

Frequency of Cholelithiasis and Associated Factors Among Patients Undergoing Abdominal Ultrasonography: A Cross-Sectional Study

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Abstract

Background: Cholelithiasis is a common gastrointestinal disorder and an important cause of morbidity worldwide. Despite its increasing burden, evidence regarding its frequency and associated risk factors in Pakistan remains limited.

Objective: To determine the frequency of cholelithiasis and identify its associated risk factors among patients undergoing abdominal ultrasonography at a tertiary care hospital in Mardan, Pakistan.

Methods: A descriptive cross-sectional study was conducted among 141 patients aged 20–70 years undergoing abdominal ultrasonography at the Department of Radiology, Mardan Medical Complex, Pakistan. Patients with a previous history of cholelithiasis or cholecystectomy were excluded. Demographic, clinical, and lifestyle data were collected using a structured questionnaire. Cholelithiasis was diagnosed by abdominal ultrasonography. Associations between cholelithiasis and potential risk factors were evaluated using the Chi-square

test, with a p-value <0.05 considered statistically significant.

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Results: The mean age of the participants was 39.9 ± 11.35 years, and 53.2% were females. Cholelithiasis was detected in 87 (61.7%) participants. Females had a significantly higher frequency of cholelithiasis than males (71.3% vs. 28.7%; $p < 0.001$). A positive family history of cholelithiasis ($p = 0.02$) and elevated liver function tests ($p = 0.03$) were significantly associated with gallstone disease. No significant associations were observed between cholelithiasis and age group ($p = 0.13$), body mass index ($p = 0.73$), serum cholesterol level ($p = 0.41$), or physical activity ($p = 0.16$).

Conclusion: Cholelithiasis was frequently detected among patients undergoing abdominal ultrasonography. Female gender, a positive family history of cholelithiasis, and elevated liver function tests were significant factors associated with gallstone disease. These findings support the use of abdominal ultrasonography for early diagnosis in high-risk individuals and highlight the need for larger multicenter prospective studies to validate these findings and inform preventive strategies.

Introduction

Cholelithiasis is a major global public health concern. Although most individuals remain asymptomatic, approximately one-fifth develop symptoms after 10 years of follow-up (1). Clinical manifestations include upper abdominal pain, particularly after fatty meals, dyspepsia, bloating, vomiting, jaundice, reduced appetite, and weight loss (2). Gallstones may lead to serious complications, including acute cholecystitis, cholangitis, pancreatitis, obstructive jaundice, gangrene, sepsis, fistula formation, paralytic ileus, and gallbladder carcinoma (3). In complicated cases, patients may present with fever, tachycardia, and a positive Murphy's sign, while jaundice is more common in chronic gallstone disease and choledocholithiasis (4).

Gallstone formation results from disturbances in biliary homeostasis and is influenced by multiple demographic, metabolic, and lifestyle factors (5). The traditional risk factors are summarized by the "four Fs": female, fat, forty, and fertile (6). Additional factors associated with gallstone disease include obesity, increasing age, pregnancy, diabetes mellitus, metabolic syndrome, dyslipidemia, rapid weight loss, bariatric surgery, physical inactivity, smoking, high-calorie and high-cholesterol diets, parity, fatty liver disease, and certain medications (4,7,8–11).

Pregnancy promotes gallstone formation through progesterone-induced gallbladder hypomotility and biliary stasis, while obesity and metabolic syndrome substantially increase the risk of gallstone development (4,9). Previous studies have also reported significant associations with marital status, socioeconomic status, dietary habits, and reduced physical activity (7,10).

Gallstone disease affects approximately 10–15% of adults in developed countries and represents a substantial healthcare burden, with more than 700,000 cholecystectomies performed annually in the United States (4,5). The prevalence varies considerably across populations, reaching approximately 10% in many Asian countries, around 4% in India, and less than 5% in African populations (12–14). In Pakistan, previous studies have reported a prevalence ranging from 9.0% to 10.2%, with a higher occurrence among females than males (7,10).

Abdominal ultrasonography is the first-line and gold-standard imaging modality for the diagnosis of cholelithiasis because of its high sensitivity, specificity, non-invasive nature, and real-time visualization of the gallbladder (15–19). Gallstones are broadly classified into cholesterol, pigment, and mixed stones, with cholesterol stones accounting for nearly 80% of cases in Western populations (4,20). Laparoscopic cholecystectomy remains the treatment of choice for symptomatic gallstone disease, while non-surgical options, including ursodeoxycholic acid and extracorporeal shock-wave lithotripsy, are reserved for selected patients (3,5,21–23).

Despite the growing burden of cholelithiasis, local evidence regarding its frequency and associated risk factors remains limited. Therefore, this study aimed to determine

the frequency of cholelithiasis and identify its associated factors among patients undergoing abdominal ultrasonography at Mardan Medical Complex.

Materials and Methods

A descriptive cross-sectional study was conducted in the Department of Radiology, Mardan Medical Complex, Mardan, Pakistan, over a six-month period. Patients aged 20–70 years undergoing abdominal ultrasonography were recruited through convenience sampling. Individuals with a previous history of cholelithiasis or cholecystectomy, those aged <20 or >70 years, and those who declined to provide written informed consent were excluded.

The minimum required sample size was 141 participants, calculated using OpenEpi sample size calculator by taking an anticipated prevalence of 10.1%, a 95% confidence level, and a 5% margin of error. After obtaining written informed consent, data were collected using a structured questionnaire including demographic, clinical, and lifestyle information.

Abdominal ultrasonography was performed by an experienced sonologist using a curvilinear transducer. Cholelithiasis was diagnosed based on ultrasonographic findings. Liver function tests and lipid profile parameters were also recorded where available. Ultrasonography was selected as the diagnostic modality because of its high sensitivity, specificity, diagnostic accuracy, safety, and cost-effectiveness.

Data were analyzed using IBM-SPSS version 26. Categorical variables were summarized as frequencies and percentages. Associations between cholelithiasis and potential risk factors were evaluated using the Chi-square test. A *p*-value <0.05 was considered statistically significant.

Results

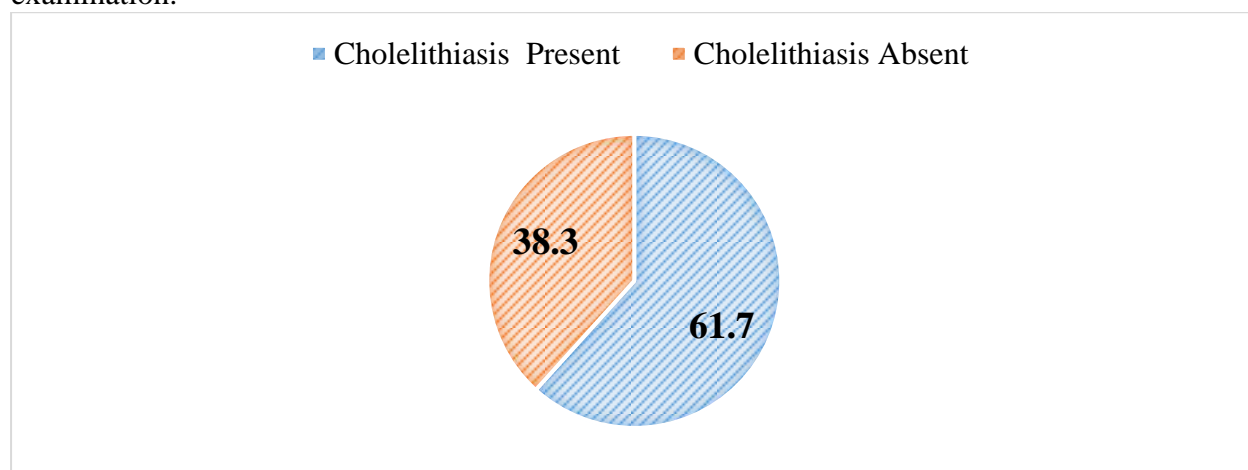
A total of 141 patients undergoing abdominal ultrasonography were included in the study. The mean age was 39.9 ± 11.35 years, with 83 (58.9%) participants aged 20–40 years. Females constituted 53.2% of the study population, and 84.4% of participants were married. Among female participants, 57 (76.0%) had ≥ 3 children. Overall, 59 (41.8%) participants were physically active, 67 (47.5%) reported a positive family history of cholelithiasis, and 67 (47.5%) had a normal body mass index. Frequent junk food consumption and lack of a balanced diet were reported by 86 (61.0%) and 91 (64.5%) participants, respectively. Elevated serum cholesterol and abnormal liver function tests were observed in 65 (46.1%) and 73 (51.8%) participants, respectively (Table 1).

Table 1. Baseline demographic, clinical, and lifestyle characteristics of the study participants

Variable	Category	Values n (%)
Gender	Male	66 (46.8)
	Female	75 (53.2)
Marital status	Married	119 (84.4)
	Unmarried	22 (15.6)
Age group (years)	20–40	83 (58.9)
	>40	58 (41.1)

Parity (females, n=75)	<3 children	18 (24.0)
	≥3 children	57 (76.0)
Physical activity	Active	59 (41.8)
	Moderately active	52 (36.9)
	Less active	30 (21.3)
Family history of cholelithiasis	Yes	67 (47.5)
	No	74 (52.5)
Body mass index	Normal	67 (47.5)
	Overweight	42 (29.8)
	Obese	32 (22.7)
Junk food consumption	Yes	86 (61.0)
	No	55 (39.0)
Balanced diet	Yes	50 (35.5)
	No	91 (64.5)
Serum cholesterol	Normal	75 (53.2)
	Low	01 (0.7)
	High	65 (46.1)
Liver function tests	Normal	68 (48.2)
	Elevated	73 (51.8)

Ultrasonography confirmed cholelithiasis in 87 (61.7%) participants, while 54 (38.3%) showed no evidence of gallstones (Figure 01). All participants presented with abdominal pain, and 110 (78.0%) had undergone a previous abdominal ultrasound examination.



Cholelithiasis was significantly more frequent among females than males (71.3% vs. 28.7%, $p<0.001$). Similarly, elevated LFTs ($p=0.039$) and a positive family history of cholelithiasis ($p=0.021$) were significantly associated with gallstone disease. No significant associations were observed between cholelithiasis and age group ($p=0.138$), BMI ($p=0.732$), serum cholesterol level ($p=0.412$), or physical activity ($p=0.164$). The association between cholelithiasis and potential risk factors is presented in Table 3.

Table 3. Association between cholelithiasis and selected risk factors

Variable	Gallstones Present n (%)	Gallstones Absent n (%)	<i>p</i> -value
Gender			<0.001
Male	25 (28.7)	41 (75.9)	
Female	62 (71.3)	13 (24.1)	
Age group (years)			0.13
20–40	47 (54.0)	36 (66.7)	
>40	40 (46.0)	18 (33.3)	
Body mass index			0.73
Normal	40 (46.0)	27 (50.0)	
Overweight	28 (32.2)	14 (25.9)	
Obese	19 (21.8)	13 (24.1)	
Serum cholesterol			0.41
Normal	43 (49.4)	32 (59.3)	
Low	01 (1.1)	0 (0.0)	
High	43 (49.4)	22 (40.7)	
Liver function tests			0.03
Elevated	51 (58.6)	22 (40.7)	
Normal	36 (41.4)	32 (59.3)	
Physical activity			0.16
Active	34 (39.1)	25 (46.3)	
Moderately active	30 (34.5)	22 (40.7)	
Less active	23 (26.4)	7 (13.0)	
Family history			0.02
Yes	48 (55.2)	19 (35.2)	
No	39 (44.8)	35 (64.8)	

Discussion

The present study evaluated the frequency of cholelithiasis and its associated risk factors among patients undergoing abdominal ultrasonography at a tertiary care hospital in Mardan. Cholelithiasis was identified in 61.7% of participants, with a significantly higher frequency among females (71.3%) than males (28.7%). These findings are consistent with those reported by Bhattacharya et al. (71.4% females vs. 28.6% males) (24), Sharma et al. (70% vs. 30%) (25), and Thamir et al. (79.5% vs. 20.5%) (26). The female predominance may be explained by hormonal influences, reproductive factors, obesity, rapid weight loss, and genetic susceptibility, all of which increase the risk of cholesterol gallstone formation.

Participants aged 20–40 years had a higher frequency of cholelithiasis (58.9%) than those aged >40 years (41.1%). Although advancing age is a well-established risk

factor for gallstone disease because of cumulative exposure to metabolic and environmental risk factors (27, 28), a Danish study reported a higher incidence among individuals aged >45 years than those aged <35 years, with the gender difference narrowing with increasing age (29). The variation from our findings may reflect differences in study population, sample size, dietary patterns, and lifestyle characteristics.

The frequencies of cholelithiasis among active, moderately active, and less active participants were 41.8%, 36.9%, and 21.3%, respectively. Previous evidence by Ansari-Moghaddam et al. demonstrated that regular physical activity is associated with a lower risk of gallstone disease (30). Physical activity, together with a balanced, fiber-rich diet, promotes healthy body weight and favorable lipid metabolism, thereby reducing the risk of gallstone formation.

Participants with a positive family history and no balanced diet had frequencies of cholelithiasis of 47.5% and 65.5%, respectively. A positive family history reflects the contribution of genetic factors to gallstone formation, and previous research has reported a close association between gallstone disease and familial predisposition (35.7%) (31). Dietary habits also influence gallstone risk; for example, a traditional Mexican diet rich in beans, corn tortillas, and chili peppers has been associated with a lower prevalence of gallbladder disease (32).

Regarding BMI, participants with normal BMI had the highest frequency of cholelithiasis (47.5%). Although obesity is a recognized risk factor, previous evidence suggests that low HDL cholesterol may contribute to gallbladder pathology independently of BMI and body weight through metabolic mechanisms (7).

Similarly, participants with normal cholesterol levels showed the highest frequency of cholelithiasis (53.2%). Cholesterol is central to gallstone formation because supersaturation of bile with cholesterol promotes crystal precipitation and stone formation. However, while previous studies reported an association between serum cholesterol and gallstone disease in univariate analysis, this association was not sustained after multivariable adjustment, suggesting that cholesterol acts alongside other metabolic and clinical factors in the development of gallstones (33).

This study provides important local evidence on the frequency and associated risk factors of cholelithiasis among patients undergoing abdominal ultrasonography. Its strengths include the use of ultrasonography for accurate diagnosis and the assessment of multiple demographic and lifestyle-related risk factors. However, the single-center cross-sectional design, relatively small sample size, and reliance on self-reported lifestyle data limit the generalizability of the findings and preclude causal inference. Large multicenter prospective studies are needed to validate these findings in the Pakistani population.

Conclusion

This study demonstrated a high frequency of cholelithiasis among patients undergoing abdominal ultrasonography at a tertiary care hospital. Female gender, a positive family history of cholelithiasis, and elevated liver function tests were significantly associated with the cholelithiasis, whereas age, body mass index, serum cholesterol level, and physical activity showed no statistically significant associations. These findings underscore the importance of recognizing individuals at increased risk and support the role of abdominal ultrasonography as an effective diagnostic modality for the early detection of cholelithiasis. Further multicenter prospective studies with larger sample sizes are warranted to validate these findings and inform targeted prevention and management strategies in the Pakistani population.

Declarations

Ethics approval: Approved by the Institutional Ethical Review Committee of Mardan Medical Complex, Mardan.

Consent to participate: Written informed consent was obtained from all participants.
Availability of data and materials: Available from the corresponding author upon reasonable request.

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Conflict of interest: The authors declare no conflict of interest.

Authors' contributions: All authors contributed to the study conception and design, data collection, analysis and interpretation, manuscript preparation, and approved the final version of the manuscript.

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