pISSN 2349-3305 | eISSN 2349-2902

## **Original Research Article**

DOI: https://dx.doi.org/10.18203/2349-2902.isj20205818

# Cholelithiasis and its relation to body mass index and waist to hip ratio: an observational study

## Darpan Bansal, Anuj Rattan, Gurpreet Singh Bhangu\*, Rupinder Singh

Department of Surgery, SGRD University, Amritsar, Punjab, India

Received: 17 July 2020 Revised: 19 December 2020 Accepted: 23 December 2020

#### \*Correspondence:

Dr. Gurpreet Singh Bhangu,

E-mail: drgurpreetsinghbhangu@gmail.com

**Copyright:** © the author(s), publisher and licensee Medip Academy. This is an open-access article distributed under the terms of the Creative Commons Attribution Non-Commercial License, which permits unrestricted non-commercial use, distribution, and reproduction in any medium, provided the original work is properly cited.

#### **ABSTRACT**

**Background**: There is increased incidence of gall stones and its variable presentations in India is a great need for a study which can provide information regarding risk factors associated with the formation of gallstones, prevalence of disease, clinical presentations and outcome of cholelithiasis. So present study done to find a relationship between body mass index (BMI) and waist to hip ratio (WHR) with cholelithiasis.

**Methods**: The observational study was conducted in tertiary care center of SGRD Amritsar comprised of 100 patients diagnosed with pain abdomen by cholelithiasis and control comprised of 100 patients with any other cause of pain abdomen. All patients were evaluated for BMI and waist to hip ratio. BMI was calculated according to the standard formula (Quetelet's index). The WHR was measured according to WHO protocol. Statistical tests were applied as quantitative variables were compared using unpaired t-test/Mann-Whitney test (when the data sets were not normally distributed) between the two groups. Qualitative variables were compared using chi-Square test /Fisher's exact test.

**Results:** A significant association of formation of gall bladder stones in female gender in comparison to their male counterpart and increased chances of formation of gall bladder stones in the patients having higher BMI and higher WHR.

**Conclusion**: Female gender and obesity is associated with increased risk of cholelithiasis.

Keywords: Cholelithiasis, Body mass index, Waist to hip ratio

## INTRODUCTION

One of the most prevalent gastrointestinal disease giving a significant burden to healthcare system is cholelithiasis.

Owing to westernization and availability of reliable investigation such as ultrasonography at affordable price, there has been increase in incidence of gallstone disease in Indian population. The incidence of gallstone disease is more in 3<sup>rd</sup>-4<sup>th</sup> decade of life and more common in females with multifactorial aetiology. North Indians have seven times higher prevalence of gallstones compared to south Indian population.

The type of calculi formed depends on various risk factors like intake of fatty diet, presence of hyperlipidaemia, sedentary lifestyle, obesity, intake of OCP's, diseases like cirrhosis, biliary tract infections, haemolytic disorders.

Obese persons with higher body mass index have been found to have increased prevalence of gall stones. The increased prevalence of stones is mostly due to supersaturation of bile with cholesterol, because of an increased synthesis by the liver and secretion into bile.<sup>4</sup>

Advanced age and female gender are well established risk factors for gallstone disease and among the avoidable risk factors; food pattern, a sedentary lifestyle, and being overweight have been found to be associated with the risk of gallstone formation.<sup>5</sup>

Because of increased incidence of gall stones and its variable presentations in India as well as in west, there is a great need for a study which can provide information regarding risk factors associated with the formation of gallstones, prevalence of disease, clinical presentations and outcome of cholelithiasis.

Among various risk factors our study aimed to find a relationship between BMI and WHR with cholelithiasis.

Aim of the study was to study and evaluate the relation of body mass index and waist-to-hip ratio and cholelithiasis.

#### **METHODS**

#### Study design

This observational study was conducted from January 2017 to January 2020 on 200 patients presenting to SGRD Amritsar with pain abdomen which fulfilled the inclusion criteria. Test subjects comprised of 100 patients diagnosed with cholelithiasis and control subjects comprised of 100 patients with any other cause of pain abdomen. Informed written consents were taken from all patients involved in study.

#### Inclusion criteria

All patients coming to SGRD with pain abdomen of both genders above age of 20 years and patients who were willing to be a part of this study.

#### Exclusion criteria

Comorbid conditions like cardiac disease/renal failure/ascites/hypoproteinemia, patients not willing to participate in study, pregnant women with gallstones, Patient with any abdominal mass having gall stone and patients with history of any previous surgery.

A detailed history was carefully taken with particular attention to hepato-biliary system and to find risk factors.

Each patient was subjected to physical examination to assess the general condition and to know the basic vital data on admission. Per abdomen examination was done according to standard protocol and findings were noted.

Patients were investigated with CBC, LFT, RFT, USG abdomen.

BMI was calculated by standard formula (Quetelet's index)-weight (kg) divided by square of height (meters).

The Waist Hip ratio was measured according to WHO protocol i.e., waist measured at the midpoint between the lower margin last palpable rib and the top of iliac crest

using a standard measuring tape. Hip circumference measured around the widest portion of buttocks with a tape parallel to the floor. The measurements were taken at the end of a normal expiration.

WHO states that abdominal obesity is defined as waist hip ratio above 0.9 males and above 0.85 in females or a BMI >30 kg/m<sup>2</sup>.

Depending on the severity of the symptoms and signs and the findings on sonogram, patients were considered for appropriate treatment.

Statistical tests using unpaired t-test/Mann-Whitney and chi-square test /Fisher's exact test. A p<0.05 was considered statistically significant. Statistical package for social sciences (SPSS) version 21.0 was used.

#### **RESULTS**

#### Age

The age distribution were matched and found comparable between the cholelithiasis group and the non-cholelithiasis group (p value > 0.05) (Table.1)The patient's age ranged from 21-75 years, with majority of patients being aged between 41-50 years (53.50%).Cholelithiasis group had a mean age of  $45.76\pm10.92$  years with a median of 45 years(Minimum age 24 years and Maximum age 72 years).Non Cholelithiasis group had a mean age of  $46.31\pm14.18$  years with a median of 45.5 years(Minimum age =21 years, maximum age =75 years).

#### Gender

The gender distribution was matched and found significant between the cholelithiasis group and the non-cholelithiasis group (p<0.05) (Table 2). Cholelithiasis group included 62 females (62.00%) and 38 males (38.00%), while there were 36 females (36.00%) and 64 males (64.00%) in the non-cholelithiasis group. The results depicted a significantly higher number of females affected with cholelithiasis than the other group.

### Final diagnosis

Out of total 200 sample size, 100 patients (50.00%) were the patients diagnosed with cholelithiasis. Control subjects comprised of patients presenting with other causes of pain abdomen e.g. acute gastritis, GERD, diverticulitis, renal calculi etc. 36 patients (18%) out of 200 subjects were diagnosed with GERD and 2 patients (1%) were diagnosed with diverticulitis. The distribution of the final diagnosis is depicted in table number 3.

Patients presenting with pain abdomen and diagnosed as intestinal perforation, acute/chronic pancreatitis or intestinal obstruction were excluded from study due to increased WHR & bowel distension/presence of ascites.

Table 1: Age distribution.

Variables		Final diag	Total (0/)	P value	
variables		Cholelithiasis (%)	Non cholelithiasis (%)	Total (%)	P value
Age distribution (years)	≤30	10 (10.00)	13 (13.00)	23 (11.50)	
	31-40	2 (2.00)	6 (6.00)	8 (4.00)	
	41-50	60 (60.00)	47 (47.00)	107 (53.50)	
	51-60	20 (20.00)	17 (17.00)	37 (18.50)	0.179
	61-70	6 (6.00)	14 (14.00)	20 (10.00)	
	>70	2 (2.00)	3 (3.00)	5 (2.50)	
Total		100 (100.00)	100 (100.00)	200 (100.00)	

**Table 2: Gender distribution.** 

Gender	Cholelithiasis (%)	Non-cholelithiasis (%)	Total (%)	P value
Female	62 (62.00)	36 (36.00)	98 (49.00)	
Male	38 (38.00)	64 (64.00)	102 (51.00)	< 0.001
Total	100 (100)	100 (100)	200 (100)	

Table 3: Final diagnosis.

Variable	Frequency	Percentage (%)	
Acute gastritis	19	9.50	
Cholelithiasis	100	50.00	
Diverticulitis	2	1.00	
GERD	36	18.00	
Pyelonephritis	9	4.50	
Renal calculi	13	6.50	
Ureteric calculus	10	5.00	
UTI	11	5.50	
Total	200	100.00	

**Table 4: BMI distribution.** 

BMI (kg/m <sup>2</sup> )	Cholelithiasis (%)	Non-cholelithiasis (%)	Total (%)	P value
18.50-24.99	21 (21.00)	52 (52.00)	73 (36.50)	
25-29.99	63 (63.00)	42 (42.00)	105(52.50)	<0.001
>30	16 (16.00)	6 (6.00)	22 (11.00)	<0.001
Total	100 (100.00)	100 (100.00)	200 (100.00)	

**Table 5: Waist hip ratio distribution.** 

Variables		Final diagnosis		Total (9/)	Davolaro
		Cholelithiasis (%)	Non-cholelithiasis (%)	Total (%)	P value
WHR distribution	Below normal	0 (0.00)	0 (0.00)	0 (0.00)	0.003
	Normal	4 (4)	18 (18)	22 (11)	
	Abnormal	96 (96)	82 (82)	178 (89)	
Total		100 (100)	100 (100)	200 (100)	

Table 6: Weight distribution.

Weight distribution	Cholelithiasis (%)	Non-cholelithiasis (%)	Total (%)	P value
Below normal	0 (00)	0 (0.00)	0 (0)	
Normal	4 (4.00)	18 (18.00)	22 (11.00)	د0.001
Abnormal	96 (96.00)	82 (82.00)	178 (89.00)	<0.001
Total	100 (100)	100 (100.00)	200 (100)	

#### Body mass index

BMI was matched between the two groups and was found to be significant (p<0.05) (Table 4). Cholelithiasis group had a mean BMI of 27.06±2.79 with a median of 24.82 (minimum=18.73 and maximum=34.18). Non-cholelithiasis group had a mean BMI of 24.85±2.79 with a median of 24.82 (minimum=17.82, maximum=31.7). In cholelithiasis group, 21 (21.00%) patients out of 100 were found to be within normal BMI limit, whereas 79 patients (79.00%) were within higher BMI limits. Out of these 79 patients, 63 patients were in pre-obese limits and 16 patients (16.00%) qualified within obesity class 1.

In non-cholelithiasis group, 52 patients (52.00%) out of 100 were found to be within normal BMI limits, whereas 48 patients (48.00%) were within higher BMI limits. Out of these 48 patients, 42 patients (42.00%) were in preobese limits and only 6 patients qualified within obesity class 1.

The results of our study were significant, thus depicting that higher BMI has a causal relationship with development of cholelithiasis.

## Waist hip ratio

Waist hip ratio was matched between the two groups and was found to be significant (p<0.05) (Table 5). cholelithiasis group had a mean WHR of 0.9±0.03 with a median of 0.9 (minimum=0.8 and maximum=1). Non cholelithiasis group had a mean of 0.88±0.04 with a median of 0.9 (minimum=0.8, maximum age=0.9) In cholelithiasis group, 4 (4.00%) patients out of 100 were found to be within normal WHR limit, whereas 96 patients (96.00%) were within higher WHR limits. In non-cholelithiasis group, 18 patients (18.00%) out of 100 were found to be within normal WHR limits, whereas 82 patients (82.00%) were within higher WHR limits. The results of our study were significant, thus depicting that higher WHR has a causal relationship with development of cholelithiasis.

## **DISCUSSION**

A total of 200 patients were included in the study, who presented with abdominal pain at Sri Guru Ram Das institute of medical sciences and research, Amritsar. They were categorized into control and test subjects. Test subjects comprised of 100 patients diagnosed with cholelithiasis and control subjects comprised of 100 patients with any other cause of pain abdomen.

## Age

In our study, the patients selected were in the age group of 24 to 72 years in the cholelithiasis group with the mean age of  $45.76\pm10.92$  years and between age group of 21 to 75 years in the non-cholelithiasis group with a mean age of  $46.31\pm14.18$  years. Peak incidence of age in

cholelithiasis group was between 41 to 50 years (60.00%) and in non-cholelithiasis group was also between 41 to 50 years (47.00%). The mean age of patients with cholelithiasis were almost similar to the patients in the non-cholelithiasis group, which is statistically insignificant (p value=0.179). The age groups in our study are comparable between both the groups. Our results are also comparable to the study conducted by Shabanzadeh et al in 2016, where average age for gall stones formation was 50 years. <sup>6</sup>

#### Gender

In our study, there were more female patients (n=62) than the male patients (n=38) in the cholelithiasis group and there were more male patients (n=62) than female patients (n=36) in the non-cholelithiasis group. The gender distribution was significant between the cholelithiasis group and non-cholelithiasis group (p<0.05). Thus, the results of our study depict that incidence of gall stone disease is higher in females as compared to the male counterparts.

Gender as a risk factor for cholelithiasis still remains controversial. While the majority of studies conducted in the West have concluded that women are more likely to develop cholelithiasis Tazuma, Volzke et al than men, studies among Asian patients have failed to identify a gender-related difference (Lai and Novacek et al.<sup>7-10</sup> In fact, Liu et al found a higher incidence of cholelithiasis in men than in women below 50 years of age, but a higher incidence in women than in men in age groups above 50 years.<sup>11</sup>

So, the female predominance with cholelithiasis in our study is consistent with the study conducted by Tazuma and Volzke et al.<sup>7,8</sup>

#### **Body** mass index

BMI was matched between the two groups and was found to be significant (p<0.05). Cholelithiasis group had a mean BMI of  $27.06\pm2.79$  whereas non cholelithiasis group had a mean BMI of  $24.85\pm2.79$ .

In cholelithiasis group 79 patients (79.00%) were within higher BMI limits. Out of these 79 patients, 63 patients were in pre-obese limits and 16 patients (16.00%) qualified within obesity class 1.

In non-cholelithiasis group, 48 patients (48.00%) were within higher BMI limits. Out of these 48 patients, 42 patients (42.00%) were in pre-obese limits and only 6 patients qualified within obesity class 1.

The results of our study are significant, thus depicting that higher BMI has a causal relationship with development of cholelithiasis.

Stender et al used a Mendelian randomization approach, where 77,679 individuals were selected, of which 4,106 developed symptomatic gallstone disease during up to 34 years of follow-up. They concluded that there is a causal association between high BMI and increased risk of symptomatic gallstone disease. In our study, BMI is found to be elevated in 79 patients (79%). Thus, our results are consistent with the study conducted by Stender et al.<sup>12</sup>

#### Waist hip ratio

Waist hip ratio was matched between the two groups and was found to be significant (p<0.05). Cholelithiasis group had a mean WHR of  $0.9\pm0.03$  whereas non cholelithiasis group had a mean of  $0.88\pm0.04$ .

In cholelithiasis group 96 patients (96.00%) were within higher WHR limits, whereas in non-cholelithiasis group, 82 patients (82.00%) were within higher WHR limits.

The results of our study were significant, thus depicting that higher WHR has a causal relationship with development of cholelithiasis.

Tsai et al conducted a prospective study on the relation of abdominal adiposity and gallstone disease in the US in 1986. Waist to hip ratio was used as one of the measures of abdominal obesity. Out of 1117 patients with gallstone disease, 866 males showed a WHR >0.9. They concluded that there is a significant association between abdominal obesity and gallstone disease. They also said that WHR could be used independently of BMI to predict the risk of developing gallstone disease. They also said that waist circumference and BMI were significantly associated with a higher risk of cholesterol gallstone. Thus, our results are similar to both the studies. The

## **CONCLUSION**

We, hereby conclude our study, with the opinion that elevated BMI and elevated WHR are associated with gallstone disease. This study recruited a small sample size. A larger sample size and a longer follow up would provide more accurate results. A double blinded randomized study is needed to assert the same.

Funding: No funding sources Conflict of interest: None declared

Ethical approval: The study was approved by the

Institutional Ethics Committee

#### **REFERENCES**

1. Reshetnyak VI. Concept of the pathogenesis and treatment of cholelithiasis. World J Hepatol. 2012;4(2):18-23.

- 2. Channa NA, Khand F, Ghanghro AB, Soomro AM. Quantitative analysis of serum lipid profile in gallstone patients and controls. Pak J Anal Environ Chem. 2010;11(1):59-65.
- 3. Sharma MP, Duphare HV. Gallstone disease in north India: clinical and ultrasound profile in a referral hospital. J Clin Gastroentrol. 1990;12(5):547-9.
- 4. Erlinger S. Gallstones in obesity and weight loss. Eur J Gastroenterol Hepatol. 2000;12(12):1347-52.
- Kratzer W, Mason RA, Kachele V. Prevalence of gallstones in sonographic surveys worldwide. J Clin Ultrasound. 1999;27(1):1-7.
- Shabanzadeha DM, Sorensena LT, Jorgensenb T.
  Determinants for gallstone formation: a new data
  cohort study and a systematic review with meta analysis. Scandi J of Gastroenterol.
  2016;51(10):1239-48.
- Guyton AC, Hall JE. Secretory functions of alimentary tract. In: Guyton AC, Hall JE, editors. Textbook of medical physiology. 11<sup>th</sup> edition. Philadelphia: Saunders; 2006;802-4.
- Volzke H, Baumeister SE, Alte D, Hoffmann W, Schwahn C, John U et al. Independent risk factors for gallstone formation in a region with high cholelithiasis prevalence. Digestion. 2005;71(2):97-105.
- 9. Lai SW, Muo CH, Liao KF, Sung FC, Chen PC. Risk of acute pancreatitis in type 2 diabetes and risk reduction on antidiabetic drugs: a population-based cohort study in Taiwan. Am J Gastroenterol. 2011;106(9):1697-704.
- 10. Novacek G. Gender and gallstone disease. Wien Med Wochenschr. 2006;156(19-20):527-33.
- 11. Liu CM, Tung TH, Chou P, Chen VT, Hsu CT, Liu JH et al. Clinical correlation of gallstone disease in a Chinese population in Taiwan: experience at Cheng Hsin General Hospital. World J Gastroenterol. 2006;12(8):1281-6.
- 12. Stender S, Nordestgaard BG, Tybjaerg-Hansen A. Elevated body mass index as a causal risk factor for symptomatic gallstone disease: a Mendelian randomization study. Hepatol. 2013;58(6):2133-41.
- 13. Tsai CJ, Leitzmann MF, Willett WC, Giovannucci EL. Prospective study of abdominal adiposity and gallstone disease in US men. Am J Clin Nutr. 2004;80(1):38-44.
- 14. Cojocaru C, Pandele GI. Metabolic profile of patients with cholesterol gallstone disease. Rev Med Chir Soc Med Nat lasi. 2010;114(3):677-82.

Cite this article as: Bansal D, Rattan A, Bhangu GS, Singh R. Cholelithiasis and its relation to body mass index and waist to hip ratio: an observational study. Int Surg J 2021;8:150-4.