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The impact of lifestyle stressors, menstrual pattern, and cardiometabolic risk factors on young females with cholelithiasis

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Abstract:

BACKGROUND: Lifestyle and nutritional transitions in the society driven by globalization have led to the rising burden of cholelithiasis. The present study was done to assess the impact of lifestyle, stress, menstrual pattern, and cardiometabolic risk factors on young females with cholelithiasis.

MATERIALS AND METHODS: A hospital-based case–control study was conducted on young females of 18–45 years. Cases and age-matched controls were compared on their lifestyle parameters like demography, marital status, occupation, educational status, family income, stress along with menstrual pattern, cardiometabolic parameters like anthropometric measures, blood pressure (BP), fasting blood sugar (FBS), and lipid profile. Chi-square test and unpaired *t*-test were used for the analysis of data using SPSS software, and $P < 0.05$ was considered statistically significant.

RESULTS: The majority of the cases were from rural areas, married, homemakers leading a comparatively sedentary lifestyle consuming more red meat, less literate, and belonged to a lower economic group with significantly more stress compared to controls. The age of menarche, neither the regularity nor irregularity of the menstrual cycle (regular cycle 21–35 days), showed any difference, but cases had significantly more pregnancies and usage of oral contraceptives compared to controls. Waist–height ratio, systolic BP, FBS, triglyceride, low-density lipoprotein (LDL), and very low-density lipoprotein (VLDL) were significantly higher in cases. Cases had a 14.4 times more risk of developing metabolic syndrome when compared with controls.

CONCLUSION: Married, rural, less literate Indian women leading a sedentary lifestyle, consuming more of red meat, and soft drinks with increased psychosomatic stress are more prone to develop cholelithiasis. Women who use hormonal contraceptives have increased occurrence of cholelithiasis and they were more prone to develop metabolic syndrome. The need for the hour is health education, to implement simple lifestyle changes, thereby decreasing the incidence of cholelithiasis in young females.

Keywords:

Cholelithiasis, gallstones, lifestyle, metabolic syndrome

Introduction

Gallstone disease or cholelithiasis, diagnosed when hardened deposits of bile are formed within the gallbladder, is a worldwide medical problem showing substantial geographical variation in its incidence. Cholelithiasis is often thought to be a major affliction in today's modern and fast-paced society. The prevalence of cholelithiasis in Indian females is more than males.[1,2]

Gallstone formation is multifactorial. There are many risk factors for cholelithiasis,

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nonmodifiable risk factors such as ethnic background, age, gender, menstrual, and family history and modifiable risk factors such as diet, obesity, rapid weight loss, sedentary lifestyle, and stress.[3]

The female gender has the most compelling association with gallstone disease,[4] especially during the fertile years. The male: female ratio for cholelithiasis is 0.52.[5] The amount of cholesterol in the bile is supposed to increase with age leading to cholelithiasis.[4] A fat, fertile, flatulent female of 50 years is a classic sufferer of cholelithiasis in Western countries. There is a rising prevalence of cholelithiasis in females <40 years of age.[2] Early marriage and frequent pregnancies in Indian females lead to increased exposure of gallbladder to progesterone at a younger age. This cultural trend could be one of the causes of the rising incidence of cholelithiasis in young females.

Diet, a modifiable risk factor, specifically high in cholesterol, fatty acids, carbohydrates, or legumes, seems to increase the risk of cholesterol gallstone.[3] Cholesterol gallstone disease is said to be a fellow traveler with metabolic syndrome, which is defined by the presence of abdominal obesity, high blood pressure (BP), high fasting glucose, increased triglyceride levels, and reduced high-density lipoprotein (HDL) levels.[6,7] In addition, dyslipidemia, hyperglycemia, and abdominal obesity are also considered cardiometabolic risk factors and crucial predictors of metabolic syndrome in coronary artery disease (CAD) patients.[8] An increase in the prevalence of metabolic syndrome in the Indian female population is 12.6%. The age-wise prevalence of metabolic syndrome was found to be the same in 20–40 years and 40–60 years, indicating that metabolic syndrome is on the rise in the younger population.[9] This could make them more prone to cholelithiasis.[3]

Today's fast-paced life leads to tremendous psychological stress in females. Meta-analysis report on the association of metabolic syndrome with psychological stress has revealed that recommendations for preventing metabolic syndrome may not achieve the desired outcome if we overlook patients' psychosocial stress and its sources.[10]

Cholelithiasis, a fellow traveler of metabolic syndrome, can have a major psychological and economic impact on young females in their most productive stage of life (18–45 years) when the social and family responsibilities are the greatest for an Indian woman. India is the diabetes capital of the world,[11] and adherence to an overall healthy lifestyle has been shown to reduce mortality in them.[12] Diabetes is also one of the diagnosis criteria for metabolic syndrome. One in four adult individuals in a state in South India is being diagnosed with metabolic syndrome leading us to believe that it is imperative to identify the association of metabolic syndrome as a risk factor in young females for cholelithiasis. Hence this work was planned to study the impact of lifestyle, stress, menstrual pattern, and cardiometabolic risk factors on young females with cholelithiasis and compare them with age-matched healthy females.

Materials and Methods

Study design and setting

The present study was a hospital-based case–control. The present study was conducted in the department of general surgery of a private medical college hospital of a deemed to be university in Dakshina Kannada, Karnataka, India.

Study participants and sampling

The data collection was done over 6 months in the 2017–2018 year. We had a total of 94 participants. The study group participants were 44 young female patients aged 18–45 years with cholelithiasis (N1) as confirmed by an ultrasound examination and 50 age-matched healthy female controls without any current illness (N2). A complete enumeration of all willing patients (purposive sampling) who had attended the outpatient department was done. Female patients with clinically overt hemolysis, female patients in the age group <18 years, and >45 years, and children were excluded from the study.

Ethical considerations

Ethical approval (protocol number YUEC 2017-090) was obtained for this study from the University Ethics Committee before the start of the study. Written informed consent was obtained from each participant after describing in full detail the procedure and purpose of the study.

Data collection tool and technique

All the participants answered the questionnaire which consisted of questions to assess the lifestyle, stress experienced, and menstrual details of the participants. The questionnaire package included five items from revised Kuppuswamy and BG Prasad socioeconomic scales for the Indian population questionnaire to collect the details of lifestyle.[13] Ten questions to assess the psychosomatic stress of the past month using Perceived Stress Questionnaire, a pretested validated questionnaire developed by Cohen S.[14-16]. The calculation of the total caloric intake for the study participants was done using the Dietary Guidelines for Indians, National Institute of Nutrition of Indian Council of Medical Research.[17] The questions to collect dietary and menstrual history were constructed taking into consideration the views and inputs from the medical and nutritional experts.

The developed questionnaire was subjected to face and content validation by five experts. The content validation was done by the experts based on the essential or nonessential of each item. The clarity and relevance of each of the questions to the study population were ascertained. The internal consistency using Cronbach's alpha score (total 0.76) was ensured before administering it to the study participants.

Lifestyle factors

A detailed history of age, married status, educational status, occupation, and family income per month was elicited.[13] Participants were asked about their history of smoking and alcohol consumption. Dietary history to calculate the total calorie consumption and assess the quality of diet with the type of meat consumed by them (red/white meat), fast food, and soft drink consumption was elicited. History about the type and duration of work, duration of sleep, use of vehicles, and practice of exercise and yoga was elicited.

Stress assessment

The participants scored on a Likert scale the questions which assessed their psychosomatic stress levels (0 – never, 1 – almost never, 2 – sometimes, 3 – fairly often, and 4 – very often). Based on their total perceived stress score (PSS), participants (cases and controls) were compared.[14-16]

Menstrual history

A detailed menstrual history including the age of menarche, duration of menstrual bleeding, the regularity of cycles (21–35-day cycle is regular), pain associated with bleeding, hormonal contraceptives usage, number of pregnancies, and duration of pregnancies was elicited.

Cardiometabolic risk factors

Anthropometric measurements

Anthropometric measurements were carried out for participants. Body weight and height were measured with participants standing erect without shoes in light clothes. Body weight was measured in kilograms to the nearest 0.1 kg using a digital scale, which was calibrated regularly. Height will be measured to the nearest 5 mm using a stadiometer. Body mass index (BMI) using Quetelet's formula, waist circumference, hip circumference, waist–hip ratio (W/H), and waist–height ratio (WHtR) were calculated. Those with BMI between 18.5 and 24.9 kg/m^2 were considered as normal, 25–29.9 kg/m^2 will be considered as overweight, and those with a BMI of more than 30 kg/m^2 as obese. As per the WHO guidelines, abdominal obesity is defined as a waist–hip ratio above 0.85 for females. Those having WHtR <0.5 were considered normal, and those having >0.5 as obese.[18]

Basal cardiovascular parameters

BP was measured on the left arm, with an appropriately sized cuff, after at least 10 min of rest in a sitting position, using a sphygmomanometer. The average of the last two measurements was used for analysis according to the Joint National Committee 8 criteria.[19]

Biochemical parameters

Blood was estimated for fasting blood sugar (FBS, mg/dl) and fasting lipid profile which included total cholesterol (TC, mg/dl), triglycerides, low-density lipoprotein (LDL, mg/dl), (HDL, mg/dl), and very LDL (VLDL, mg/dl) by an automated method using VITROS 5600 Integrated Chemistry System.

Metabolic syndrome

From the above-measured parameters, it was determined if the participants have metabolic syndrome, based on Harmonization of Metabolic Syndrome: Joint Interim Statement of the International Diabetes Federation Global consensus definition, and also a Consensus Statement for Diagnosis of Obesity, Abdominal Obesity, and the Metabolic Syndrome for Asian Indians. According to this, the presence of any three of the following five criteria is necessary for a female to have metabolic syndrome: (a) increased waist circumference: ≥80 cm, (b) increased triglyceride: ≥150 mg/dl or on pharmacological treatment, (c) HDL cholesterol: <50 mg/dl or on treatment, (d) BP: >130 mmHg systolic BP (SBP) or >85 mmHg diastolic BP (DBP) or on treatment for hypertension, and (e) fasting glucose: ≥100 mg/dl or on treatment for diabetes mellitus.[20,21]

Statistical analysis

Statistical analysis was done using the IBM SPSS Statistics for Windows Version 21.0, Armonk, NY, USA (and MS Excel. The mean ± standard deviation of age of the participants, hours of work, and sleep per day, total caloric intake, PSS score, duration of menstrual bleeding, anthropometric measurements (BMI, W/H ratio, and WHtR), FBS, and fasting lipid have been calculated. Unpaired *t*-test was done to compare the above mentioned parameters between the two groups. Age-wise distribution of cases, age of menarche, number of pregnancies, and occurrence of metabolic syndrome are presented as frequencies and percentages. The lifestyle parameters, physical activity parameters, dietary parameters, and menstrual history parameters between cases and controls are compared using the Chi-square test. All tests are two-tailed, and $P < 0.05$ was considered statistically significant.

Results

Lifestyle, dietary parameters, and stress

Both the groups in our study cases and controls were age matched with the mean age of cases and controls as

35.59 ± 8.348 years and 34.26 ± 5.197 years, respectively. The occurrence of cholelithiasis increases with age with the highest number, 26 cases in the age group of 36–45 years, 12 cases in the 26–35 years group, and 6 cases in the 18–25 years age group. Table 1 shows that a significant majority of cases were from the rural areas, married, homemakers, less educated females, and less family income.

33 cases and 41 controls used vehicles for 70% or more of their outings and 13 cases and 16 controls practiced exercise/yoga regularly. But the differences between the groups were not statistically significant.

The comparison between the personal habits and work showed that on average, the cases worked 6.05 ± 0.9 h/day and controls worked for 8.46 ± 1.5 h/day and this difference was statistically significant. In addition, even though cases slept for 7.11 ± 0.8 h/day and controls for 7.06 ± 1.02 h/day, the difference was not statistically significant.

None of the participants had smoking habits nor consumed alcohol, tobacco chewing, or beetle nut. Table 2 shows that in both cases and controls, participants consuming a nonvegetarian diet are more. The cases consumed significantly more red meat and soft drinks while controls consumed white meat. All participants regularly consumed fruits and vegetables. The total caloric consumption by cases is statistically more than the control group [Figure 1]. None of the participants were smokers or alcoholics.

The total PSS score of cases was 27.09 ± 3.741 and controls was 20.06 ± 4.909. Cases have statistically significant (P < 0.0001) more stress as seen in the PSS score compared to controls.

Menstrual history and obstetric history

The age of menarche was 13.18 ± 1.18 years and 12.12 ± 1.58 years in cases and controls, respectively. The cases had a statistically more (P = 0.0004) age of menarche. We did not find any difference between the duration of menstrual bleeding in cases and controls, with a mean duration of 6.14 ± 1.091 days in cases and 5.68 ± 1.316 days in controls.

Thirty-six cases and 38 controls had regular menstrual cycle and 25 cases and 24 controls had pain associated with menstruation, but the comparison of these was not statistically significant. Eleven cases in comparison to two controls used hormonal contraceptive pills, and this was statistically significant (P = 0.003).

The majority of the cases (56.8%) had three pregnancies and controls (42%) had undergone two pregnancies. All women had full-term delivery.

Cardiometabolic parameters and metabolic syndrome

There was a significant difference in the WHtR between cases and controls [Figure 2]. There was no

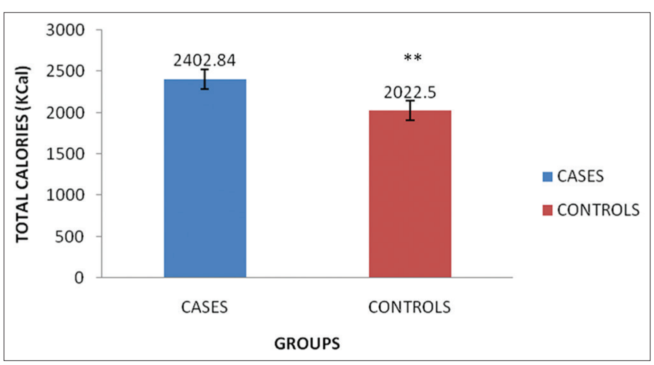

Figure 1: Comparison of total caloric intake between cases and controls. Values are expressed as mean ± standard deviation; Student's unpaired t-test. ** P<0.01

Table 1: Comparison of lifestyle parameters between cases and controls (n=94)

Items	Cases, frequency ($N1$=44), n (%)	Controls, frequency ($N2$=50), n (%)	P
Demography			
Rural	38 (86.4)	20 (40)	<0.01
Urban	6 (13.6)	30 (60)	
Marital status			
Married	43 (97.7)	19 (38)	<0.001
Unmarried	1 (2.3)	31 (62)	
Occupation			
Homemaker	39 (88.6)	4 (8)	<0.0001
Clerical, shop owner, farmer	1 (2.3)	0	
Skilled worker	0	4 (8)	
Semi-skilled laborer	2 (4.5)	0	
Unskilled worker	1 (2.3)	0	
Semi-professional	0	11 (22)	
Professional	1 (2.3)	31 (62)	
Educational status			
Illiterate	3 (6.8)	1 (2)	<0.0001
Primary school certificate	13 (29.5)	5 (10)	
Middle school certificate	9 (20.5)	3 (6)	
High school certificate	7 (15.9)	4 (8)	
Intermediate or post high school diploma	10 (22.7)	0	
Graduate or postgraduate	0	33 (66)	
Professional or honors	2 (4.6)	4 (8)	
Family income (INR)			
21,438-42,875	0	30 (60)	<0.0001
16,078-21,437	5 (11.4)	13 (26)	
10,719-16,077	11 (25)	7 (14)	
6431-10,718	14 (31.8)	0	
2165-6430	14 (31.8)	0	

Values are expressed as frequency and percentage; Chi-square test. INR=Indian currency

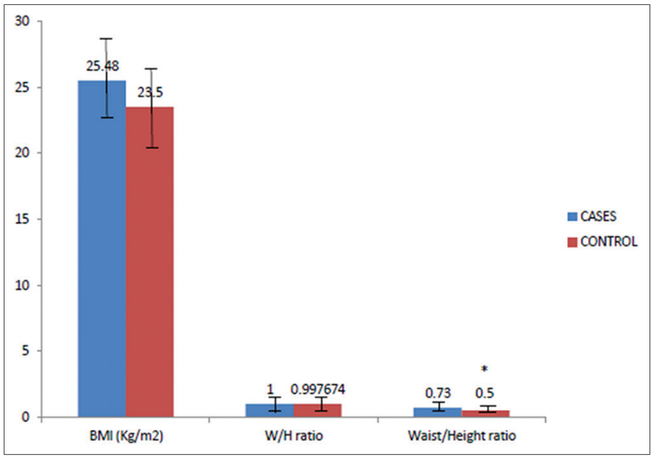

Figure 2: Comparison of anthropometric parameters between cases and controls. Values are expressed as mean ± standard deviation; Student's unpaired *t*-test. *$P < 0.05$

difference in the waist circumference between the cases and the controls. There was a significant increase in SBP, TC, triglycerides, LDL, and VLDL in cases than controls [Table 3]. Metabolic syndrome was seen in 22.7% of the cases. Females with metabolic syndrome are at 14.4 times more risk of developing cholelithiasis than those who did not have it [Table 4].

Discussion

Cholelithiasis was always considered a disease of the West. However, lifestyle and nutritional transitions in Indian society driven by urbanization have led to a rising burden of cholelithiasis in younger individuals[22] when compared with the Western population. The awareness about the risk factors leading to cholelithiasis becomes imperative in the prevention of the disease, hence we had planned to undertake this study to explore the impact of lifestyle, stress, menstrual pattern, and cardiometabolic risk factors on young females with cholelithiasis and compare them with age-matched healthy females.

Lifestyle, stress, and dietary parameters

In our study, cholelithiasis had a peak incidence in the age group of 35–45 years with a mean age of 35.59 ± 8.34 years. Nagaraj *et al*. in a study conducted in Kolar, Karnataka, India, reported maximum cases in the age group of 41–50 years with an observed lower age limit of 20 years.[23] In contrast, Unisa *et al*. reported that cholelithiasis was more common in more than 50 years of age in the North Indian rural population.[24] In our study, we found that one of the cases was 18 years of age.

Even though cholelithiasis is an urban disease, a significant majority of our cases were from rural areas. Our study is in agreement with Mohan who reported that the incidence of cholelithiasis is increasing in the rural population, which could be due to changes in dietary habits and lifestyle modification, but their study did not have a control group.[25] A significant majority of cases in our study were married, homemakers, and less literate when compared to controls. In contrast, Singh *et al*. in a

Table 2: Comparison of dietary parameters between cases and controls (*n*=94)

Items	Cases, frequency (*N*1=44), *n* (%)	Controls, frequency (*N*2=50), *n* (%)	*P*
Diet			
Nonvegetarian	39 (88.6)	45 (90)	0.8
Vegetarian	5 (11.4)	5 (10)	
Red meat consumption			
Do not consume	9 (20.5)	34 (68)	<0.001
Monthly	7 (15.9)	0	
Fortnightly	9 (20.5)	3 (6)	
1-3 times a week	18 (40.9)	10 (20)	
>3 times a week	1 (2.3)	3 (6)	
White meat consumption			
Do not consume	7 (15.9)	5 (10)	0.002
Monthly	1 (2.3)	0	
Fortnightly	8 (18.2)	1 (2)	
1-3 times a week	12 (27.3)	8 (16)	
>3 times a week	16 (36.4)	28 (56)	
Daily	0	8 (16)	
Fast food			
Yes	41 (93.2)	49 (98)	0.2
No	3 (6.8)	1 (2)	
Soft drinks			
Yes	43 (97.7)	36 (72)	0.001
No	1 (2.3)	14 (28)	

Values are expressed as frequency and percentage; Chi-square test

Table 3: Comparison of blood pressure and blood test parameters between cases and controls (*n*=94)

Parameters	Cases (*N*1=44)	Controls (*N*2=50)	*P*
SBP (mmHg)	118.91±19.91	108.08±13.12	0.002
DBP (mmHg)	80.82±17.61	75.92±8.87	0.09
FBS (mg/dl)	105.82±28.63	85.58±12.75	<0.001
Lipid profile TC (mg/dl)	173.00±30.55	151.66±16.98	<0.001
Triglyceride (mg/dl)	169.66±42.03	117.74±30.81	<0.001
HDL (mg/dl)	44.11±6.333	45.94±5.964	0.153
LDL (mg/dl)	111.64±28.25	90.64±15.63	<0.001
VLDL (mg/dl)	17.25±4.09	15.08±3.12	0.004

Values are expressed as mean±SD; Student's unpaired *t*-test. SD=Standard deviation, SBP=Systolic blood pressure, DBP=Diastolic blood pressure, TC=Total cholesterol, FBS=Fasting blood sugar, HDL=High-density lipoprotein, LDL=Low-density lipoprotein, VLDL=Very low-density lipoprotein

Table 4: Comparison of occurrence of metabolic syndrome in cases and controls (*n*=94)

Items	Cases, frequency (*N*1=44), *n* (%)	Controls, frequency (*N*2=50), *n* (%)	OR	*P*
Metabolic syndrome				
Yes	10 (22.7)	1 (2)	14.4	0.01
No	34 (77.3)	49 (98)		

Values are expressed as frequency and percentage; Chi-square test. OR=Odds ratio study conducted in Chandigarh, North India, reported that cholelithiasis was frequent in those belonging to high socioeconomic status.[26] The difference in the results could be our study was conducted in South India, and the latest trend of urbanization of rural India could be one of the causes.

We did not find any difference in physical activity, the practice of yoga, and sleep pattern between cases and controls, but the cases have significantly fewer working hours in comparison to controls. This could be because most of them were homemakers, and led a sedentary lifestyle. We agree with Sachdeva *et al*. who had reported a sedentary lifestyle as a risk factor for cholelithiasis.[27]

The majority of our participants consumed a nonvegetarian diet. The cases consumed significantly more red meat and soft drinks while controls consumed white meat. The total caloric consumption by cases is statistically more than the control group. Park *et al*. in a study done in Korea reported that meat and fried foods increased the risk of cholesterol gallstone.[28] Furthermore, sugar-sweetened beverage consumption increases blood glucose levels and has a positive association with weight gain, and diabetes, all of which are risk factors for cholelithiasis.

The cases of our study had significantly more psychosomatic stress than controls as depicted by their PSS. Individuals with increased psychological stress are prone to unhealthy lifestyle behaviors including changes in dietary habits, increased intake of calories, and decreased physical activity[29] which in turn could eventually lead to metabolic syndrome and gallstone formation.[10]

Menstrual history and obstetric history

The majority of the cases had a mean age of menarche at 13.18 ± 1.18 years, used hormonal contraception, and had three pregnancies; most of them had full-term pregnancies in comparison with that of controls. The mean age of menarche in the control group was 12.12 ± 1.58 years. The majority of the participants, both cases and controls, had a regular menstrual cycle. Ryu *et al*. conducted a study on 83,275 Korean women, and reported that early menarche was associated with an increasing prevalence of gallstone disease in a large sample of middle-aged women.[30] The disparity in their findings with ours could be because of the demography, and sample size, as theirs had a larger sample size. In contrast, a study was done by Chen *et al*. in Taiwanese vegetarian females reported that the age of menarche is not associated with gallstones.[31] The more the number of pregnancies, especially in an Indian scenario, increases the risk of developing cholelithiasis. During pregnancy, bile becomes lithogenic due to a remarkable increase in estrogen levels and progesterone levels. Our study is in agreement with Gaharwar study who found that females on Oral Contraceptive pills (OCP) are more prone to cholelithiasis, as estrogens and progesterone present in hormonal pills cause bile to become more lithogenic.[2] Estrogen acts by increasing ERα and ERβ in hepatocytes and 3-hydroxy-3-methylglutaryl coenzyme A reductase, thereby resulting in hepatic cholesterol hypersecretion and biliary lithogenicity. Progesterone, a potent inhibitor of hepatic acyl-coenzyme A: cholesterol acyltransferase, allows more free cholesterol to enter an intrahepatic pool for biliary secretion. Progesterone also leads to impair gallbladder motility function, with the resulting increase in fasting gallbladder volume and bile stasis. Increasing parity is also a risk factor for gallstones, especially in younger women.[32]

Cardiometabolic parameters and metabolic syndrome

Anthropometric parameters

The mean BMI of the cases in our study was 25.48 ± 5.3 Kg/m^2, which was higher than controls, but it was not significant when compared to that of controls. Although obesity based on increased BMI is a known risk factor for cholelithiasis, Kharga *et al*. claimed that in addition to the overweight and obese patients, even individuals with normal BMI develop symptomatic cholelithiasis.[33] We did not find any significant difference in the W/H ratio between cases and controls, but Bhandari *et al*. reported an increase in the W/H ratio in cases in comparison to the controls.[34] This could be because we had studied only females whereas Bhandari *et al*. had studied both genders which could have led to a difference between the reports.

There was a significant difference only in the WHtR between cases and controls, with a mean waist–height ratio of cases being 0.73 ± 0.5. The WHtR is an indicator of abdominal obesity. If the WHtR is 0.6 or more, then it is time to take appropriate action for the reduction of abdominal obesity. Furthermore, the literature says waist–height ratio can be used to assess risk for adults for obesity, and improve the efficiency for screening for cardiometabolic risk.[18]

Blood pressure and blood test parameters

We found a significant increase in SBP in cases in comparison with controls. Sachdeva *et al*. in their work found out an increase in SBP and DBP in gallstone disease in cholelithiasis cases when compared to controls.[27] Stress leads to hypertension, and as our cases had a higher stress score than the controls, it could be one of the reasons for high SBP. In accordance with the study conducted by Bhandari *et al*., the cases in our study had a significant increase in FBS, TC, triglycerides, LDL, and VLDL compared to controls.[34] A study by Mohebbi *et al*. has reported that the transtheoretical model (TTM) developed from psychotherapy for health education among hypertensive women can significantly improve a woman's perception toward health care.[35] A meta-analysis by Mohebbi *et al.* showcased the importance of health education and promotion-based interventions as an effective intervention in patients.[36] This again emphasizes the need to identify the risk factors like hypertension and educate women regarding the risk factors to decrease the burden of cholelithiasis on the population. In future, research on the effectiveness of TTM on cholelithiasis patients can be explored.

Metabolic syndrome

Metabolic syndrome is a co-traveler with cholelithiasis. Metabolic syndrome was seen in 22.7% of cases in our study. In our study, females with cholelithiasis were at 14.4 times more risk of developing metabolic syndrome than controls. Peswani *et al*. in their study reported that 36% of cholelithiasis cases had metabolic syndrome using the National Cholesterol Education Program's Adult Treatment Panel III definition, but their study cases had a mean age of 56.18 years; in contrast, our study cases were young female patients with a mean age of 35.59 ± 8.348 years.[37] Chen *et al*. reported that gallstone disease appears to be strongly associated with metabolic syndrome, and the more the components of metabolic syndrome, the higher the prevalence of gallstone disease.[38]

Our study showed an alarming increase in the occurrence of metabolic syndrome in younger females with cholelithiasis, especially in their most productive stage of life. It would be ideal to remember that metabolic syndrome is also an established risk factor for CAD,[39] and hence, it becomes imperative that all patients with cholelithiasis be investigated further for metabolic syndrome to assess their risk of developing CAD in future.

Education is looked upon as a pillar of health care. Health education on a healthy lifestyle not only increases awareness and perception of empowerment in women but also helps in expanding her knowledge on the preventive measures of diseases.[35,40] By incorporating and implementing appropriate lifestyle modifications, it is possible to decrease or prevent the onset of cholelithiasis in young females, thus reducing the disease burden on the individual in particular and the world in general.

Limitation and recommendations

The results of our study merit further evaluation with larger sample size and quantification of stress and its role in the pathogenesis of cholelithiasis using relevant biochemical assays. This forms the future scope of our study.

Conclusion

We conclude that married, rural, less literate Indian women leading a sedentary lifestyle, consuming more red meat, and soft drinks are more prone to develop cholelithiasis. These women have increased psychosomatic stress, which could be due to their low socioeconomic status, an increased number of pregnancies, making them more prone to cholelithiasis. This shift of increased prevalence of cholelithiasis from urban to rural could be because of drastic urbanization of rural population leading to decreased physical activity ultimately resulting in a sedentary lifestyle. Age of menarche and regularity of the menstrual cycle did not influence, but hormonal contraceptive usage increased the occurrence of cholelithiasis. They were obese as observed by their increased WHtR, an indicator of abdominal obesity. The occurrence of metabolic syndrome in young females with cholelithiasis is more than that of controls. The need for the hour is health education, to implement simple lifestyle changes, thereby decreasing the incidence of cholelithiasis in young females, which could eventually decrease the development of metabolic syndrome and CAD in them in future.

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Conflicts of interest

There are no conflicts of interest.

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