple variable sized echogenic foci giving posterior acoustic shadow completely filling the gall bladder lumen.

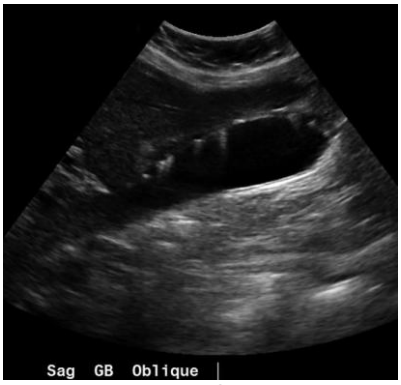


IMAGE 7(a). Evidence of multiple intramural echogenic foci showing comet tail artifacts S/o adenomyomatosis.

DISCUSSION

The present study was conducted in the Department of Radiology at LN Medical College and JK Hospital, using a cross-sectional gallbladder pathology and non-alcoholic fatty liver disease (NAFLD). A total of 210 participants were recruited over 18 months using convenience sampling. These individuals were referred to the radiology department for abdominal ultrasonography (USG), which was employed to diagnose both gallbladder pathology and NAFLD. The primary objective of this study was to determine the prevalence of NAFLD among individuals with gallbladder pathologies, with secondary objectives including the assessment of the severity of NAFLD and identification of specific gallbladder diseases in these patients

The comparison groups in this study, consisting of participants with and without NAFLD, were crucial for highlighting differences in clinical presentations, demographic profiles, and comorbidities between these two populations. Understanding these differences is important for clinical practice, as it allows healthcare providers to identify high-risk individuals and tailor diagnostic and management strategies accordingly. For instance, individuals with NAFLD and concomitant gallbladder pathology may require more aggressive interventions due to the higher prevalence of metabolic comorbidities such as diabetes and hypertension observed in this study.

Recent studies : Lee YC et al. (2014) discovered that persons with GSD had increased age, raised BMI, higher blood pressure, higher fasting plasma glucose, cholesterol, and triglyceride levels, as well as a greater incidence of diabetes and hypertension. In contrast, they had reduced eGFR and HDL-C values, along with a decreased incidence of current smoking and alcohol use[69]. Chang Y et al. (2013) evaluated the correlation between the severity of non-alcoholic fatty liver disease (NAFLD) and the occurrence of diabetes. A distinct positive correlation was identified across NAFLD categories with an elevated risk of diabetes, seen in both cross-sectional and cohort studies in a dose-response

relationship. In multivariate-adjusted models, the hazard ratios for diabetes were 2.00 (1.79-2.24) when comparing NAFLD with low NFS to no NAFLD, and 4.74 (3.67-6.13) when comparing NAFLD with intermediate or high NFS to no NAFLD[70]. Sepehrimanesh M, et al (2020) examined the correlation between Non-alcoholic fatty liver disease, Metabolic syndrome, and its components with Gallstone disease. A definitive correlation was shown between NAFLD and GSD, including a significant link between increased waist circumference and the risk of GSD. Individuals withGSD are advised to undergo assessment for the probable existence of NAFLD and to explore treatment options in conjunction with lifestyle adjustments to attain a healthy weight. Further study is necessary to clarify the intricate relationship between GSD, NAFLD, and obesity.

The present study found that the prevalence of non-alcoholic fatty liver disease (NAFLD) among patients with gallbladder diseases (GSD) was substantial, with NAFLD observed in 33.81% of the participants. Sepehrimanesh et al. (2020) reported a higher prevalence of NAFLD (42.4%) in patients with gallstone disease compared to non-GSD patients (22.6%). Similarly, Fattahi et al. (2016) found NAFLD prevalence rates of 32.9% in men and 27.4% in women in a large population-based study, consistent with the prevalence reported in the present study. Lu et al. (2021) found no significant difference in gallstone disease prevalence between patients with and without NAFLD (23.8% vs. 21.2%)[73]. However, they observed a higher rate of cholecystectomy in NAFLD patients (61.2% vs. 47.3%, $P < 0.001$), suggesting that while the overall prevalence of gallstone disease may not differ significantly, patients with NAFLD may be more likely to undergo surgical intervention. Lu Y et al. (2021) performed a retrospective analysis including 4,325 patients of type 2 diabetes. Their findings indicated no substantial difference in the frequency of gallstone disease (GSD) between individuals with and without non-alcoholic fatty liver disease (NAFLD). The rising prevalence of cholecystectomy and the declining occurrence of asymptomatic gallstones in individuals with NAFLD suggest a possible elevated risk of gallstone disease consequences linked to NAFLD. In conclusion, the correlation among NAFLD severity, diabetes, and gallstone disease is intricate and need more study to elucidate the multifaceted interactions among these variables. Kim NH et al. (2024) did a research to evaluate the influence of non-alcoholic fatty liver disease on the risk of gallbladder polyps in lean and non-obese adults. The prevalence of NAFLD and gallbladder polyps measuring > 5 mm was found as 28.5% and 2.9%, respectively. Individuals with NAFLD had a markedly increased probability of developing GBPs > 5 mm.

Kwak et al. (2015) also reported a higher prevalence of gallstone disease (8.3%) among patients with NAFLD compared to those without NAFLD(5.1%, $P < 0.001$). Kong L, et al. (2023) performed a research to examine the prevalence of NAFLD and associated risk factors in healthy persons. The prevalence of NAFLD in the Chongqing population was determined to be 28.5%, with a considerably greater rate in males (38.1%) compared to women (13.6%). NAFLD exhibited greater prevalence in males aged 51-60 years and females over 60 years. Logistic regression analysis determined that gender, age, body mass index (BMI), central obesity, hypertension, impaired fasting glucose/diabetes mellitus (DM), triglycerides (TG), low-density lipoprotein cholesterol (LDL-C), high-density lipoprotein cholesterol (HDL-C), hyperuricemia (HUA), alanine transaminase (ALT), and cholelithiasis are independent factors correlated with the presence of NAFLD[80]

The consistent findings across studies suggest a clear association between gallbladder diseases and NAFLD. The present study identified a significant association between non-alcoholic fatty liver disease (NAFLD) and gallbladder diseases, particularly gallstones and cholecystitis. This finding is consistent with several studies that have explored the relationship between NAFLD and gallbladder pathology, providing a broader understanding of how these conditions may be interlinked. Sepehrimanesh et al. (2020) demonstrated a clear connection between NAFLD and gallstone disease (GSD)[71]. Additionally, the study highlighted the role of metabolic syndrome components, particularly waist circumference, as key factors linking NAFLD and GSD. Similarly, in the present study, metabolic comorbidities such as obesity and diabetes were found to be more prevalent among participants with both NAFLD and gallbladder disease, further reinforcing the role of metabolic dysfunction in the pathogenesis of both conditions. Kwak et al. (2015) reported that NAFLD was more prevalent among patients with gallstone disease (41.3% vs. 29.6%, $P < 0.001$), NAFLD (OR = 1.35). This suggests that NAFLD and gallbladder diseases may share common pathophysiological mechanisms, including metabolic disturbances and inflammatory processes.

Diet was another statistically significant factor in the present study, with nonvegetarian diets being more common among patients with NAFLD (77.5%) compared to vegetarian diets(40.3%, $P < 0.0001$).

In conclusion, the statistically significant findings of the present study point to a strong association between NAFLD and gallbladder diseases, particularly in patients with single gallstones, obesity, non-vegetarian diets, and dyslipidaemia. These results mirror findings from previous studies and suggest that metabolic factors play a central role in the co-occurrence of these conditions.

Another non-significant result in the current study was the relationship between gender and NAFLD. Although there was a higher prevalence of NAFLD among females (78.9%) compared to males (21.1%), the association was not statistically significant ($P = 0.608$).

Summary
The present study aimed to explore the association between non-alcoholic fatty liver disease (NAFLD) and gallbladder diseases, with a focus on the prevalence of NAFLD among patients diagnosed with various gallbladder pathologies. Conducted over an 18-month period at the Department of Radiology, LN Medical College and JK Hospital, the study included 210 participants who underwent abdominal ultrasonography (USG) to diagnose both NAFLD and gallbladder diseases such as gallstones, cholecystitis, and adenomyomatosis.

The study found that NAFLD was present in 33.81% of the participants, with a significant association between NAFLD and single gallstones, obesity, and metabolic disturbances like dyslipidaemia. Several statistically significant findings were highlighted, including the higher prevalence of NAFLD in patients with single gallstones (70.4%) and the association between NAFLD and obesity, where 42.3% of NAFLD patients were obese compared to 36% of those without NAFLD. Additionally, dietary patterns and lipid profiles showed notable differences, with non-vegetarian diets and dyslipidaemia being more common among NAFLD patients.

The non-significant findings in the present study highlight that certain demographic factors, such as residence, gender, and socioeconomic status, may not have a direct or strong association with NAFLD in the context of gallbladder diseases. These results underscore the complexity of NAFLD pathogenesis and suggest that metabolic and lifestyle factors, rather than purely demographic variables, are likely to be the more influential determinants in the co-occurrence of NAFLD and gallbladder pathology. Further research is needed to better understand the nuanced roles of these non-significant variables and their interaction with other risk factors

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