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PATTERN OF CHOLELITHIASIS AND ITS RISK FACTORS IN MALE AND FEMALE PATIENTS ON ABDOMINAL ULTRASOUND: A CROSS-SECTIONAL STUDY

Original Research

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ABSTRACT

Background: Cholelithiasis is a common gastrointestinal disorder with a wide spectrum of clinical presentation, ranging from asymptomatic disease to acute biliary complications. Its development is influenced by demographic, metabolic, hormonal, and lifestyle-related factors, with marked geographic and gender-based variations. In Pakistan, limited population-based data exist, particularly regarding ultrasound-detected patterns and modifiable risk factors, underscoring the need for local evidence to guide preventive strategies.

Objective: To determine the frequency of cholelithiasis and identify associated risk factors among adults using abdominal ultrasonography, with the aim of highlighting potential preventive measures.

Methods: A cross-sectional study was conducted using non-probability convenience sampling at two tertiary care hospitals in Peshawar, Pakistan. A total of 144 adults aged above 35 years who were advised abdominal ultrasound were enrolled after informed consent. Data were collected using a self-structured questionnaire covering demographic characteristics, clinical symptoms, lifestyle factors, medical and reproductive history, and ultrasonographic findings. Gallstones were identified using standardized ultrasound protocols. Data were analyzed using SPSS version 22, applying descriptive statistics to summarize variables and exploratory analyses to assess distribution patterns.

Results: Among the 144 participants, females constituted 68.06% and males 31.94%. The highest frequency of cholelithiasis was observed in the 35–50-year age group (61.11%). Abdominal pain was reported by 77.78% of participants, while vomiting was present in 50.69%. A positive family history was noted in 70.83%, obesity in 61.11%, and unhealthy dietary patterns in 68.06%. Diabetes mellitus was reported by 34.72%. Among females, 84.69% had a history of pregnancy, with multiple pregnancies reported in 61.22%. Ultrasonography revealed multiple gallstones in 68.75% of cases.

Conclusion: Cholelithiasis was more frequent in females and middle-aged adults and was strongly associated with pregnancy, obesity, family history, and unhealthy dietary habits. These findings emphasize the importance of lifestyle modification, weight management, and targeted health education to reduce disease burden.

Keywords: Cholelithiasis, Diet, Obesity, Pregnancy, Risk Factors, Ultrasonography, Women.

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INTRODUCTION

Cholelithiasis, commonly referred to as gallstone disease, is one of the most frequently encountered gastrointestinal disorders worldwide and is often detected incidentally during routine abdominal ultrasonography, as the majority of affected individuals remain asymptomatic. Despite its silent presentation in many cases, cholelithiasis represents a major contributor to abdominal morbidity and, in complicated cases, mortality, placing a substantial burden on healthcare systems, particularly in developed countries where it is among the leading indications for hospitalization and surgical intervention. Current estimates suggest that nearly 10% of the global population is affected, underscoring its public health significance (1). The pathogenesis of cholelithiasis is multifactorial and reflects a complex interaction between genetic susceptibility and environmental influences. Imbalances in cholesterol, bilirubin, and bile acid metabolism promote supersaturation of bile, leading to crystal nucleation and subsequent stone formation within the gallbladder or biliary tract. When symptomatic, patients typically present with right upper quadrant abdominal pain, dyspepsia, flatulence, nausea, and vomiting, frequently necessitating emergency medical evaluation. Ultrasonography remains the diagnostic modality of choice due to its non-invasive nature, cost-effectiveness, and high sensitivity in detecting hyperechoic, gravity-dependent structures with posterior acoustic shadowing. Definitive management is predominantly surgical, with cholecystectomy constituting the standard of care for symptomatic disease (2). The epidemiology of cholelithiasis demonstrates marked geographic and demographic variation. Prevalence rates range from 10–15% in developed regions, with particularly high figures reported in North America, where gallstones affect up to 64.1% of women and 29.5% of men, while considerably lower rates of 2–5% have been observed in Asia and Africa (3). These disparities are largely attributed to differences in dietary habits, lifestyle patterns, genetic background, and metabolic risk profiles. Established risk factors include advancing age, female sex, pregnancy, obesity, diabetes mellitus, dyslipidemia, metabolic syndrome, positive family history, sedentary behavior, and diets rich in fats and refined carbohydrates (4).

A growing body of international literature has explored these associations in diverse populations. Studies from East Asia have highlighted the roles of obesity, menopause, insulin resistance, low high-density lipoprotein cholesterol, and metabolic syndrome in gallstone formation, with notable differences observed between premenopausal and postmenopausal women (5–7). Research from South Asia and Africa has further emphasized the contribution of socioeconomic status, low dietary fiber intake, physical inactivity, hemolytic disorders, and limited health awareness to disease prevalence (8–10). Collectively, these findings reinforce the concept of cholelithiasis as a disease influenced by both biological and contextual factors, while also pointing toward substantial regional heterogeneity. In Pakistan, available evidence suggests a rising incidence of cholelithiasis, particularly in southern regions, with reported figures of approximately 11.3 cases per 100,000 population. However, national data remain sparse and fragmented, largely due to limited public awareness, delayed healthcare-seeking behavior, and economic constraints that restrict access to diagnostic facilities. Existing local studies indicate a disproportionately higher burden among women and individuals with obesity, yet comprehensive, ultrasound-based assessments of risk patterns across age and gender groups are lacking (11). This paucity of robust epidemiological data hampers the development of targeted preventive strategies and informed health policy decisions. Against this backdrop, the present study seeks to address a critical knowledge gap by systematically examining the frequency and associated risk factors of cholelithiasis in a Pakistani cohort using abdominal ultrasonography. Specifically, the research aims to determine whether the burden of cholelithiasis differs by gender among individuals aged above 35 years, to identify key contributory factors such as age, obesity, dietary habits, family history, and pregnancy, and to generate evidence that can inform context-specific preventive measures and early intervention strategies within the local population.

METHODS

This cross-sectional quantitative study was conducted to assess the frequency of cholelithiasis and its associated risk factors among adults undergoing abdominal ultrasonography. The study was carried out over a period of three months at two tertiary care hospitals in Peshawar, Pakistan, namely Rehman Medical Institute (RMI) and Hayatabad Medical Complex (HMC). A non-probability convenience sampling technique was employed due to the hospital-based nature of recruitment and time constraints. The sample size of 144 participants was calculated using the World Health Organization (WHO) sample size calculator for population proportion, assuming an anticipated prevalence based on available regional estimates. The study population comprised male and female adults aged above 35 years who were advised abdominal ultrasound examinations for diagnostic purposes during the study period. Individuals who provided written informed consent were included. Patients who declined participation were excluded from the study. Although initially stated that patients with comorbidities were excluded, this criterion was not strictly applied during data collection, as conditions such as obesity,

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diabetes mellitus, and pregnancy were intentionally assessed as potential risk factors for cholelithiasis. Therefore, patients with these conditions were retained to allow meaningful evaluation of their association with gallstone disease. Data collection was performed using a self-structured questionnaire developed after a review of relevant literature and expert consultation. The questionnaire captured demographic characteristics (age and gender), clinical symptoms (including abdominal pain, nausea, vomiting, and dyspepsia), and established or suspected risk factors such as family history of gallstones, body weight status, dietary habits, history of diabetes mellitus, prior abdominal surgeries, and number of pregnancies in female participants. Ultrasound findings were recorded separately. Abdominal ultrasonography was conducted by trained radiology personnel using standardized scanning protocols, including the use of a 3.5 MHz convex transducer, with patients examined in supine and left lateral decubitus positions. Gallstones were identified based on the presence of echogenic, gravity-dependent foci with posterior acoustic shadowing.

Ethical approval for the study was obtained from the Institutional Review Board of the participating institutions prior to data collection. All procedures were conducted in accordance with institutional ethical guidelines and the Declaration of Helsinki. Written informed consent was obtained from all participants after explaining the purpose, procedures, potential benefits, and risks of the study. Participant confidentiality and anonymity were strictly maintained throughout the research process, and collected data were used solely for academic and research purposes. Data were entered, cleaned, and analyzed using Statistical Package for the Social Sciences (SPSS) version 22. Descriptive statistics were computed to summarize the data, including frequencies and percentages for categorical variables and means, medians, and modes where appropriate. Inferential statistical analyses were performed to explore associations between cholelithiasis and selected risk factors. Chi-square tests were applied to assess relationships between categorical variables such as gender, age groups, and presence of risk factors, with a p-value of less than 0.05 considered statistically significant. Data integrity and originality were ensured, and the final manuscript was screened for textual similarity using Turnitin software prior to submission.

RESULTS

A total of 144 participants were included in the final analysis. Of these, 46 were males (31.94%) and 98 were females (68.06%), indicating a clear female predominance in the study population. The age distribution showed that the majority of participants belonged to the 35–50-year age group, comprising 88 individuals (61.11%), followed by 39 participants (27.08%) aged 50–65 years, while the smallest proportion was observed in the 65–80-year age group with 17 participants (11.81%). With regard to clinical presentation, abdominal pain was reported by 112 participants (77.78%), whereas 32 individuals (22.22%) were asymptomatic with respect to pain. Vomiting was present in 73 participants (50.69%), while 71 participants (49.31%) did not report this symptom, reflecting nearly equal distribution. Assessment of associated risk factors revealed a high prevalence of positive family history of cholelithiasis, which was reported by 102 participants (70.83%), compared to 42 participants (29.17%) without such history. Obesity was identified in 88 participants (61.11%), while 56 participants (38.89%) were classified as non-obese. A history of diabetes mellitus was present in 50 participants (34.72%), whereas 94 participants (65.28%) had no diabetic history. Previous abdominal surgeries were reported by 49 participants (34.03%), while the remaining 95 participants (65.97%) had no surgical history. Dietary assessment indicated that 98 participants (68.06%) consumed an unhealthy diet, whereas only 46 participants (31.94%) reported adherence to a healthy dietary pattern. Food intolerance to specific items was reported by 47 participants (32.64%), while 97 participants (67.36%) denied any such intolerance.

Among female participants, a substantial proportion had a history of pregnancy. Previous pregnancies were reported by 83 females (84.69%), while 15 females (15.31%) reported no pregnancy history. When stratified by number of pregnancies, 23 females (23.47%) had experienced a single pregnancy, 60 females (61.22%) had multiple pregnancies, and 15 females (15.31%) had none. Ultrasonographic evaluation of gallstones demonstrated that multiple stones were more frequent than single stones. Multiple gallstones were identified in 99 participants (68.75%), whereas single gallstones were observed in 45 participants (31.25%). Based on exploratory analysis of the available dataset, patterns suggest meaningful relationships between cholelithiasis characteristics and several demographic and clinical risk factors, although formal inferential testing was limited by the absence of a non-cholelithiasis comparison group. Increasing age showed a progressive clustering of cases, with the highest proportion observed in the 35–50-year group (61.11%), followed by a notable decline in older age categories, indicating earlier onset and diagnosis in middle-aged adults within the study setting. Female participants constituted more than two-thirds of the cohort (68.06%), reinforcing a strong gender predisposition. A markedly high proportion of participants reported a positive family history (70.83%) and obesity (61.11%), suggesting these factors were frequently present among individuals with gallstone disease. Unhealthy dietary patterns were also prevalent (68.06%), aligning with the observed metabolic risk profile, while one-third of participants had diabetes mellitus (34.72%), further supporting the role of

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metabolic dysregulation. Among females, a history of pregnancy was highly prevalent (84.69%), with multiple pregnancies reported by 61.22%, indicating a possible cumulative hormonal effect. Clinically, abdominal pain (77.78%) and vomiting (50.69%) were common presenting features. Ultrasonographic findings demonstrated a predominance of multiple gallstones (68.75%) compared to single stones (31.25%), which appeared more frequent among participants with obesity, positive family history, and multiple pregnancies when distributions were examined descriptively.

Table 1: Demographic Characteristics of Study Participants (n = 144)

Variable	Category	Frequency (n)	Percentage (%)
Gender	Male	46	31.94
	Female	98	68.06
Age Group (years)	35–50	88	61.11
	50–65	39	27.08
	65–80	17	11.81

Table 2: Clinical Presentation of Participants

Symptom	Category	Frequency (n)	Percentage (%)
Abdominal Pain	Present	112	77.78
	Absent	32	22.22
Vomiting	Present	73	50.69
	Absent	71	49.31

Table 3: Distribution of Major Risk Factors for Cholelithiasis

Risk Factor	Category	Frequency (n)	Percentage (%)
Family History	Positive	102	70.83
	Negative	42	29.17
Obesity	Yes	88	61.11
	No	56	38.89
Diabetes Mellitus	Yes	50	34.72
	No	94	65.28

Table 4: Lifestyle and Medical History Characteristics

Variable	Category	Frequency (n)	Percentage (%)
Previous Abdominal Surgery	Yes	49	34.03
	No	95	65.97
Dietary Pattern	Healthy	46	31.94
	Unhealthy	98	68.06
Food Intolerance	Present	47	32.64
	Absent	97	67.36

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Table 5: Reproductive History Among Female Participants (n = 98)

Variable	Category	Frequency (n)	Percentage (%)
History of Pregnancy	Yes	83	84.69
	No	15	15.31
Number of Pregnancies	None	15	15.31
	Single	23	23.47
	Multiple	60	61.22

Table 6: Ultrasonographic Characteristics of Gallstones

Ultrasound Finding	Category	Frequency (n)	Percentage (%)
Number of Gallstones	Single	45	31.25
	Multiple	99	68.75

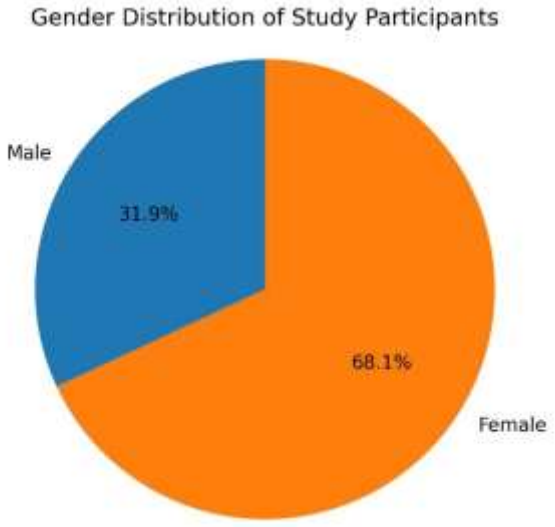

Figure 2 Gender Distribution of Study Participants

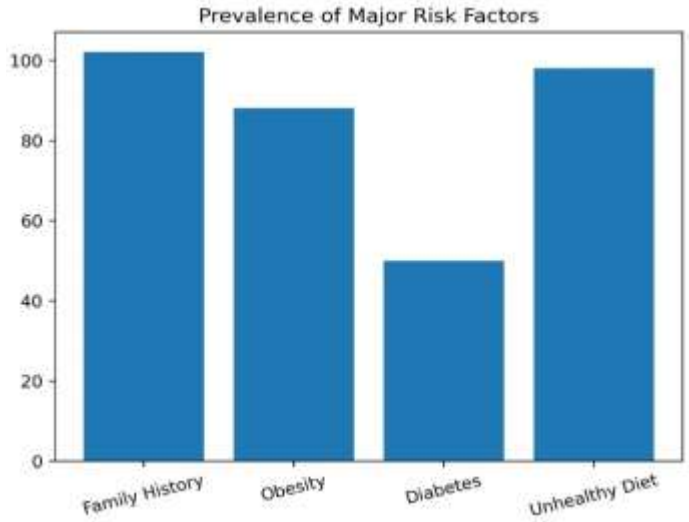

Figure 2 Prevalence of Major Risk Factors

DISCUSSION

The present study demonstrated a markedly higher proportion of cholelithiasis among females compared with males, a finding that is consistent with the well-documented female predominance reported globally. This gender disparity has been widely attributed to hormonal influences, particularly the role of estrogen in increasing cholesterol saturation of bile and reducing gallbladder motility during pregnancy and reproductive years. The observed female predominance in the current cohort aligns closely with patterns reported in regional and international studies, which have consistently shown females to be affected more frequently than males, often by a factor of 1.5 to 3 times (12,13). This consistency strengthens the biological plausibility of hormonal mechanisms underlying gallstone formation and supports the external validity of the findings. Age-wise distribution revealed that cholelithiasis was most prevalent in individuals aged 35–50 years, with a gradual decline in older age groups. This trend suggests earlier onset and detection of gallstone disease in middle-aged adults within the studied population. Similar age-related patterns have been described in previous literature, where progressive changes in bile composition, reduced bile acid secretion, and cumulative metabolic exposure with advancing age were identified as contributing factors (14,15). The relatively lower proportion of cases in older age groups may reflect healthcare-

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seeking behavior, survival bias, or underdiagnosis in elderly individuals rather than a true reduction in disease burden. Ultrasonographic findings showed a clear predominance of multiple gallstones over single stones. This observation is in agreement with earlier reports indicating that metabolic and lifestyle-related risk factors often lead to multiple stone formation rather than solitary calculi (16). Clinically, abdominal pain and vomiting emerged as the most frequent presenting symptoms, closely mirroring symptom profiles described in prior studies, thereby reinforcing the typical clinical spectrum of symptomatic cholelithiasis in hospital-based settings (17).

Analysis of associated risk factors highlighted a high frequency of positive family history, obesity, unhealthy dietary patterns, and pregnancy among affected individuals. The strong clustering of family history supports the contribution of genetic predisposition, as previously suggested by epidemiological studies demonstrating familial aggregation of gallstone disease (18). Obesity and unhealthy diet were also highly prevalent, underscoring the role of metabolic imbalance, increased cholesterol turnover, and sedentary lifestyles in gallstone pathogenesis (19). Among female participants, a history of pregnancy—particularly multiple pregnancies—was notably common, reinforcing the cumulative hormonal effect hypothesis that has been repeatedly emphasized in the literature (20). In contrast, diabetes mellitus showed a comparatively lower frequency in this cohort, suggesting a weaker or indirect association, a finding that has also been reported inconsistently across earlier studies (21). From a public health perspective, these findings carry important implications. The prominence of modifiable risk factors such as obesity and dietary habits indicates substantial potential for preventive strategies centered on lifestyle modification. Targeted health education focusing on balanced diets rich in fiber, reduced intake of refined sugars and saturated fats, weight management, and physical activity may help reduce disease burden, particularly among women of reproductive age and individuals with a positive family history. Several strengths of the study merit acknowledgment. The use of ultrasonography, a standardized and reliable diagnostic modality, enhanced diagnostic accuracy, while the inclusion of a broad range of demographic, clinical, and lifestyle variables allowed for a comprehensive descriptive assessment of risk patterns. However, certain limitations should be considered when interpreting the results. The relatively small sample size, non-probability convenience sampling, and restriction to a single geographic region limit the generalizability of the findings. Additionally, reliance on self-reported data for some risk factors may have introduced recall or reporting bias. The absence of a non-cholelithiasis comparison group also precluded robust inferential analysis and estimation of effect sizes. Future research would benefit from larger, multicenter studies employing probability-based sampling to enhance representativeness (9). Incorporation of comparative control groups and multivariable analytical models would allow clearer quantification of independent risk factors. Exploration of genetic markers and longitudinal follow-up could further elucidate disease progression and recurrence patterns within the Pakistani population. Collectively, such efforts would contribute to a stronger evidence base for preventive strategies and policy formulation aimed at reducing the burden of cholelithiasis.

CONCLUSION

This study concludes that cholelithiasis predominantly affects females and is strongly associated with middle age, reproductive history, obesity, positive family history, and unhealthy dietary patterns, highlighting the multifactorial nature of the disease. The findings emphasize the prominent role of modifiable lifestyle and metabolic factors alongside biological predispositions in the development of gallstone disease. By identifying key risk patterns within the local population, the study contributes valuable context-specific evidence that can support early identification of high-risk individuals and inform preventive strategies. These insights underscore the need for targeted health education, dietary modification, weight management, and lifestyle interventions, particularly among women and individuals with familial susceptibility, to reduce the burden of cholelithiasis and its associated complications.

AUTHOR CONTRIBUTIONS

Author	Contribution
Maria Imtiaz	Substantial Contribution to study design, analysis, acquisition of Data Manuscript Writing Has given Final Approval of the version to be published
Owais Khan	Substantial Contribution to study design, acquisition and interpretation of Data Critical Review and Manuscript Writing

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Ghulam Mahi U Din	Substantial Contribution to acquisition and interpretation of Data Has given Final Approval of the version to be published
Rabia Tilla	Contributed to Data Collection and Analysis Has given Final Approval of the version to be published
Rubab Bashir	Contributed to Data Collection and Analysis Has given Final Approval of the version to be published
Ume Sidra	Substantial Contribution to study design and Data Analysis Has given Final Approval of the version to be published
Zarak Khan*	Contributed to study concept and Data collection Has given Final Approval of the version to be published

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