Surg. Gastroenterol. Oncol. 2025;30(2 Suppl):S16-S22 DOI: 10.21614/sgo-798

A Cross-Sectional Study of Risk Factors in Patients who Underwent Laparoscopic Cholecystectomy

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ABSTRACT

Background: Gallbladder (GB) stone disease is a common gastrointestinal disorder with notable variations in demographic, clinical, and surgical outcomes between male and female patients. Understanding these differences can aid in optimizing management strategies and improving patient outcomes. *Aim:* This study aimed to assess the demographic characteristics, clinical factors, and postoperative outcomes in male and female patients diagnosed with GB stones undergoing cholecystectomy.
Methods: This is a cross sectional study which included 100 patients with GB stone undergoing cholecystectomy. Data on demographic variables, comorbidities, stone characteristics, operative details, and postoperative findings were analyzed to identify significant sex-based differences.
Results: The majority of patients were female (78%), with males comprising only 22% of the study population. Males had a significantly higher BMI (32.5 ± 3.45 kg/m^2) than females (30.08 ± 3.6 kg/m^2) ($p = 0.046$). Smoking was significantly more prevalent among males (68.18%) compared to females (8.97%) ($p < 0.001$). Males had larger GB stones on average (11.96 ± 4.93 mm vs. 9.75 ± 4.44 mm, $p = 0.048$) and were more likely to have single large stones, whereas females had a higher proportion of multiple stones ($p = 0.011$). Males also experienced longer operative times (67.73 ± 14.12 min vs. 61.0 ± 13.03 min, $p=0.039$) and had a higher prevalence of surgical adhesions (22.73% vs. 5.13%, $p=0.023$). However, no significant sex-based differences were observed in hospital stay duration, drain use, or postoperative complications.
Conclusion: The study highlights notable sex-based differences in GB stone disease, particularly in BMI, smoking prevalence, stone characteristics, and surgical outcomes. Males tended to have larger, single stones, longer operative times, and a higher incidence of adhesions.
Keywords: gallbladder stones, cholecystectomy, sex differences, BMI, smoking, stone characteristics, surgical outcomes.

Received: 03.05.2025
Accepted: 23.07.2025

INTRODUCTION

Laparoscopic cholecystectomy (LC) has become a gold standard procedure since its introduction in the late 1980s and is now used worldwide as a treatment for cholelithiasis. Over time, the hospital stay after LC has decreased, day-case procedures have become commonplace, and patients have had an

earlier recovery and return to work. Furthermore, the indications for LC and the age of patients undergoing this procedure has broadened over time. These are important considerations given that cholelithiasis is becoming an increasingly common pathology in the Western world, affecting an increasing number of people at a younger age and having an economic impact in health care (1).

Regarding sex-wise variation, women are at a higher risk of gallstone disease than men. The male to female ratio for cholelithiasis is 0.52:1 (2). Gender difference begins in adolescence and continues through the reproductive years; between the ages of 50 and 65, approximately 20% of women and 5% of men have gallstones. The reason for higher risk of developing cholelithiasis probably has to do with hormonal and reproductive factors, i.e. oral contraceptives or hormone therapy taken by women as well as pregnancy (3). Naturally occurring menopause around the age of 49 is associated with the start of hormone replacement therapy (HRT). This therapy is the most effective way of treating vasomotor and genitourinary symptoms, while observational studies show a relationship between HRT and an increased risk of gallstones (4). It is estimated that 10% of all pregnant women suffer from cholelithiasis, in addition, a study conducted in Chile showed that the incidence of gallstones was 12.2% in multiparous women compared to 1.3% in nulliparas at the same age (5).

The present study aimed to assess the demographic characteristics, clinical factors, and postoperative outcomes in male and female patients diagnosed with GB stones undergoing cholecystectomy.

METHODS

This is a cross sectional study which included 100 patients with gallbladder (GB) stone undergoing cholecystectomy. Those patients presented to surgical department at Al-Hussein Teaching Hospital/ Nassiryiah during the period from June 2024 to June 2025. All patients having GB stone based on US examination and scheduled to undergo LC were included in this study. Patients with a history of cholecystectomy or gastrectomy, those unfit for pneumoperitoneum due to cardiac or pulmonary causes and patients with bleeding disorders were excluded from the study.

The study was approved by the Institutional Review Board of College of Medicine, Thi-Qar University. A written consent from each patient was obtained prior to data collection after explaining the aim of study. The confidentiality of data throughout the study was guaranteed and the patient were assured that data will be used for research purpose only.

Data Collection

Demographic data include: age, sex, occupation, socioeconomic status and smoking status. Clinical data include: past medical history, disease duration, common bile duct (CBD) diameter, stone size, stone numbers Laboratory investigation: serum levels of liver enzymes, lipid profile and total leukocyte count.

Study Groups

Patients were categorized into two groups according to their sex:
Group1: males (22 patients);
Group 2: females (78 patients).

Operative Technique

Gallstones in the gallbladder and bile duct were detected by abdominal ultrasound. It was confirmed by highly reflective echoes from the anterior surface of the stones or movement upon postural change, with or without marked posterior acoustic shadowing.

Laparoscopic cholecystectomy operation for those with GB stone performed by the four-port technique: the first port is inserted by open method or verus needle and insufflating with CO2. The other three ports were then inserted under direct camera vision. The gallbladder was retracted up to the right axillary direction. The Calot's triangle was explored with the lateral retraction of Hartman's pouch.

Dissection of the hepatoduodenal ligament above the cystic artery and cystic duct was performed using an electrocautary laparoscopic traction. Dissection of the gallbladder peritoneum above the cystic artery was achieved with the help of electrocautery hook. The right side of the gallblader peritoneum was opened, and a hole above the cystic artery was done. Laparoscopic dissector was used for isolating the cystic duct and artery. The cystic plate posterior to cystic artery was dissected, exposing the liver. After meticulous dissection, the cystic artery and duct were isolated, clipped and then cut.

Follow-up

The patients were called to visit the clinic after 10 days for stitches removal. They were followed up to one month postop during which all patients were

assessed for postoperative complications like jaundice, wound infection and collection.

Data Analysis

Data were analyzed by statistical package for social sciences (SPSS) version 25 using descriptive statistics. Descriptive statistics such as mean, standard deviation, frequency and percentage were used to describe the data. Continuous data were presented as mean and standard deviation, and analyzed with Student t-test. Categorical variables were expressed as number and percentage and analyzed with Chi-square test. A value of $p < 0.05$ was considered statistically significant.

RESULTS

Distribution of patients according to sex: females accounted for the majority of patients (78%) while males represented only 22% of the patients (*fig. 1*).

Demographic Characterization of Male and Female with GB Stone

The mean age of male patients was 39.68 ± 12.1 years, while for females, it was 37.83 ± 13.13 years. The difference in age was not statistically significant ($p = 0.555$). Also different categories of age did not differ significantly between male and female. The majority of both male (72.73%) and female (74.36%) patients resided in urban areas, with a smaller proportion from rural areas (27.27% males, 25.64% females). There was no significant difference in the place of residence between the sexes ($p = 0.878$). Males had a higher average BMI (32.5 ± 3.45 kg/m²) compared to females (30.08 ± 3.6 kg/m²), with a statistically significant difference ($p = 0.046$). In particular, overweight account for 45.45% of males compared with 33.33% of females, although obesity was slightly more common in females than males (35.9% vs. 31.82%). A significant sex-based difference in smoking habits was observed ($p < 0.001$). A higher proportion of males were ex/current smokers (68.18%) compared to females (8.97%). Regarding physical activity, 86.36% of males were more likely to engage in active physical activity compared to females (74.36%). However, the difference was not significant. History of contraceptive use was reported in 16.67% of the females (*table 1*).

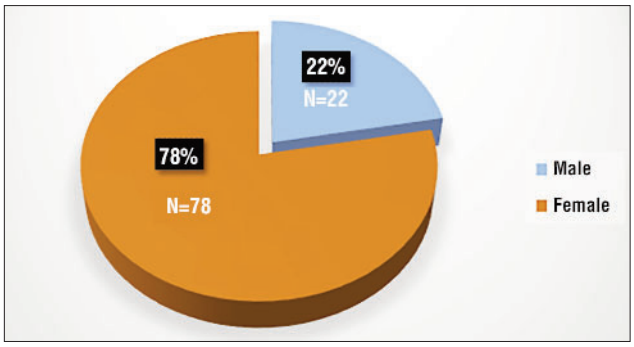

Figure 1 - Distribution of patients according to sex

Clinical Characteristics of Male and Female

Diabetes Mellitus was More prevalent in males (9.90%) than females (2.56%), but the difference was not statistically significant ($p = 0.209$). There was almost a similar prevalence of hypertension in males (9.09%) and females (10.26%) ($p = 0.872$). IHD present in 4.55% of males and 2.56% of females ($p=0.530$). Other comorbidities: present in 4.55% of males and 2.56% of females. The mean total WBC in males was 8.42 ± 2.72 × 10^9/L which was slightly lower than that of females 8.95 ± 3.16 × 10^9/L with no significant difference ($p = 0.472$). The mean stone size in males was 11.96 ± 4.93 mm (range: 2.5-23.5 mm) which was larger than that of females (mean = 9.75 ± 4.44 mm, range:

Table 1 - Demographic characterization of male and female with GB stone

Variables	Male (n= 22)	Female (n=78)	p-value
Age, years			0.555
Mean±SD	39.68±12.1	37.83±13.13	
Range	16-62	16-74	
15-30	6(27.27%)	24(30.77%)	
31-45	7(31.82%)	32(41.03%)	
46-60	8(36.36%)	19(24.36%)	
61-75	1(4.55%)	3(3.85%)	
Residence			0.878
Urban	16(72.73%)	58(74.36%)	
Rural	6(27.27%)	20(25.64%)	
Body mass index, kg/m²			0.046
Mean±SD	32.5±3.45	30.08±3.6	
Range	25-38	23-38	
Normal weight	5(22.73%)	24(30.77%)	
Overweight	10(45.45%)	26(33.33%)	
Obese	7(31.82%)	28(35.9%)	
Smoking			<0.001
Never	7(31.82%)	71(91.03%)	
Ex/current	15(68.18%)	7(8.97%)	
Physical activity			0.362
Active	19(86.36%)	58(74.36%)	
Moderate activity	0(0%)	5(6.41%)	
Little activity	3(13.64%)	15(19.23%)	
History of contraceptive			
No	----------	65(83.33%)	----
Yes		13(16.67%)	

1.5-20 mm) with a significant difference (p = 0.048). Furthermore, Females were significantly more likely to have multiple stones, while males had a higher proportion of single large stones (p = 0.011).

Dilated CBD diameter was reported in 13.64% of males and 7.69% of females with no significant difference (p = 0.408). The mean operative time in males was 67.73 ± 14.12 min (Range: 50-90 min) which was longer than that of females (mean = 61.0 ± 13.03 min, Range: 40-129 min) with a significant difference (p = 0.039). Adhesion was reported in 22.73% in males compared with 5.13% with a significant difference (p = .023). In contrast, there was no significant difference in the frequency of hemorrhage and conversion to open surgery between males and females (*table 2*).

Postoperative Findings in Male and Female with GB Stone Undergoing Cholecystectomy

Hospital study ranged from 1-3 days with no significant difference between males and females. Likewise, drain and cholangitis were reported in 40.91% and 4.55%, respectively of males; and in 51.28% and 2.56%, respectively of females with no significant differences (*table 3*).

Table 2 - Clinical characterization of male and female with GB stone

Variables	Male (n= 22)	Female (n=78)	p-value
Past medical history			
Diabetes mellitus	2(9.90%)	2(2.56%)	0.209
Hypertension	2(9.09%)	8(10.26%)	0.872
IHD	1(4.55%)	2(2.56%)	0.530
Others	1(4.55%)	2(2.56%)	0.530
Total WBC×10^9/L			0.472
Mean±SD	8.42±2.72	8.95±3.16	
Range	4.5-16.5	3.4-19.3	
Stone size, mm			0.048
Mean±SD	11.96±4.93	9.75±4.44	
Range	2.5-23.5	1.5-20	
Stone number			0.011
Single	8(36.36%)	10(12.82%)	
Multiple	14(63.64%)	68(87.18%)	
CBD diameter, mm			0.408
Normal	19(86.36%)	72(92.31%)	
Dilated	3(13.64%)	6(7.69%)	
Operative time, min			0.039
Mean±SD	67.73±14.12	61.0±13.03	
Range	50-90	40-129	
Adhesion			0.023
No	17(77.27%)	74(94.87%)	
Yes	5(22.73%)	4(5.13%)	
Hemorrhage			0.330
No	17(77.27%)	67(85.9%)	
Yes	5(22.73%)	11(14.1%)	
Conversion to open surgery			0.350
No	22(100%)	71(91.03%)	
Yes	0(0%)	3(13.64%)	

WBC: white blood cells, Other comorbidities include one case of each of cerebrovascular accent. Pulmonary embolism and chronic kidney disease

Table 3 - Postoperative findings in male and female with GB stone undergoing cholecystectomy

Variables	Male (n= 22)	Female (n=78)	p-value
Hospital stay, days			0.867
1	20(90.91%)	70(89.74%)	
2	2(9.09%)	7(8.97%)	
3	1(4.55%)	1(1.28%)	
Drain use			0.390
No	13(59.09%)	30(38.46%)	
Yes	9(40.91%)	40(51.28%)	
Cholangitis			0.530
No	21(95.45%)	76(97.44%)	
Yes	1(4.55%)	2(2.56%)	

DISCUSSION

According to the result of the study, females account for more than males. This is in accordance with most previous studies in this regard.

In a Korean study including 30544 individuals, cholelithiasis was more common in female than males (6). In an Iraqi study, Abdullah et al. (7), gallbladder stones were seen in females more than male with the (p < 0.05). The commonly perceived opinion that women are at greater risk of developing gallstone disease than men may largely be due to extraneous risk factors, such as pregnancy and sex hormones. The number of pregnancies is the main one related to the high rates of gallstone disease in women. Sex hormones are most likely to be responsible for the increased risk. Estrogen increases biliary cholesterol secretion causing cholesterol super saturation of bile.

In the present study, no age or residence difference was found between males and females. On the contrary to this finding, a nation study from China on 10,937,993 adults, using the multivariate analysis found the overall age standardized prevalence was higher in women than in men (p < 0.001) (7).

Another study from China on 1779 patients showed that patients with gallbladder diseases were more often from a rural area and had a lower level of educa tion and lower income. In a multivariate analysis, only living in a rural area was significantly associated with gallbladder diseases [odds ratio (OR) = 1.65, 95% CI: 1.49-1.82](8). The differences between these studies and ours probably due to difference in sample size.

As per sexrelated association between BMI and gall stones, males had a higher BMI compared to females, in particular, overweight, although obesity was slightly

more common in females than males. The association between elevated BMI as an independent risk factor for the development of gallstones has well established (9). It has been estimated that an increase of more than 5 points in the BMI value increases the risk of gallstone formation by 1.63 times (10). However, this association was obvious in females, while for males it has been so to a lesser degree. Attempts have been made to justify this variability due to the greater composition of lean mass in males. But it must be taken into account that there are other predominant factors in the female sex such as estrogen levels, which increase the secretion and synthesis of hepatic cholesterol, with greater cholesterol saturation index and formation of crystals, which make it a more prevalent disease in this group of patients (11).

A significant sexbased difference in smoking habits was observed ($p < 0.001$). Several studies have explored the relationship between smoking and gallstones; however, their conclusions are different and paradoxical (12).

Notably, the associations between smoking and GB stone were specifically observed among women (13). A recent prospective study demonstrated a statistically significant relationship between gallstones and smoking in men and women (13).

Concerning sexrelated association between physical activity and gall stones, males were engage more in active physical activity. Physical activity has been extensively studied for its potential to mitigate obesity and insulin resistance risk factors and promote overall metabolic health (14). Regular physical activity has been shown to improve insulin sensitivity, reduce abdominal obesity, and favorably modulate lipid profiles, thereby potentially reducing the risk of gallstone formation (15). Furthermore, exercise has been associated with improved gallbladder motility, which may facilitate the clearance of bile and prevent the stagnation that contributes to gallstone formation (16).

DM, was insignificantly more prevalent in males than females of this study whereas HT was present in both sexes in similar prevalence. In a study from China on 27,463 diagnosed with gallstone disease on ultrasound examination, multivariable logistic regression showed that hypertension was significantly associated with the risk of gallstone disease and gallstone disease was stronger in women than in men (17).

Contrary to our results, a study from USA on 474 diabetic males and 396 diabetic females looked for the association between DM and gallstone formation found among many factors, female sex was significant independent predictors persisting in the multivariate model (18).

Males show larger stones than females, more likely to have single stones compared to multiple stones by females. In a very recent study from Chile on 8948 individuals with gallstones (4918 females and 4030 males) found no difference in the number of stones or percent between males and females. Regarding the size, females tend to have lesser number of < 20 mm, higher number of 2029 and > 29 mm stones than males (19). Another prospective study of 100 patients from Egypt, found no difference in the number of stones (solitary or multiple) between males and females (18).

Males showed longer operative time relative to females. In accordance with our study, an American study reviewed 38 736 records for age, sex, procedure performed, operative time, postoperative diagnosis, and functional status of patients with gallstones found the average operative time is higher for men than women in all age groups and the variance becomes greater as the patients become older (20). The Egyptian study found the operative time and post operative hospital stay was significantly increased in males versus females ($p = 0.007$ and 0.017, respectively) (18). The operative time was significantly increased in males in comparison was reported in many previous studies (21-23). where the average operative time was longer in males than females and the difference was statistically significant.

Regarding the sexrelated GB adhesion, our study reported males to have more percent of this finding than females. Many studies have shown that symptomatic gallstones, inflammation, and fibrosis are more extensive in men than in women (24).

Many studies found prospective operative time was longer in males versus females concluding that male sex was identified as an independent risk factor for prolonged LC on multivariate analysis. For example, in Egypt (22,23). In harmony with our study, the latter study found no significant difference amongst both groups with respect to postoperative complications (25). Moreover, a study from Denmark found no significant sex differences in the proportion of bile duct lesions (those requiring reconstructive surgery as well as those that could be handled by endoscopy or tube drainage, suturing, or both) (26).

CONCLUSION

Collectively, these data indicate that Males had larger gallstones on average and were more likely to have single large stones, whereas females had multiple

smaller stones, males also had longer operative times and a higher rate of adhesions suggesting that male patients may have more complicated gallbladder disease at presentation. Thus, preoperative imaging (such as CT or MRCP) should be considered in male patients with suspected complicated gallbladder disease. Surgeons should be prepared for potentially more difficult dissections in male patients and plan accordingly.

Limitations

This analysis may be limited by factors such as retrospective data collection. Additionally, the sample size and demographic distribution may affect the generalizability of the findings to broader populations. Operative times and intraoperative findings such as adhesions are subject to surgeon variability and may not solely reflect disease severity. Furthermore, the definition of "complicated gallbladder disease" may vary between institutions. Prospective studies with standardized criteria are needed to validate these findings and better inform preoperative planning.

Author's Contributions

Sura Saleh Salman: conceptualization; data curation; investigation; methodology; project administration; resources; software; writing – original draft and writing – review & editing.

Muhanad A. Alridha: conceptualization; data curation; investigation; methodology; project administration; writing – original draft and writing – review & editing.

Abdulhussein Sejeel Ashour: conceptualization; data curation; investigation; methodology; project administration; resources; writing – original draft and writing – review & editing.

Conflicts of Interest

The authors declare no conflict of interest regarding this article.

Funding: None.

Ethical Approval

The Medical Ethical Committee of The Department of Surgery, College of Medicine, University of Thi-Qar approved this study (12/11/2024).

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