Case Study

The Prevalence of Gallstones and Cholecystitis among Obese Individuals in Saudi Arabia: A Cross-Sectional Study

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Abstract

Both obesity and gallbladder diseases are major health issues that are continuously growing, especially in the developed world. Among the heterogeneous set of causes of gallbladder disease is the formation of gallstones. The aim of this study is to determine the prevalence of cholelithiasis and cholecystitis among obese individuals in Saudi Arabia. This study is an observational study conducted using a self-administered questionnaire. The statistics show that 20.2% of the respondents have been diagnosed with obesity, while 7.0% have been diagnosed with gallstones and 5.2% with cholecystitis. The eating habits of respondents were also surveyed, with 7.6% reporting healthy and balanced eating habits, while 41% reported mostly healthy eating habits with occasional indulgences. 43.9% of respondents reported mostly unhealthy eating habits with occasional healthy options, while 7.5% reported unhealthy and unbalanced eating habits. In terms of exercise habits, 31.9% of respondents reported exercising rarely (less than once a week), while 26.4% reported exercising sometimes (1-2 times a week). 17.5% reported exercising regularly (3-5 times a week), while 6.5% reported exercising daily (more than 5 times a week). Finally, 17.8% of respondents reported never exercising. Age had a statistically significant difference in the prevalence of gallstones and cholecystitis among obese individuals. Also, annual income was found to have a significant association. In conclusion, the prevalence of gallstones and cholecystitis among obese individuals in Saudi Arabia is a significant healthcare concern, as there is a significant correlation between being obese and suffering from gallstones and/or cholecystitis.

Keywords: Gallstones, Cholecystitis, Cholelithiasis, Prevalence, Cholesterol, Obesity

Introduction

Acute cholecystitis is inflammation of the gallbladder that is most likely secondary to the occlusion of the cystic duct, usually by a gallstone (calculous) or less likely by a gallstone (acalculous), but rather by impaired emptying of the gallbladder, thenceforth causing gallbladder distension and ensuing chemical or bacterial inflammation [1-3]. According to the updated guidelines of the World Society of Emergency Surgery, a patient with a "fever, right upper quadrant pain or tenderness, vomiting or food intolerance" and whose physical examination has yielded a positive Murphy's sign should be considered for further workup on the suggestive diagnosis of acute calculous cholecystitis [4]. Additional indicators of acute cholecystitis include the 'unremitting' nature of the right upper quadrant pain, anorexia, and nausea [3], taking into account the lack of specific diagnostic tools adequate enough to diagnose or exclude acute cholecystitis [4].

Regardless of gender, the incidence of gallstone disease has been found to increase with age [5]. A set of risk factors, however — collectively known as "the four F's: female, fat, forty and fertile" — have been identified. A recent systematic review elaborated on the topic further, concluding that a genetic predisposition, old age, being female, pregnancy, taking hormone replacement therapy (HRT) after menopause, consuming a high-caloric diet that is rich in easily digestible carbohydrates but low in fiber, as well as obesity are among

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the major risk factors associated with the development of cholelithiasis [6]. Obesity, especially abdominal obesity, increases the risk of not only cholelithiasis but also of requiring cholecystectomy to surgically remove the gallbladder due to the increased incidence of symptomatic cholelithiasis among obese individuals [7]. Despite that, the definitive, all-inclusive specific risk factors for the development of cholelithiasis in certain individuals, but not in others, remain ambiguous and difficult to define [8].

In Saudi Arabia, the prevalence of cholelithiasis is about 8.6% [5], reflecting the fact that cholelithiasis is among the most common diseases that affect the gastrointestinal system. Nevertheless, about 75% of patients with gallstones are usually initially asymptomatic [9], highlighting a possible underdiagnosis of the condition. Causing concern, however, is mostly the complications of cholecystitis. Among the possibly fatal complications of acute cholecystitis are necrosis of the bladder wall (gangrenous cholecystitis), perforation or a fistula secondary to wall ischemia and infection, and a potential pericholecystic abscess [3].

A variety of stone types are involved in the pathophysiology of cholelithiasis: cholesterol stones, pigment stones, and mixed stones — cholesterol stones comprising the vast majority of cases of cholelithiasis [10]. Consistent with previous studies pertaining to the involvement of dysregulation of cholesterol metabolism in the pathophysiology of cholelithiasis, it has been recently found that in both — males and females — the majority of cholecystitis cases have concomitant dyslipidemic issues, including high levels of cholesterol, triglycerides, low-density lipoprotein (LDL), and low levels of high-density lipoprotein (HDL) [11], a finding common among obese individuals [12]. With regards to the involvement of cholesterol in cholelithiasis, among the defects implicated are the supersaturation of cholesterol in the gallbladder bile and rapid precipitation of cholesterol crystals in the bile [13]. Additionally, inflammatory processes have been found to be associated with the predisposition to cholelithiasis [14]. Considering the aforementioned, it is not surprising that obesity is one of the recognized major risk factors for the development of cholelithiasis [1].

In hopes of elucidating any further correlations between the pathophysiology of obesity and that of cholecystitis and defining any specific risk factors that contribute to the pathogenesis of cholecystitis in certain obese populations, among others, this study aims at comparing the prevalence of gallstone disease among the obese and non-obese population in Saudi Arabia and assessing any relevant factors that may explain any prevalence variation between the obese and non-obese populations. The main purpose of this study is to determine the prevalence of gallstones and cholecystitis among the obese population in Saudi Arabia. An additional objective of this research is to identify whether gallstones and cholecystitis are more frequent among obese or non-obese populations.

Materials and Methods

Study Design

The present observational cross-sectional study was conducted among obese patients to assess the prevalence rate of gallstones and cholecystitis in the Kingdom of Saudi Arabia (KSA).

Study Setting: Participants, Recruitment, and Sampling Procedure

The study comprised cholecystitis patients who visited the hospital between September 2023 and September 2024, with samples categorized by gender and obesity status.

Inclusion and Exclusion criteria

This study will include all obese people from the Saudi population aged 18 years old or above and diagnosed with gallstones or cholecystitis. Obese people under 18 years old and non-Saudi people were excluded from the study.

Sample Size

The sample size was calculated by Raosoft with a confidence level of 95% and a 5% margin of error; the minimum sample size was 323

Method for Data Collection and Instrument (Data Collection Technique and Tools)

A structured, self-administered, anonymously-answered questionnaire has been constructed and used as a data collection tool for our study. The questions of the questionnaire have been developed and combined upon searching the literature for studies relevant to the subject of our study, whose objectives are similar to ours and whose methodology is analogous to that of our study. The questionnaire is available in both Arabic and English to facilitate better communication with a larger number of people. It consists of six sections, namely: introduction (inclusive of consent and statement of confidentiality), sociodemographic data, medical history, lifestyle and dietary habits, symptoms and medical consultation, and a closing statement, all of within which 26 questions the subjects are asked to answer, anonymously. The questions take into regard the different elements that may help in finding a correlation between the prevalence of cholecystitis and obesity in Saudi Arabia.

Analyzes and Entry Method

Data was entered on the computer using the Windows program "Microsoft Office Excel Software" (2016). The data was then uploaded to the Statistical Package for Social Science Software (SPSS) version 20 software (IBM SPSS Statistics for Windows, Version 20.0. Armonk, NY: IBM Corp.) for statistical analysis.
The data that was collected was inputted into a computer

using Microsoft Excel (2016) for the Windows program. The information was then entered into the Statistical Package for Social-Science Software (SPSS) version 20 program to be analyzed.

Results and Discussion

Table 1 revealed that in terms of age, the majority of participants, 58.2%, fell within the 20-30 age range, followed by 15.2% in the 31-40 age range. It is interesting to note that there were only 7 participants, 1.0%, who were over 60 years old. Gender-wise, the majority of participants were female, accounting for 63.8% of the total, while males made up 36.2%. In regards to nationality, the data shows that the majority of participants, 90.2%, were Saudi, with only 9.8% being non-Saudi. The distribution of participants based on location reveals that the majority were from the East 48.8%, followed by the West 32.4%. When it comes to education level, the majority of participants, 72.0%, had a university education, while 22.8% had completed intermediate or high school. In terms of occupation, the data shows that a significant portion of the participants were students, 50.5%, followed by government employees, 15.5%, and private sector employees, 12.5%. The BMI distribution reveals that the majority of participants had a normal BMI of 50.1%, while 25.0% were overweight and 19.4% were obese. Finally, the marital status of the participants shows that the majority were single, 58.2%, followed by married individuals 39.0%.

Table 1. Sociodemographic characteristics of participants (n=697)

Parameter		No.	Percent
Age	less than 20	61	8.8
	20_30	406	58.2
	31_40	106	15.2
	41_50	87	12.5
	51_60	30	4.3
	more than 60	7	1.0
Gender	Male	252	36.2
	Female	445	63.8
Nationality	Saudi	629	90.2
	Non-Saudi	68	9.8
Location	East	340	48.8
	Middle	78	11.2
	North	28	4.0
	South	25	3.6
	West	226	32.4
Education Level	Illiterate	1	.1
	primary education	2	.3
	Intermediate or high school	159	22.8
	University	502	72.0
	Postgraduate	33	4.7
Occupation	Government employee	108	15.5
	Private sector employee	87	12.5
	not working	104	14.9
	student	352	50.5
	Retired	19	2.7
	Other	27	3.9
BMI	underweight	39	5.6
	normal	349	50.1
	overweight	174	25.0
	obese	135	19.4
Marital Status	Married	272	39.0
	Single	406	58.2
	Divorced	14	2.0
	Widowed	5	.7

Table 2 revealed that a significant number of individuals have been diagnosed with obesity, gallstones, and cholecystitis. The statistics show that 20.2% of the respondents have been diagnosed with obesity, while 7.0% have been diagnosed with gallstones and 5.2% with cholecystitis. Furthermore, the data also indicates that a portion of the respondents have undergone treatment or surgery related to gallstones or cholecystitis, with 6.6% reporting such interventions. In addition, a significant number of respondents, 17.1%, reported using medications.

Table 2. Participants' medical history (n=697)

	Yes	No
Have you ever been diagnosed with obesity?	141 20.2%	556 79.8%
Have you ever been diagnosed with gallstones?	49 7.0%	648 93.0%
Have you ever been diagnosed with cholecystitis?	36 5.2%	661 94.8%
Have you undergone any treatment or surgery related to gallstones or cholecystitis?	46 6.6%	651 93.4%
Do you use any medications?	119 17.1%	578 82.9%

Table 3 provides insight into various health-related behaviors and conditions among the surveyed population. The first section asks about smoking habits, with 87.4% of respondents identifying as non-smokers, while 10.5% are smokers and 2.2% are ex-smokers. The next section shows that the most commonly reported chronic disease is hypertension, with 28.6% of respondents reporting this condition. Diabetes and high blood fats were also reported by a significant percentage of respondents, at 16.5% and 13.9%, respectively. Chronic heart disease, chronic liver disease, and chronic kidney disease were reported by 5.6%, 4.1%, and 2.5% of respondents, respectively. The following section asks about a family history of gallstones or cholecystitis, with 26.3% of respondents reporting one family member or relative with this

history, while 9.6% and 16.2% reported two or more family members or relatives, respectively. 47.9% of respondents reported no family history of these conditions. The eating habits of respondents were also surveyed, with 7.6% reporting healthy and balanced eating habits, while 41% reported mostly healthy eating habits with occasional indulgences. 43.9% of respondents reported mostly unhealthy eating habits with occasional healthy options, while 7.5% reported unhealthy and unbalanced eating habits. The frequency of fatty or fried food consumption was also asked, with 40.5% of respondents reporting consuming these foods several times a week, while 17.4% reported consuming them once a day. 15.1% reported consuming these foods once a week, while 13.9% reported consuming them rarely or sometimes. Only 0.4% reported never consuming fatty or fried foods. The consumption of vegetables and fruit was also surveyed, with 43.3% of respondents reporting eating vegetables every day, while 56.7% reported not eating vegetables every day. Similarly, 35% of respondents reported eating fruit every day, while 65% reported not eating fruit every day. The frequency of fish consumption was also surveyed, with 50.4% of respondents reporting consuming fish rarely (less than once a week), while 36.6% reported consuming it sometimes (1-2 times a week). Only 0.1% reported consuming fish daily (more than 5 times a week). In terms of exercise habits, 31.9% of respondents reported exercising rarely (less than once a week), while 26.4% reported exercising sometimes (1-2 times a week). 17.5% reported exercising regularly (3-5 times a week), while 6.5% reported exercising daily (more than 5 times a week). Finally, 17.8% of respondents reported never exercising. The final section asks about anxiety symptoms, with 47.2% of respondents reporting experiencing anxiety scarcely, while 24.4% reported experiencing it regularly. 15.9% reported experiencing anxiety daily, while 12.5% reported never experiencing anxiety. Lastly, respondents were asked whether they sought medical attention for their symptoms, with 28.8% reporting that they did seek medical attention, while 71.2% did not. This data can be useful for healthcare professionals and policymakers in identifying potential health risks and developing targeted interventions to improve overall health outcomes.

Table 3. Participants' lifestyle and dietary habits (n=697)

Parameter		No.	Percent
Smoking status	Smoker	73	10.5
	Ex-smoker	15	2.2
	Non-smoker	609	87.4
Do you have any of these diseases? (You can choose more than one option)	Hypertension	24	3.4
	Diabetes	20	2.9
	High blood fats	27	3.9
	Anemia	99	14.2
	Thyroid diseases	24	3.4
	Chronic heart disease	8	1.1
	I don't have a chronic disease	513	73.6
	Other	47	6.7
How many family members or relatives have a history of gallstones or cholecystitis?	1	183	26.3
	2	67	9.6
	More than 2	113	16.2
	Nothing	334	47.9
How do you describe your eating habits?	Healthy and balanced	53	7.6
	Mostly healthy, but with occasional indulgence	286	41.0
	Mostly unhealthy, with occasional healthy options	306	43.9
	Unhealthy and unbalanced	52	7.5
How often do you eat fatty or fried foods?	Once a day	121	17.4
	Several times a day	89	12.8
	once a week	105	15.1
	Several times a week	282	40.5
	Rarely or sometimes	97	13.9
	Never	3	.4
Do you eat vegetables every day?	Once a day	121	17.4
	Yes	302	43.3
	No	395	56.7
Do you eat fruit every day?	Yes	244	35.0
	No	453	65.0
How often do you eat fish?	Daily (more than 5 times a week)	1	.1
	Regularly (3-5 times a week)	32	4.6
	Sometimes (1-2 times a week)	255	36.6
	Rarely (less than once a week)	351	50.4
	Never	58	8.3
How often do you exercise?	Daily (more than 5 times a week)	45	6.5
	Regularly (3-5 times a week)	122	17.5
	Sometimes (1-2 times a week)	184	26.4
	Rarely (less than once a week)	222	31.9
	Never	124	17.8
	RUQ pain	697	12.1

Did you have any of the following symptoms? (You can choose more than one option)	Nausea	149	21.4
	Vomiting	60	8.6
	Bloating	135	19.4
	Fever	38	5.5
	Palpitation	126	18.1
	Other	13	1.9
	Colored feces	33	4.7
	Diarrhea	78	11.2
	Constipation	129	18.5
	Shortness of breath	86	12.3
	Itchiness	59	8.5
	No symptoms	348	49.9
Did you seek medical attention for your symptoms?	Yes	201	28.8
	No	496	71.2

As illustrated in **Figure 1**, 47% of participants Scarcely suffer from anxiety, and 13% never suffer from anxiety.

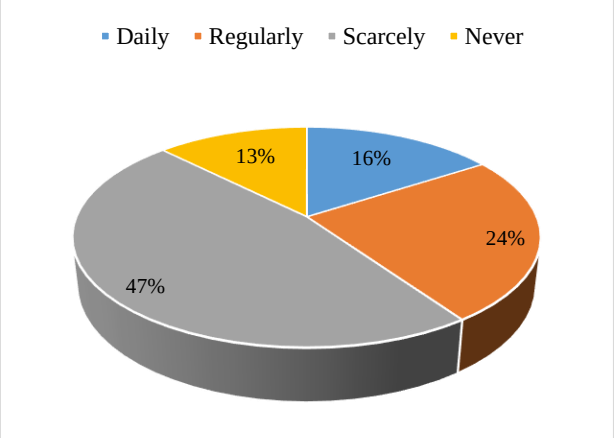

Figure 1. Participants' anxiety (n=697)

Table 4 In terms of age, the highest percentage of cholecystitis diagnosis was found in the 20-30 age group, with 2.7% of the total participants in that age range having been diagnosed with the condition with a p-value of 0.843. Marital status did not show a significant difference in cholecystitis diagnosis, with similar percentages across single, married, divorced, and widowed individuals with a p-value of 0.486. When looking at gender, the data showed that 2.9% of female participants had been diagnosed with cholecystitis, compared to 2.3% of male participants, with a p-value of 0.288. The location of participants also showed some variation, with the highest percentage of diagnosis in the West region at 2.4% and the lowest in the North and South regions at 0.1%, both with p-values of 0.373. Occupation did not show a significant difference in diagnosis rates, with a p-value of 0.646. BMI and the presence of obesity did show a correlation with cholecystitis diagnosis, with higher percentages in the overweight and obese categories with a p-value of 0.001.

Table 4. Association between sociodemographic and prevalence of gallstones and cholecystitis among obese individuals in Saudi Arabia

		Have you ever been diagnosed with cholecystitis?		Total (N=697)	P value
		Yes	No		
Age	less than 20	3 0.4%	58 8.3%	61 8.8%	0.834
	20_30	19 2.7%	387 55.5%	406 58.2%	
	31_40	5 0.7%	101 14.5%	106 15.2%	
	41_50	6 0.9%	81 11.6%	87 12.5%	
	51_60	2 0.3%	28 4.0%	30 4.3%	
	more than 60	1 0.1%	6 0.9%	7 1.0%	
marital status	Single	21 3.0%	385 55.2%	406 58.2%	0.486
	Married	13 1.9%	259 37.2%	272 39.0%	
	Divorced	1 0.1%	13 1.9%	14 2.0%	
	widow	1 0.1%	4 0.6%	5 0.7%	
Gender	Male	16 2.3%	236 33.9%	252 36.2%	0.288
	Female	20 2.9%	425 61.0%	445 63.8%	
Nationality	Saudi	35 5.0%	594 85.2%	629 90.2%	0.147
	Non-Saudi	1 0.1%	67 9.6%	68 9.8%	
Location	East	15 2.2%	325 46.6%	340 48.8%	0.373
	Middle	2 0.3%	76 10.9%	78 11.2%	
	North	1 0.1%	27 3.9%	28 4.0%	

	South	1	24	25	
		0.1%	3.4%	3.6%	
	West	17	209	226	
		2.4%	30.0%	32.4%	
	Illiterate	0	1	1	
		0.0%	0.1%	0.1%	
	Primary	0	2	2	
		0.0%	0.3%	0.3%	
Education Level	Preparatory	14	145	159	0.203
		2.0%	20.8%	22.8%	
	University	20	482	502	
		2.9%	69.2%	72.0%	
	Postgraduate	2	31	33	
		0.3%	4.4%	4.7%	
	Governmental employee	6	102	108	
		0.9%	14.6%	15.5%	
	Private sector employee	5	82	87	
		0.7%	11.8%	12.5%	
Occupation	Don't work	8	96	104	0.646
		1.1%	13.8%	14.9%	
	Retired	0	19	19	
		0.0%	2.7%	2.7%	
	Student	15	337	352	
		2.2%	48.4%	50.5%	
	Other	2	25	27	
		0.3%	3.6%	3.9%	
	underweight	0	39	39	
		0.0%	5.6%	5.6%	
	normal	10	339	349	
BMI		1.4%	48.6%	50.1%	0.001
	overweight	11	163	174	
		1.6%	23.4%	25.0%	
	obese	15	120	135	
		2.2%	17.2%	19.4%	
Have you ever were diagnosed with obesity?	Yes	11	130	141	
		1.6%	18.7%	20.2%	0.113
	No	25	531	556	
		3.6%	76.2%	79.8%	

Gallstones and cholecystitis are common health issues that are often associated with obesity. In Saudi Arabia, the prevalence of obesity has been on the rise in recent years, and it is important to understand the relationship between obesity and these conditions in order to address the healthcare needs of the population. Gallstones are solid particles that form in the gallbladder, while cholecystitis is the inflammation of the gallbladder. Both conditions can cause significant discomfort and can lead to more serious complications if left untreated. The risk factors for developing gallstones and cholecystitis include obesity, rapid weight loss, and a high-fat diet, among others [1, 3]. In Saudi Arabia, the prevalence of obesity is high, with a significant portion of the population being overweight or obese. This is often attributed to changes in lifestyle and dietary habits, as well as a lack of physical activity. As a result, the incidence of gallstones and cholecystitis among obese individuals is also expected to be high [5].

In the broader populace, factors such as advanced age, obesity, physical activity, dietary habits, female sex, and parity have been identified as variables that elevate the probability of acquiring gallstones [15]. Our study showed that gallstones and cholecystitis are more prevalent in obese individuals than normal-weight individuals. Consistent with the findings of the research indicated that a significant proportion of individuals diagnosed with gallstones, namely 67.4%, exhibited obesity [5]. One study conducted in Saudi Arabia found that the prevalence of gallstones among obese individuals was significantly higher compared to non-obese individuals. The study also found that the risk of developing gallstones increased with higher levels of obesity. Similarly, the prevalence of cholecystitis was also found to be higher among obese individuals [16]. In a separate investigation, the prevalence of gallstone formation was shown to be somewhat elevated among those who exhibited a BMI over 25 kg/m² after surgical intervention, in contrast to those who achieved a BMI within the normal range [17]. According to the findings of Grover and Kothari, there was a notable increase in the occurrence of postoperative cholelithiasis among individuals with a BMI equal to or more than 40 kg/m² [18]. Our study showed no significant association between gender and prevalence of gallstones and cholecystitis. On the contrary, some studies found that there is a significant association. The results of a study indicate a greater prevalence of gallstones in the female population [17]. Another study also indicates a higher prevalence of cholelithiasis among females compared to men, with a female-to-male ratio of 1.6:1 [19]. Other prior research has also shown similar findings, indicating a notable incidence of the condition in females. This observation may be attributed to the influence of the estrogen hormone, which potentially increases cholesterol saturation in the bile, thereby promoting gallstone development [20-22].

Furthermore, there exists a correlation between physical inactivity as well as obesity and an increased occurrence of gallstone disease. Recent research has shown a substantial correlation between physical inactivity and increased susceptibility to the prevalence and risk factors linked with gallstones [23]. The current findings are consistent with previous research on gallstones. Numerous studies have

shown a positive correlation between regular physical exercise and a reduced likelihood of developing gallstones [24, 25].

Our study showed a significant association between BMI and being diagnosed with cholecystitis, as overweight and obese participants showed higher levels of getting cholecystitis than normal-weight participants. A Population-Based Study in Southeast Iran also showed similar results, as 4.4% of obese participants were diagnosed with a gallstone compared to 2.2% of normal-weight participants [23]. Similarly, in a prospective cohort study conducted by Liu *et al*., the researchers investigated several methods of assessing obesity levels within a Chinese population. The study aimed to determine which ways of measuring obesity exhibited a significant association with an elevated risk of developing gallstone disease. A total of 88,947 individuals without a previous medical record of gallstones were subjected to an evaluation, during which their BMI, waist circumference, and abdominal perimeter were measured. Various combinations were constructed between the anthropometric data collected, and an evaluation was conducted to see which of the numerous models provides the most accurate prediction of illness progression. Following the correction for potential confounding factors, it was shown that there exists an association between the rise in BMI, waist circumference, and abdominal perimeter and an elevated risk of gallstone development in both genders. However, it is important to note that distinct prediction models were used for each group [26]. It is important to address the healthcare needs of obese individuals in Saudi Arabia in order to prevent and manage gallstones and cholecystitis. This may involve promoting healthy lifestyle choices, such as regular exercise and a balanced diet, as well as providing access to medical care for those who are at risk or have already developed these conditions. Additionally, healthcare providers should be aware of the increased risk of gallstones and cholecystitis among obese patients and should take this into consideration when assessing and treating these individuals. This may involve weight management strategies, as well as monitoring for early signs and symptoms of gallbladder-related issues [5, 11].

In the process of analyzing the results, it is crucial to take into account the limitations inherent in the present investigation. The sample size of the research was rather small. In addition, it should be noted that the research lacked a control group consisting of individuals who were not obese and a study group of obese individuals. This absence of a control group poses challenges in terms of drawing broader conclusions about the whole population.

Conclusion

In conclusion, the prevalence of gallstones and cholecystitis among obese individuals in Saudi Arabia is a significant healthcare concern. It is important for healthcare providers and policymakers to address this issue by promoting healthy lifestyle choices and providing access to appropriate medical care for those at risk or affected by these conditions. By addressing the relationship between obesity and gallbladder-related issues, the overall health and well-being of the population can be improved.

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ETHICS STATEMENT: Ethical approval was obtained from the research ethics committee of the University of Tabuk Research Ethics Committee with Application number [UT-319-165-2023]. Informed consent was obtained from each participant after the study was explained in full and clarification that participation was voluntary. Data collected were securely saved and used for research purposes only. Written informed consent was obtained from all individual participants included in the study.

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