University of Thi-Qar Journal of Science (UTJsci)
E-ISSN:2709-0256, P-ISSN: 1991-8690 Vol. (10), No.1(Special Issue: ISCAMET), April 2023

# Evaluation of the relationship of obesity with some vital factors as a predictive indicator of cholecystitis in Thi-Qar Governorate

WisamRaisanNayyef
*Community health techniques*
*Al-Nasiriyah Technical Institute/*
*Southern Technical University*
Thi-Qar/ Iraq
wesamsm@stu.edu.iq

ALI A.H. ALBAKAA
Nursing techniques
*Al-Nasiriyah Technical Institute/*
*Southern Technical University*
Thi-Qar/ Iraq
alialbakaa14@stu.edu.iq

Anwar Shaqi Ajil
Community health techniques
*Al-Nasiriyah Technical Institute/*
*Southern Technical University*
Thi-Qar/ Iraq
noor.ajil@stu.edu.iq

***Abstract*—Cholecystitis represents inflammation of the gallbladder. It can lead to many complications,cholecystitis can be either acute or chronic. The inflammation is caused by a blockage in the gallbladder, which stops the flow of bile that flows directly into the small intestine to digest fats. Often this blockage is caused by gallstones, which leads to condensation and stagnation of bile.**

**Adults who haveobese, are at increased risk of many chronic diseases such as diabetes, gallstones, high blood pressure and heart disease. Obesity is associated with increased bile cholesterol excretion.**

**The study has included (175) samples of cholecystitis patients who attended the hospital for the period from January to September 2022, the samples were divided according to gender and obesity status. It was found that the highest incidence of cholecystitis in males was in the age group (55-64) and it was (14%), then the age groups (35-44) and (>65) was (12%).The highest incidence of cholecystitis among women in the age group (35-44) was (27%), then the age group (45-54) was (23%) and then the age group (55-64) was (15%).**

**This study has found that, both obesity status and (BMI >25) were higher in women (79%) while it was in males (52%), and it hasfound that, blood pressure, diabetes and metabolic syndrome arethe most common comorbid conditions associated with cholecystitis.**

**It was also found through this study that most cases of cholecystitis for both sexes are at high levels of cholesterol, triglycerides, LDL and low levels of HDL. This is consistent with most studies confirming that most gallstones consist of cholesterol, that cholesterol metabolism has a role in the mechanism of gallstone formation, and that most patients underwent and that most patients underwent laparoscopic cholecystectomy (70%).**

***Keywords: Cholecystitis, Gallstones, Obesity, lipid profile, and metabolic syndrome***

## I. INTRODUCTION

Cholecystitis represents inflammation of the gallbladder, it leads to many complications such as perforation of the gallbladder or death of cells in the gallbladder system**(Varun*et al.*, 2019)**.Cholecystitis can be acute or chronic, and most often affects the elderly. Chronic cholecystitis occurs after repeated episodes of acute cholecystitis and is mostly due to gallstones **(Bhatta and SinghS,2018)**. Symptoms of cholecystitis include pain in the upper right abdomen and other symptoms such as fever and vomiting, the need for immediate fluid treatment to calm the inflammation, and sometimes surgery, stated that one can live for a long time and for more than 20 years with gallstones are asymptomatic, only 10% require surgery **(Varun*et al.*, 2019).**

The inflammation is the result of a blockage in the gallbladder that stops the flow of bile, which flows directly into the small intestine to digest fats. This blockage is often the result of gallstones, which leads to condensation and stagnation of bile, making it a suitable environment for the proliferation of types of germs and the occurrence of secondary infection caused by an intestinal organism, and thus the gallbladder wall becomes inflamed,which causes chronic inflammation in the gallbladder. Gallstones may be a cause of pus collecting in the gallbladder or the rupture of its wall. There are several important risk factors in the formation of gallstones, which lead to stagnation of the gallbladder and decreased emptying of the gallbladder causing cholecystitis, namely age, gender, genetic obesity, oral contraceptives, pregnancy, rapid weight loss, bacterial infection, medications and metabolic disorders **(Russel*et al.*, 2000)**.

Gallstones affect 7% of males and 15% of females aged 18-65 years, and about 90% of gallstones do not cause any symptoms, as (2%) are very small and represent a chance of developing pain during the first ten years, and then complete the formation of gallstones, causing inflammation. The most common type of gallstones is the mixed type, followed by the cholesterol type**(Finlayson*et al.*, 1999;Varun*et al.*, 2019**). Obesity has become the world's leading metabolic disease to the extent that the World Health Organization refers to obesity as a global

epidemic. About 25% of obese people (with a BMI over 40) have gallstones. It is believed that if excess body weight is around the stomach, the risk of complications from these stones is higher **(Ota*et al*., 2002)**.

Body mass index (BMI) has been frequently applied in a large number of epidemiological studies as a measure of body adiposity **(Amir*et al*., 2015)**. BMI values are age-independent and similar for both sexes. BMI is often considered a risk factor in causing cholelithiasis **(Varun *et al*., 2019).** Adults who are overweight are at increased risk of many chronic diseases such as diabetes, gallstones, high blood pressure and heart disease. Obesity is associated with increased bile cholesterol excretion **(Field*et al*., 2001)**.

The study aimed to evaluate the relationship of obesity with some vital factors as a prognostic indicator for cholecystitis in Thi Qar Province.

## II. MATERIAL AND METHODS

This study was conducted from January to September 2022, the patients were informed of the purpose of the study, and the data were collected by direct interview using a questionnaire sheet with laboratory results. The total samples were 175 samples, only 65 samples were collected from Al-Hussein Teaching Hospital and the remaining 110 samples were collected from private hospitals for ease of obtaining information. The samples were 50 males and 125 females with cholecystitis, and they were divided according to their obesity status. Body mass index (BMI) was calculated according to the formula:

Body mass index (BMI) = weight (kg) / height $(m)^2$

Classification of adults by body mass index **(WHO, 2000)**: 1. Under- weight <18.5

2. Normal weight 18.5 - 24.99

3. Over- weight >25

In addition, waist and hip circumferences were taken using a standard tape measure with: (WHO, 2000). Lipid profile test included determination of total cholesterol (TC), high-density lipoprotein cholesterol(HDL), low-density lipoprotein cholesterol(LDL), and triglycerides(TG). The blood lipid profile was assessed by the Biolabo kits, France by hospital laboratories.

## III.RESULTS AND DISCUSSION

Inflammation of the gallbladder is one of the common complications of gallstones, as these stones block the duct through which bile passes, causing the accumulation of bile juice, and therefore gallstones may be a cause of pus and collecting in the gallbladder or the explosion of its wall with the presence of other factors that increase the likelihood of its occurrence such as obesity **(Varun*et al*., 2019)**.

TABLE (1) DISTRIBUTION OF CHOLECYSTITIS PATIENTS BY SEX

| Sex | Patients | |
|---|---|---|
| | No. | % |
| **Male** | 50 | 29% |
| **Female** | 125 | 71% |
| **Total** | 175 | 100% |

Table (1), shows that, females are more likely to have cholecystitis with 71% and 29% for males. It is already known that women are more likely to develop cholecystitis and gallstones than men, and the likelihood of developing gallstones in women is twice as likely as men, especially during the fertile years, and decreases after menopause. The main mechanism is the female sex hormones, because estrogen stimulates the liver to remove more cholesterol from the blood and turn it into bile. It was also found that men with gallstones were less likely to develop symptoms than women **(Helen*et al*., 2009)**.

TABLE (2) DISTRIBUTION OF CHOLECYSTITIS PATIENTS BY OBESITY STATUS

| Sex / Obesity Status | Obese | | Non-obese | | Total | % |
|---|---|---|---|---|---|---|
| | No. | % | No. | % | | |
| **Male =50** | 26 | 52% | 24 | 48% | 50 | 100% |
| **Female =125** | 99 | 79% | 26 | 21% | 125 | 100% |

TABLE (3) DISTRIBUTION OF CHOLECYSTITIS PATIENTS ACCORDING TO BMI

| Body mass Index (BMI) | | Male | | Female | |
|---|---|---|---|---|---|
| | | No. | % | No. | % |
| Under–weight | < 18.5 | 3 | 6% | 2 | 2% |
| Normal weight | 18.5 – 24.9 | 21 | 42% | 24 | 19% |
| Over – weight | ≥ 25 | 26 | 52% | 99 | 79% |
| Total | | 50 | 100% | 125 | 100% |

Tables (2,3) shows that, both obesity status and (BMI >25) were higher in women as it was (79%) while it was for males (52%), so obesity in females plays an important role cholecystitis and formation gallstones.

It is assumed that the reason for this difference between the genderis total body fat andthe base value which is much higher for females than for males **(Varun *et al*., 2019)**.

In addition, cholecystitis was observed in (26) obese males (BMI >25), and (24) non-obese males (BMI less than 25), and this indicates the possibility of cholelithiasis in males who suffer from obesity and non-obese in the same proportion, this corresponds to some research **(Zhang*et al*., 2022)**.

Some studies have concluded that acute cholecystitis is more common in non-obese males **(Varun *et al.*, 2019).**

Researchers have reported that gallstones are more likely to develop in men and women who are overweight or obese and who follow a diet rich in saturated fats and refined sugars. Cholesterol stones are the most common type of gallstones in obese people. Cholesterol gallstones in obesity are multifactorial and are primarily associated with metabolic disorders associated with excessive cholesterol secretion in the liver **(Alixandra*et al*., 2022)**.

Obesity reduces the level of bile salt in relation to the cholesterol contained in bile, which leads to an increased risk of cholesterol saturation and the formation of gallstones. It should be noted that the risk of developing gallstones also increases with rapid weight loss (strict diet), it increases the production of cholesterol in the liver, which leads to hypersaturation and an increased risk of developing gallstones. At the same time, in these cases, cholesterol is activated from adipose tissue and excreted in the bile. This leads to hypercholesterolemia and reduces the contraction of

the gallbladder, which leads to its stagnation and the formation of gallstones.

There are published data indicating the role of central obesity, a strong contributor to the development of metabolic syndrome, in the formation of gallstones **(Amir *et al.*, 2015).**

TABLE (4) DISTRIBUTION OF CHOLECYSTITIS PATIENTS BY AGE

| Age (years) | Obese | | | | Non-obese | | | |
|---|---|---|---|---|---|---|---|---|
| | Male | % | Female | % | Male | % | Female | % |
| <25 | 0 | 0% | 2 | 2% | 1 | 2% | 0 | 0% |
| 25-34 | 2 | 4% | 8 | 6% | 4 | 8% | 2 | 2% |
| 35-44 | 6 | 12% | 34 | 27% | 3 | 6% | 11 | 9% |
| 45-54 | 5 | 10% | 28 | 23% | 4 | 8% | 2 | 2% |
| 55-64 | 7 | 14% | 19 | 15% | 7 | 14% | 8 | 6% |
| 65+ | 6 | 12% | 8 | 6% | 5 | 10% | 3 | 2% |
| Total | 26 | 52% | 99 | 79% | 24 | 48% | 26 | 21 % |

Table (4), shows that the highest incidence of cholecystitis in males was in the age group (55-64), and it was (14%), then the age groups(35-44) and (>65) was (12%), while the highest incidence of cholecystitis rate among women was in the age group (35-44) and it was (27%), then the age group (45-54) was (23%) and then the age group (55-64) was (15%).

From previous findings, this indicates that cholecystitis occurs regardless of age **(Varun*et al.*, 2019)**.

The most susceptible age group in males is (55-64) was (14%), which is an older age group, where a sedentary lifestyle may pose an additional risk of developing cholelithiasis.

It has been reported that regular exercise may reduce the risk of gallstones and gallbladder disease by up to 34%. Some researchers believe that in addition to controlling weight, exercise helps control blood sugar levels and insulin levels, which, if abnormal, may contribute to the formation of gallstones**(Amir *et al.*, 2015)**.The age group most susceptible to infection in females is (34-44) by 27%, which means that this group may be accompanied by high levels of estrogen caused by pregnancy or hormonal treatment using contraceptives (consisting of estrogen),it causes high cholesterol levels in the gallbladder, and decreased contractility on the other hand, leading to the formation of stones **(Bhatta and SinghS, 2018).**

Furthermore, the age group affected in women is (45-54) as well as (54-65), and this may be due to several factors, including the type of nutrition or a lack of physical activity and hormonal changes associated with menopause**(Bhatta and SinghS, 2018;Varun*et al.*, 2019)**.

Cholecystitis is a syndrome that includes a continuum of clinical conditions. Many known risk factors for cholecystitis, such as age, gender and obesity, as well as much comorbidity, so the prevalence of cholecystitis is with the gradual increase in age and the emergence of diseases **(Cho *et al.*, 2010; Sol *et al.*, 2011)**.

TABLE (5) DISTRIBUTION OF CHOLECYSTITIS PATIENTS BY COMORBIDITIES

| Comorbidities | Male | | Female | |
|---|---|---|---|---|
| | No. | % | No. | % |
| Hypertension | 15 | 30% | 30 | 18% |
| Diabetes Mellitus | 6 | 12% | 24 | 23% |
| Heart disease | 4 | 8% | 7 | 6% |
| Duodenal ulcer | 5 | 10% | 9 | 7% |
| Renal disease | 2 | 4% | 5 | 4% |
| Respiratory diseases | 2 | 4% | 3 | 2% |
| Gout | 1 | 2% | 5 | 4% |
| Metabolic syndrome | 13 | 26% | 28 | 25% |
| Anemia | 1 | 2% | 4 | 3% |
| Polycystic ovaries | ----- | ----- | 4 | 3% |
| None | 1 | 2% | 6 | 5% |
| Total | 50 | 100% | 125 | 100% |

Table (6) includes a group of diseases associated with cholecystitis in patients, which may be risk factors for the formation of gallstones.

It was found that blood pressure, diabetes mellitus and metabolic syndrome are the most common pathological conditions associated with cholecystitis in both sexes of patients, and this has been confirmed by several studies.

Complications of cholecystitis often increase in elderly patients, often suffering from diseases other than biliary tract diseases, such as diabetes, cardiovascular diseases, cerebrovascular diseases, respiratory diseases, which leads to a worsening of the general condition **(Sol *et al.*, 2011)**.

It has been reported that high blood pressure is positively associated with the risk of developing gallstone disease **(Zhang*et al.*, 2022)**.It is possible that people with hypertension may have more sympathetic nerve activities that easily inhibit bowel movement and cause gallstone disease **(Lin*et al.*, 2014)**.

And through the same previous table that shows the effect of diabetes on gallbladder diseases and the results were consistent with other studies.Some studies suggest a role for diabetes as a risk factor for gallbladder disease (acute cholecystitis) and gallstone formation, leading to a higher degree of gallbladder distension and increased wall tension resulting from kinetic disorders from microangiopathy and diabetic neuropathy **(Serban*et al.*, 2021).**

Incriminating mechanisms have been associated with insulin resistance and disorders of lipid metabolism resulting in elevated cholesterol and triglyceride levels. These symptoms are often associated with obesity in the metabolic syndrome associated with type 2 diabetes. In other studies, an increase in bile saturation indices and a decrease in gallbladder motility were observed due to a decrease in cholecystokinin receptors in the gallbladder wall resulting in a reduced sensitivity of smooth muscle to humoral stimulation**(Serban*et al.*,2021;Monika*et al.*, 2019).**

Diabetics tend to have negative clinical manifestations and are recommended for early surgical treatment in case of symptomatic gallstones**(Sol *et al.*, 2011).**It is also shown by the same table that the state of cholecystitis and gallstones increases in the presence of metabolic syndrome (MetS) which is a combination of metabolic disorders, including high blood sugar, high blood pressure (BP), high

triglycerides, and low high-density lipoprotein cholesterol (HDL), and central obesity are all risk factors for gallbladder disease.

Most of the previous studies reported an association between MetS and cholelithiasis in both sexes, the risk of developing cholelithiasis increased gradually with an increase in the number of metabolic components, and reported that the prevalence of obesity, abdominal obesity and metabolic syndrome in subjects with gallstones, was higher than in those without gallstones **(Lin *et al*., 2014;*Y.et al*.,2021).**

TABLE (6) DISTRIBUTION OF CHOLECYSTITIS PATIENTS BY LIPID PROFILE CONCENTRATIONS

| Lipid Profile | Male | | | | Female | | | |
|---|---|---|---|---|---|---|---|---|
| | TC No. (%) | TG No. (%) | HDL No. (%) | LDL No. (%) | TC No.(%) | TG No. (%) | HDL No.(%) | LDL No.(%) |
| High risk | 24 (48%) | 26 (52%) | 24 (48%) | 27 (54%) | 100 (80%) | 98 79%) | 101 (81%) | 100 (80%) |
| Border line | 19 (38%) | 20 (40%) | 17 (34%) | 15 (30%) | 17 (14%) | 24 (19%) | 18 (14%) | 18 (14%) |
| Low risk | 7 (14%) | 4 (8%) | 9 (18%) | 8 (16%) | 8 (6%) | 3 (2%) | 6 (5%) | 7 (6%) |
| Total (%) | 50 (100%) | | | | 125 (100%) | | | |

Several studies have confirmed the relationship between blood lipid levels and the risk of gallbladder disease. Although gallstones are formed from a hypersaturation of cholesterol in the bile, high levels of total cholesterol in the blood are not necessarily associated with the formation of gallstones **(Bhatta and SinghS, 2018).**

Through this study and as in the table (6) it was found that most cases of cholecystitis for both sexes are at high levels of cholesterol, triglycerides and LDL and low levels of HDL. This is consistent with most studies that confirm that most gallstones are composed of cholesterol, and that cholesterol metabolism has a role in the mechanism of gallstone formation **(Zhang *et al*., 2022)**.

Gallstone formation is associated with low levels of HDL and high levels of triglycerides. Some evidence suggests that high triglyceride levels may impair gallbladder emptying procedures **(Bhatta and SinghS, 2018)**.

Furthermore, gender differences in their eating habits and anatomy, such as body fat percentage and peritoneal cavity size, could have an impact on the clinical presentation of cholelithiasis symptoms. Acute cholecystitis in men is still unknown. A difference in BMI is associated with the severity of cholecystitis, especially in men**(Cho *et al*., 2010).**

Diet, including a high-fat diet, as well as when the level of fiber is low, may affect the formation of stones.

Through table (6), it confirms what was shown in Table (5) of the pathological cases associated with cholecystitis, which confirm the increase in complications of the development of cholecystitis and the formation of gallstones, and in both sexes, for example, high blood pressure, high diabetes and metabolic syndrome, which is accompanied by a high levels of cholesterol, triglycerides, LDL and low HDL level.

Table (7) shows the type of cholecystectomy for cases of cholecystitis, which shows that the percentage of laparoscopic cholecystectomy (70%) is higher than the percentage of excision with open surgery.

TABLE(7) DISTRIBUTION OF CHOLECYSTITIS PATIENTS BY CHOLECYSTECTOMY

| cholecystectomy | Obese | | | | Non-Obese | | | | Total | % |
|---|---|---|---|---|---|---|---|---|---|---|
| | Male | % | Female | % | Male | % | Female | % | | |
| laparoscopic cholecystectomy | 15 | 30% | 63 | 50% | 22 | 44% | 23 | 19% | 123 | 70% |
| open cholecystectomy | 11 | 22% | 36 | 29% | 2 | 4% | 3 | 2% | 52 | 30% |
| Total | 26 | 52% | 99 | 79% | 24 | 48% | 26 | 21% | 175 | 100% |

Laparoscopic cholecystectomy (LC) is the standard and appropriate treatment for acute cholecystitis**(Alixandra*et al*., 2022)**.This is expected due to high cost-effectiveness, shorter hospital stay, less pain and complications after surgery, etc**(Varun*et al*., 2019).**Therefore, laparoscopy is preferred over the open method, and most of our samples were collected from private hospitals that work with this technique.

About 18% of laparoscopic cholecystectomy requires diversion to open cholecystectomy for reasons such as dense adhesions to a nearby organ, severe inflammation and necrosis of the gallbladder which makes laparoscopic dissection risky and unpredictable bleeding, therefore, laparoscopy is preferred over open method **(Alixandra*et al*., 2022)**.

It was also found in the same study that a group of obese patients underwent a cholecystectomy for necessary, diagnosed and precisely defined reasons. Current studies indicate that in obese patients, laparoscopic cholecystectomy is associated with a more difficult technique, increasing the switch to open surgery, which includes increased abdominal wall mass and large amounts of intra-abdominal fat, as well as gallbladder adhesions caused by an inflammatory process with adjacent viscera and fat, making it difficult to achieve surgical exposure to laparoscopic cholecystectomy **(Alixandra*et al*., 2022: Choi *et al*., 2022).**

## IV. CONCLUSION

Cholecystitis is a common disease in Thi-Qar Governorate and in all societies. In this study, the focus was on the relationship of obesity with cholecystitis and the formation of gallstones in terms of gender, age, body mass index, associated diseases and high fat.

The results clearly indicated that the severity of cholecystitis and the formation of gallstones were associated with obesity in patients of both gender, especially in women.

A high body mass index (BMI) in women or (high or low) in men is also a risk factor for gallstones and cholecystitis.

Aging in males is considered as a risk factor for cholecystitis and is statistically significant. In women, cholecystitis can occur in all life stages, especially during the periods of ovulation and pregnancy, followed by aging due to hormonal changes.

High cholesterol, triglycerides, LDL, and low HDL are significantly associated with obesity and are risk factors for cholecystitis and gallstone formation. Moreover, patients with high blood pressure, diabetes, or with metabolic syndrome are more likely to develop cholecystitis, and this needs further studies to validate these conclusions.And that most patients underwent laparoscopic cholecystectomy.

## REFERENCES


**Amir Reza Radmard, ShahinMerat, SoheilKooraki, MahyaAshrafi, Abbas Keshtkar,andHosseinPoustchi.(2015).** Gallstone disease and obesity: a population-based study on abdominal fat distribution and gender differences. Annals of Hepatology, *5*(14), 702-709.

**Alixandra Wong, Sanjeev Naidu, Raymond P. Lancashire and Terence C. Chua.(2022).**The impact of obesity on outcomes in patients undergoing emergency cholecystectomy for acute cholecystitis. ANZ Journal of Surgery, *92* (2022), 1091–1096.

**Bhatta S., and SinghS.(2018).**Study of gallbladder lesions and its relationship with serum lipid profile. International Journal of Advances in Medicine, *5*(5),1245-1249.

**Cho J. Young, Han H. Seong, Yoon Y. Seok, and Ahn K. Soo.(2010).**Risk Factors for Acute Cholecystitis and a Complicated Clinical Course in Patients with Symptomatic Cholelithiasis. Arch Surg, *145*(4),329-333.

**Choi H. , Kwon S. Kil, Han J-Ho, Lee J. Su, Kang G., Kang M. (2022).** Incidence of acute cholecystitis underwent cholecystectomy in incidence dialysis patients: a nationwide population-based cohort study in Korea. Kidney Res ClinPract,*41*(2),253-262.

**Field AE, Coakley EH, Must A, et al. (2001).**Impact of overweight on the risk of developing common chronic disease during a 10 year period. Arch Intern Med, *161*(13), 1581-1586.

**Finlayson NDC, Hayes PC, Simpson KJ. (1999).** Disease of the liver and biliary system. In: Haslett CH, Chilvers ER, Hunter JAA, Boon NA. (editors). Davidson's Principles and Practice of Medicine. Edinburgh, London, New York: Churchill Livingstone. 728-740.

**Helen H. Wang, Min Liu, Deborah J. Clegg, PieroPortincasa, and David Q.-H.Wang (2009).**New insights into the molecular mechanisms underlying effects of estrogen on cholesterol gallstone formation.BiochimBiophysActa, *1791*(11), 1037–1047.

**Lin I-Ching, Yang Yu-Wen, Wu M-Feng, Yeh Yi-Hui, Liou J-Chang, Lin Yi-Li and Chiang C-Hsiang.(2014).**The association of metabolic syndrome and its factors with gallstone disease. BMC Family Practice, *15*(138),1-6.

**Monika Łącka, PiotrSpychalski, MałgorzataDobrzycka,Olga Rostkowska, and JarosławKobiela.(2019).**Acute cholecystitis in patients with diabetes mellitus – systematic review. European Journal of Translational and Clinical Medicine, *2*(2):71-79.

**Ota T, Takamura T, Hirai N, Kobayashi KI(2002).**Preobesity in World Health Organization classification involves the metabolic syndrome in Japanese. Diabetes care, *25*(7),1252-3.

**Russel R, Williams N, Bulstrode C. (2000).** The gall bladder and bile ducts. Bailey and Love's Short Practice of Surgery.23rd ed. Arnold publisher, New York; 975.

**Serban D., Balasescu S. Andreea, Alius C., Balalau C., Sabau D. and Smarandache G. atalin.(2021).**Clinical and therapeutic features of acute cholecystitis in diabetic patients. Experimental and Therapeutic Medicine, *22*(758):1-6.

**Sol Lee, Chul-Woon Chung, Kwang Hyun Ko, and Sung Won Kwon.(2011).**Risk factors for the clinical course of cholecystitis in patients who undergo cholecystectomy. Korean J HepatobiliaryPancreatSurg, *15*(3),164-170.

**Varun V. Chauhan, Bhushan A. Shah, Shivaratna J. Mahadik,andRohan P. Videkar.(2019).**Evaluation of relationship of body mass index with severity of cholecystitis. International Surgery Journal, *6*(3):868-875.

**WHO (2000).** Obesity: preventing and managing the global epidemic. WHO Tech Rep Ser No. 89.

**Y. Kim, Oh Chang-Mo, Ha Eunhee, Park S. Keun, Jung J. Young andRyoo J-Hong.(2021).**Association between metabolic syndrome and incidence of cholelithiasis in the Korean population. Journal of Gastroenterology and Hepatology 36 , 3524–3531.

**Zhang M., Mao M., Zhang Ch. , Hu F., Cui P., Li G., Shi J., Wang X. and ShanX.(2022).** Blood lipid metabolism and the risk of gallstone disease: a multi-center study and meta-analysis. Lipids in Health and Disease, *21*(26),1-12.

**Zhang Y. , Sun L., Wang X. and Chen Z.(2022).**The association between hypertension and the risk of gallstone disease:a cross - sectional study. BMC Gastroenterology, *22*(138),1-10.