



**Association of Gall Stone Disease with Body Mass Index and Waist Hip Ratio**

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**Abstract**

**Introduction:** Gallstone Disease is a common medical problem encounter almost every-day both in Outpatient and Emergency Departments. It is one of the ancient diseases known to man since gallstone has been found in the gallbladder of Egyptian mummies dating back to 1000 BC. The traditional risk factors for cholelithiasis are female, fat, forty and fertile but age, multiparity, obesity, hyperlipidemia, cigarette smoking, diabetes are other additional risk factor. This study aim to study the association of gall stone disease with body mass index (BMI) and Waist hip ratio (WHR).

**Methods:** A cross sectional study was conducted from August 2017 to July 2019. All the cases of cholelithiasis planned for cholecystectomy were included in the study. The patient’s socio-demographic data, relevant clinical

history, BMI and WHR was recorded in preformed proforma. Haematological and biochemical parameter were recorded pre-operatively. Data collected were analyzed using SPSS-version-21. Descriptive statistics like mean, frequency, percentage and mean was used for socio demographic variables like age, sex, education, etc. Chi-square test and student t-test was used to test the significance between proportions (association between demographic, BMI and WHR and cholelithiasis). A p-value of less than 0.05 were considered as statistically significant.

**Results:** 240 patients were recruited and studied. Majority of the patients were from the 3<sup>rd</sup>, 4<sup>th</sup> and 5<sup>th</sup> decade of life (72%). Female consist of 72.8%. High serum cholesterol was found in 52.1% of cases. Most of the patients had increased BMI (75.9%). Mean BMI was

25.4 with a standard deviation of 3.04. WHR was increased in 183 cases (76.2%).

**Conclusion:** Gall stone disease was significantly associated with increased BMI and Waist hip ratio.

**Keywords:** Cross sectional study, BMI, Waist hip ratio, Gall stone disease.

### Introduction

Gallstone Disease is a common medical problem encounter almost every-day both in Outpatient and Emergency Department. It is one of the ancient diseases known to man since gallstone have been found in the gallbladder of Egyptian mummies dating back to 1000 BC.<sup>1</sup> A Greek physician, Alexander Trallianus, first described gallstones in the fifth century and they continue to be a major health problem in today's world as well.<sup>2</sup> Gallstone disease (GSD) is the most common biliary tract disease and its prevalence varies from 5 to 25% worldwide.<sup>2</sup> Gallstone disease (GSD) and its complications are major global public health issues, and it remains a common cause of surgical intervention, contributing substantially to health care costs. The prevalence of gallstone disease varies in different parts of India with North Indian having higher prevalence compared to South Indian.<sup>3</sup>

The traditional risk factors for cholelithiasis were female, fat, forty and fertile but age, multiparity, obesity, hyperlipidemia, cigarette smoking, diabetes are other additional risk factors.<sup>4</sup> Overweight and obesity are well-established risk factors for gallstone disease.<sup>1</sup> Gallbladder disease is one of the most frequent obesity-related co-morbid conditions and symptomatic or not, is directly correlated to the body mass index (BMI).<sup>5</sup> BMI is measured of obesity and calculated by weight in kilograms divided by height in metre square.<sup>6</sup> The importance of obesity as a risk factor for gallstone disease has been well documented in women. However,

the association with obesity as measured by body mass index (BMI) is inconsistent in men. Interestingly, Heaton et al recently observed in a cross-sectional study of British men that waist-to-hip ratio (WHR) was positively related to gallstone disease, whereas BMI was unrelated to the risk.<sup>7</sup> WHR is the measured of additional body fat distribution and calculated by waist circumference divided by hip circumference.<sup>8</sup>

Overweight and obesity is a modifiable risk factor for gallstone and other diseases like diabetes, heart diseases etc. Risk factors might varies from region to region and person to person. This study might help some individuals to prevent the obesity related diseases and reduce the burden to him and to the nation as a whole.

### Materials and Methods

A cross sectional study was conducted from August, 2017 to July 2009, in Manipur at the Department of Surgery, Regional Institute of Medical Sciences (RIMS), Imphal. The study population were all the patients of both sexes aged more than 18 years who were diagnosed as cholelithiasis and planned for elective cholecystectomy in the Department of Surgery at RIMS, Imphal during the study period. Pregnant patients and those who refused to participate were excluded from the study. A sample size of 240 was calculated based on Unisa S et al<sup>9</sup> and consecutive sampling was done until the required sample size was reached.

### Study variables

Socio-demographic characteristics like Age, sex, address, marital status, occupation, religion, height, weight, waist circumference, hip circumference and BMI, and lifestyle habits like dietary habits, smoking, alcohol use, lipid profile were independent variable and Gallstone Disease was dependent variable.

**Data collection**

Data was collected after obtaining written informed consent. All the data were collected using a self-administered structured questionnaire. Patients admitted in surgical ward diagnosed with gallstone disease were included for study. Data collected were checked for consistency and completeness.

**Operational definition**

Body Mass Index (BMI): BMI is a weight in kgs by height squared in metres.<sup>6</sup>

Normal range - 18.5-22.9

Overweight - 23- 24.9

Obese Class 1 - 25-29.9

Obese Class 2 -  $\geq 30$

Waist circumference: The measurement was taken at the approximate midpoint between the lower margin of the last palpable rib and the top of the iliac crest.<sup>8</sup>

Hip circumference: Hip circumference measurement taken around the widest portion of the buttocks.<sup>8</sup>

**Statistical analysis**

Data were entered in IBM SPSS version 21 software. Descriptive statistics like mean, frequency, percentage and mean was used for socio demographic variables like

age, sex, education, etc. Chi-square test and student t-test was used to test the significance between proportions (association between demographic, BMI and hip waist ratio and cholelithiasis). A p-value of less than 0.05 was considered as statistically significant. Ethical approval was obtained from the Research Ethics Board, RIMS, Imphal before the beginning of the study.

**Results and Observation**

A cross-sectional study was conducted in the Surgical ward, Regional Institute of Medical Sciences from August 2017 to July 2019 among 240 diagnosed case of gallstone diseases admitted in Surgical ward of RIMS to determine the association of Gallstone Diseases with Body Mass Index and Waist-Hip Ratio in Gallstone Disease patients.

Majority of the patients were from the 3<sup>rd</sup>, 4<sup>th</sup> and 5<sup>th</sup> decade of life in 72% of patients. The most common one was 51-60 years in 26.7% of cases. Mean age was 42 years with a standard deviation of 12.5 years.

Age in years	Male n (%)	Female n(%)	Total N(%)	Chi-square test
18-30	10(19.6)	44(23.3)	54(22.5)	Value=9.943 df-4 p-0.041
31-40	7(13.7)	45(23.8)	52(21.7)	
41-50	13(25.5)	47(24.9)	60(25.0)	
51-60	21(41.2)	43(22.8)	64(26.7)	
>60	0(0.0)	10(5.3)	10(4.2)	
Total	51(100.0)	189(100.0)	240(100.0)	

Table 1: Relation between age and sex among gallstone patients

In all the age groups, female was predominant except 41-50 and 51-60 years as shown in table 3 and the finding was found to be significant. Most of the patients were from rural area (65%). Hindu constituted majority of the

patients in 79.2% of cases followed by Christian in 14.2% and Muslim in 6.6%. Unemployment was seen in 15.8% of cases, employed in 12.9% and self-employed in 30.4%. Most females were housewives in 51.9% of cases

and most males are self-employed (52.9%). Finding was found to be significant ( $p < 0.05$ ). Majority of the patients were non vegetarian (93.3%). Smoking was seen in 15% of gallstone patients. Chewing tobacco was seen in 17.9%, Alcohol consumption in 9.6% of patients. Physical inactivity was found in 39.2% of cases. High serum cholesterol was found in 52.1% of cases. Mean

serum cholesterol was 175.1 with a standard deviation of 24. Serum triglyceride was found high in 32.1% of cases. Mean triglycerides was 153.0 with a standard deviation of 57.6. Serum High Density Lipoprotein (HDL) was found to be decreased in 54.2%. Mean Serum HDL was 37.6 with a standard deviation of 6.00.

BMI	Frequency	Percentage
<18.5	3	1.2
18.5-22.9	55	22.9
23-24.9	22	9.2
25-29.9	141	58.8
30 and more	19	7.9
Total	240	100.0
Mean $\pm$ SD	25.4 $\pm$ 3.04	

Table 2: Distribution of the patients by BMI

Most of the patients had increased BMI in 75.9% of cases. Mean BMI was 25.4 with a standard deviation of 3.04.

Age in years	BMI					
	<18.5* n(%)	18.5-22.9 n(%)	23-24.9 n(%)	25-29.9 n(%)	30 and more n(%)	Total
18-30	3(100.0)	25(45.5)	6(27.3)	17(12.1)	3(15.8)	54(22.5)
31-40	0(0.0)	8(14.5)	6(27.3)	33(23.4)	5(26.3)	52(21.7)
41-50	0(0.0)	12(21.8)	7(31.8)	35(24.8)	6(31.6)	60(25.0)
51-60	0(0.0)	10(18.2)	3(13.6)	46(32.6)	5(26.3)	64(26.7)
>60#	0(0.0)	0(0.0)	0(0.0)	10(7.1)	0(0.0)	10(4.2)
Total	3(100.0)	55(100.0)	22(100.0)	141(100.0)	19(100.0)	240(100.0)

Table 3: Relation between BMI and age among gallstone patients

(\*column and # rows were excluded from the analysis)

Chi-square test=27.7, df-9,  $p < 0.001$

All underweight patients were in the age group 18-30 years. Majority of the normal BMI was also from the group 18-30 years. Overweight (BMI-23-24.9) was seen more in 41-50 years age group. Obesity class I (BMI-25-

29.9) was seen more in 51-60 years. Obesity class II (BMI->30) was seen more in 41-50 years age group. The findings were found to be significant ( $p < 0.05$ ).

Sex	BMI					Total
	<18.5* n(%)	18.5-22.9 n(%)	23-24.9 n(%)	25-29.9 n(%)	30 and more n(%)	
Male	0(0.0)	11(21.6)	7(13.7)	25(49.0)	8(15.7)	51(100.0)
Female	3(1.6)	44(23.3)	15(7.9)	116(61.4)	11(5.8)	189(100.0)
Total	3(1.2)	55(22.9)	22(9.2)	141(58.8)	19(7.9)	240(100.0)

Table 4: Relation between BMI and sex among gallstone patients

Chi-square test; value-8.31, df-4, p-0.081 In both sex, most of the patients had BMI 25-29.9 (obesity stage I)

but more among females. This finding was found to be insignificant. (p>0.05).

Age in years	WHR		Total	Chi square test
	≤0.9	>0.9		
18-30	32(56.1)	22(12.0)	54(22.5)	Value=50.382, df-4, p-0.000
31-40	9(15.8)	43(23.5)	52(21.6)	
41-50	9(15.8)	51(27.9)	60(25.0)	
51-60	5(8.8)	59(32.2)	64(26.6)	
>60	2(3.5)	8(4.4)	10(4.3)	
Total	57(100.0)	183(100.0)	240(100.0)	

Table 5: Relation between age in years and WHR among gallstone patients

Increased WHR was seen more among 51-60 years, followed by 41 -50 years and the finding was statistically significant (p<0.05).

Sex	WHR		Total N(%)	Chi square test
	≤0.9	>0.9		
Male	15(29.4)	36(70.6)	51(100.0)	Value=1.146, df-1, p-0.284
Female	42(22.2)	147(77.8)	189(100.0)	
Total	57(23.8)	183(76.2)	240 (100.0)	

Table 6: Relation between sex and WHR among gallstone patients

WHR was significantly more among females than males (77.8% vs 70.6%) (p<0.219) as shown in Table 6.

**Discussion**

A cross-sectional study was conducted in 240 diagnosed cases of cholelithiasis admitted in the surgical ward, Regional Institute of Medical Sciences from August 2017 to July 2019 to determine the association of Gallstone Diseases with Body Mass Index and Waist-Hip Ratio.

Majority of the patients were from the 3<sup>rd</sup>, 4<sup>th</sup> and 5<sup>th</sup> decade of life in 72% of patients. The most common age involved was 50-60 years 26%. Likewise, the most commonly involved age group for cholelithiasis (around 22%) was found to be 55-64 years in the study by Harish B<sup>9</sup>. Mean age was 42 years with a standard deviation of 12.5 years.

Female predominance was seen in this study (78.8%). In the study by Singh H et al<sup>10</sup>, females constituted 74% of

the cases which is similar to this study. Sharma MA<sup>11</sup> showed 71.4% were female, 28.6% were male. Similar observations were noted by Nagaraj S et al,<sup>12</sup> Ganey JB et al<sup>13</sup> showed that 70% were female and 30% were male. In this study, among the higher age group i.e. 41-60 years male predominance was seen except after 60 years. Same observation was noted in the study by Sachdeva S et al<sup>14</sup> in which, among 31-60 years there was male predominance but above 60 years, females were more. So, younger age group were more of females in both the studies. Majority of the patients were non vegetarian in 93.3% of cases. In the study by Harish B<sup>17</sup> also most of the patients were non vegetarian (93.93%) which is in concordance with this study. Smoking was seen in 15% of cases. Chewing tobacco was seen in 17.9% of cases and alcohol consumption was found in 9.6% of patients. Physical inactivity was found in 39.2% of cases. In the study by Hou L et al<sup>15</sup>, gallstone risk was positively associated with cumulative occupational sitting time (p trend = 0.01) and inversely associated with occupational cumulative energy expenditure (p trend = 0.03) as well as with household physical activity (p trend = 0.02). High serum cholesterol was found in 52.1% of cases. Mean serum cholesterol was 175.1 with a standard deviation of 23. Serum triglyceride was found high in 32.1% of cases. Mean triglycerides was 153.0 with a standard deviation of 57.6. Serum HDL was found to be decreased in 54.2%. Mean Serum HDL was 37.6 with a standard deviation of 6.00. In the study by Shrestha KB et al<sup>4</sup>, triglycerides were increased in n=34 (28.3%) which is similar to this study. Hayat S et al<sup>16</sup>, in their comparative analysis of serum lipid profile in patients with gallstone disease also found that both serum cholesterol, serum triglycerides were high and serum HDL was found to be low, which are similar conclusion to the present studies. Though we do not specifically

study the correlation of deranged lipid profile in increased BMI patient.

BMI was raised in 77% of cases in this study. In the study by Singh H et al<sup>10</sup>, it was found in 72% of cases. In the study by Shrestha KB et al<sup>4</sup>, the patients with BMI 18-25 were n=72(60%), BMI 25-30 were n=33(27.5%) and BMI >30 were n=11(9.1%). In this study also patient with BMI >30 was seen in 7.9% of cases but patients with BMI 25-30 was higher in this study than the above study. This shows that increased BMI is associated with increased incidence of cholelithiasis.

Tsai CJ et al<sup>17</sup> conducted a prospective study on the relation of abdominal adiposity and gallstone disease in the United States in 1986. Waist to hip ratio was used as one of the measures of abdominal obesity. In that study 77.5% of the cases 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. Both the above studies revealed elevated WHR in a significant number of gallstone cases. In this study also WHR>0.9 was found in 76.2% which is quite similar to the above studies.

In the study by Hou L et al<sup>5</sup>, BMI (p trend < 0.001) and WHR (p trend < 0.001) were both related to a high prevalence of gallstone disease, and a significant interaction between BMI and WHR on gallstone risk was found. Katsika D et al<sup>18</sup>, in their study found that overweight and obesity were associated with a significantly higher risk for symptomatic GSD in the whole study population. In the study by Hsu HY et al<sup>2</sup> BMI and waist circumference were risk factors for gallstone disease in both men and women. They concluded that all obesity indicators predicted the risk of GSD in women but only BMI and waist circumference

were associated with GSD risk in men, and central obesity might play a more important role in the prediction of GSD risk in men. Our study also shows that WHR increased in 4<sup>th</sup> and 5<sup>th</sup> decade of life. WHR increased in both sexes with slightly higher percentages in female patients (77.8% vs 70.6%). This may mean there is higher chance of cholelithiasis in female with increasing age till sixth decade.

### Conclusion

From this study we can conclude that there is significant association of gallstone disease with Body Mass Index and Waist Hip Ratio. Result also shows that gallstone disease is more prevalent in women than in men.

Body Mass Index and Waist Hip Ratio are relatively higher in female and most of them are above forty years of age which may account for higher prevalence of gallstone disease in female.

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