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Research Article

Assessment of prevailing determinants of cholelithiasis in adults of Faisalabad

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ABSTRACT

Gallstone disease or cholelithiasis is a prevalent pathology of the digestive tract. Gallstones (GS) are hard, stone-like fragments of cholesterol, bile, and bilirubin formed in the gallbladder. A patient's age, sex, body mass index, diet, and other fundamental physical and lifestyle characteristics are closely linked to cholelithiasis. Cholecystectomy is the primary treatment but can lower the quality of life. The study aimed to assess the predominant factors, particularly dietary and lifestyle choices, contributing to the escalation of GS cases in a specific region. It was a survey-based cross-sectional study conducted by developing a standardized questionnaire. Data from 150-200 patients were collected from the surgical and gastroenterology wards of hospitals. Each patient's lipid level information, dietary preferences, lifestyle choices, and medical background were noted. The study results indicated that high BMI, family history of GS, diabetes, fatty liver, excess intake of roti, excess fat intake, excessive consumption of packaged food, excessive tea consumption, high cholesterol levels, lack of physical activity, low fiber intake, multiple pregnancies, and the use of estrogen-based drugs were significant contributing factors to the prevalence of GSin Faisalabad. Based on these results, it is recommended to maintain a healthy weight, increase fiber intake, reduce fat and packaged food consumption, engage in regular physical activity, and carefully manage the use of hormonal medications to prevent GS. Additionally, women with multiple pregnancies should be monitored closely for GS risk.

Keywords: Cholelithiasis, gallstone disease, adults, prevalence.

INTRODUCTION

Gallstone disease (GSD) is a hepato-biliary disorder, clinically known as cholelithiasis. Gallstones (GS) are rock-like deposits formed in the gallbladder due to bile, bilirubin, and cholesterol accumulation. GS can be classified into three main types based on their chemical composition: cholesterol stones, comprising crystalline cholesterol monohydrate; pigment stones, consisting of bilirubin calcium salts; and mixed stones, which are a combination of both types (Cariati et al., 2017). Globally, 6% of the population has GS, with women developing biliary calculi four times more. frequently than men (Wang et al., 2024). Among all digestive, liver, and pancreatic diseases, GSD has become the second most common primary diagnosis in the United States, with a prevalence of roughly 20% in wealthy countries., and the incidence of GS continues to increase, in European countries, and some Middle East countries like Saudi Arabia. With some estimates indicating a prevalence of 10-15%, cholelithiasis is also on the rise and becoming a serious health issue in Pakistan. (Khatti *et al*., 2023).

The clinical presentation of a patient with cholelithiasis can range from completely asymptomatic to classical biliary colic symptoms or atypical cholecystitis symptoms of nausea, dyspepsia, and fever. Around 80% of GS patients are asymptomatic, and only 1%–4% of them have the potential to develop serious complications (AGUIAR et al., 2022). Two types of risk factors can affect GS formation: non-modifiable and modifiable. The factors that can't be changed are advancing age, female gender, family history, and ethnicity, while high calorie or high carbohydrate, high cholesterol intake, low fiber diet, reduced physical activity, pregnancy, metabolic syndrome, fast weight loss, total parenteral nutrition, hepatic diseases, bariatric surgery and drugs are modifiable (Baddam et al., 2023).

Cholecystectomy is the only treatment option, but it comes with complications that can pose a danger to a patient's well-being and quality of life (Sun *et al*., 2022). Cholecystectomy is one of the most common operations performed globally.

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GS and cholecystectomy have a detrimental effect on digestive health because, in addition to its traditional functions in the digestion and absorption of fatty nutrients, there is mounting evidence that the gallbladder plays physiological roles in glucose, fat, and energy homeostasis. Therefore, understanding the gallbladder's metabolic functions is crucial for effectively managing and preventing the metabolic consequences associated with obesity (Shi et al., 2020).

To investigate the impact of age on GS a study was conducted at Sheikh Khalifa Bin Zaid Hospital to evaluate the relationship between age and GS as a risk factor in the local population. The study involved 100 patients, 14 men and 86 women, with a mean age of 46.2 years. The most common pigment stones were found in 44 patients, while the highest incidence of GS was found in the age groups 41-50 and 31-40. The results suggest that age significantly influences the occurrence of GSD (Rahman et al., 2022).

The diet quality influences the formation as well as inhibition of GS. Unhealthy dietary choices such as eating refined sugar raise the production of insulin, hepatic cholesterol synthesis, bile cholesterol saturation, and gallbladder motility, all of which are linked to the formation of GS (Rahmani et al., 2020). High carbohydrate or high calorie diets are common in developing nations, and a recent study found that overnutrition causes obesity and stone development by increasing cholesterol release. A high-fiber diet, on the other hand, speeds up intestinal transit and lowers bile acid buildup and cholesterol saturation (Tehrani et al., 2023). In one research, comparing dietary components, physical activity, body composition, and serum lipids in women with and without GSD in West Mexico found that women with GS had higher body fat percentage, an elevated dietary omega-6: omega-3 (ω-6: ω-3) polyunsaturated fatty acids (PUFA) ratio, and higher simple carbohydrates (sCH) intake. They also had lower high-density lipoprotein (HDL) cholesterol levels (Campos-Perez et al., 2022).

Among the gallbladder stones the most prevalent are cholesterol stones. The presence of elevated plasma cholesterol, low levels of HDL, and elevated levels of LDL lead to a significant rise in cholesterol excretion with bile and the development of cholesterol GS (Zeng et al., 2021). Environmental factors like exposure to toxic metals can raise the GS rate as polluted particles can either be cleared through the release of bile or build up in the gallbladder as stones (Nie et al., 2023). The rising number of GS has sparked concerns about it. Indigestion of fats, deficiency of fat-soluble vitamins, and pancreatitis are serious health problems that arise from GS. Reducing the incidence of GS requires identifying the main risk factors. In light of this, the present study aims to assess the relationship between dietary and lifestyle choices, and the incidence of GS and determine the potential contributing factors of cholelithiasis within the specified region.

MATERIALS AND METHODS

Study Design: In this research, a cross-sectional study design was employed, which falls under observational study methods. A cross-sectional survey study involves collecting data from a sample of individuals at a single point at a time. This method provides a snapshot of the population being studied, offering insights into the prevalence of certain characteristics, behaviors, or outcomes at that particular moment.

The survey investigated the prevailing determinants of cholelithiasis mainly the dietary and lifestyle factors. A survey-based cross-section study was carried out from February-July 2024. Data was collected through two methods, the first one physically in surgical and gastroenterology wards of different hospitals in the Faisalabad district, and the second one was online through on-call or using Google E-Questionnaire. Before the start of the study, a permission letter was granted from the ethical committee of the National Institute of Food Science and Technology, University of Agriculture Faisalabad, Pakistan. The only participants in this study were patients with GS disease. For this, a standardized qualitative survey was performed. After explaining the study's purpose, written well-informed consent was obtained from participants before the interview. The average interview lasted about 4-5 minutes. The patient's comfort and feasibility were considered. The survey was conducted between the working days from Monday to Friday.

Study setting : The study was carried out in Faisalabad. The inclusion and exclusion criteria were established. The specification of inclusion and exclusion criteria was done to obtain a sample ideal for the intended study.

The inclusion and exclusion criteria mainly included the following.

(a) Inclusion Criteria: Individuals aged more than 20 years, having undergone cholecystectomy or with GS on ultrasonography were included.

(b) Exclusion criteria: The research did not involve participants below the age of twenty.

Data Collection: The data was collected from patients who have to undergo or have undergone cholecystectomy by using the self-structured customized questionnaire. A standardized structured questionnaire was designed to analyze the health status, dietary habits, lifestyle choices, and environmental factors influencing the occurrence of GS. The questionnaire was divided into seven sections for gathering patients' information regarding general demographic data, anthropometric measurements, medical history, dietary intake practices, lifestyle and environmental factors, psychological and socioeconomic status, pregnancy and hormones. Data collection was done by using a questionnaire and Google E-questionnaire. Participants filled out forms by using links through social media channels like WhatsApp and class groups and also filled out physically by visiting the surgical

and gastroenterology wards of different hospitals. Due to the low cost and quick response times, online web-based survey was utilized.

Questionnaire: A comprehensive study questionnaire was created by compiling information from various previous studies. The questions were designed to be simple and general to ensure that participants felt comfortable while answering them. Additionally, the assessment questionnaire was prepared in both English and Urdu languages to facilitate better understanding among the participants. The data obtained from this questionnaire was used to estimate the dominant contributing factors of GS. The acronym for the questionnaire was AQ (Assessment Questionnaire).

Contact information: The questions about the address or name of the participants featured in it, which remained strictly confidential.

Demographic characteristics: It included questions related to their gender, age, education, employment status, household income, and share of income for diet. The questionnaire was crafted based on data obtained from the Japanese cohort study (Colvin et al., 2022).

Anthropometric measurements: Anthropometric evaluation included weight, height, BMI, and waist circumference.

Height: According to the standard, height was measured when the individual was not wearing shoes. Individuals stood straight and looked ahead. It was ensured that individuals' head and shoulder contacted the walls. Height was measured in the closest 0.1cm.

Weight: Weight was measured by using a weight machine or balance machine. The individuals were wearing lightweight clothes and without shoes standing on a weight machine. The weight was measured to the nearest 0.5kg. The individuals were classified into the following different categories such as underweight, normal weight, overweight, or obese.

BMI: BMI is a body mass index; it was measured by taking an individual's weight in kilograms and dividing it by the square of height in meters. The usual formula, which divides height in meters (m2) by weight in kilograms (kg), was used to determine it.

BMI was calculated from the reported height and weight of the respondents

- BMI ≤ 18.5 is categorized as under-weight
- BMI 18.5-24.9 is considered normal
- BMI 25-29.9 falls under overweight category
- BMI ≥ 30 indicates obesity

Waist Circumference: It was calculated by wrapping centimeter tape around the belly button.

Assessment of dietary habits: Participants were asked about specific aspects of their dietary habits, starting with an evaluation of their meal patterns. Parameters such as the number of meals eaten per day, fluid intake between meals, consumption of fatty foods, and the hours of the day without eating were considered to gain insights into participants' dietary routines. Milk and dairy products consumption, coffee and tea consumption, meat intake, and fruits and vegetables intake were assessed. The inquiry then extended to the type of flour and cooking oil participants were using. Frequency of commonly eaten Pakistani snacks was assessed. The question to assess whether the individuals were following any specific dietary pattern due to any disease, allergy, or any other cultural or religious belief was asked. The assessment then concluded with inquiries about attempts to manage weight, adherence to dietary rules, and use of dietary supplements.

Assessment of medical history: This part addressed family history of cholelithiasis, history of chronic diseases especially diabetes, hepatic diseases and gastrointestinal disorders, rapid weight reduction, surgeries, allergies and complete serum lipid profile.

Assessment of physical activity & environmental factors: In this section questions were asked about their level of activeness to establish whether they fell into the categories of sedentary, moderately active, or highly active lifestyle patterns. Additionally, questions addressing environmental factors such as living conditions (exposure to radiations or toxins) were also asked.

Pregnancy and hormones: Patients' use of hormone-based medications or contraceptives as well as the frequency of their pregnancies were questioned.

Data analysis: Data entry and calculations were performed after the survey was completed. Metrics related to GSD, linked to lifestyle and dietary aspects, were analyzed using the Statistical Package for the Social Sciences (SPSS-16). The significance of lifestyle and dietary factors as risk factors for cholelithiasis was determined using the Chi-square test (Montgomery, 2017).

RESULTS AND DISCUSSION

Demographic characteristics: The demographic characteristics including age, educational level, employment status and household income were analyzed as shown in the Figure 1. It is illustrated that the likelihood of having GS varies significantly across different age groups with highest number in the 50-59 age group (55 out of 160, 34.4%), followed by the group aged 20-29 accounted for 30% (48 out of 160) and those aged 40-49 comprised 18.8% (30 out of 160), while participants aged 30-39 constituted 12.5% (20 out of 160). Individuals over 60 were the least represented, comprising 4.4% (7 out of 160). The result aligns with the study conducted at Sheikh Khalifa Bin Zaid Hospital involving 100 patients, 14 men and 86 women, with a mean age of 46.2 years. The study stated that the highest incidence of GS was found in the age groups 41-50 and 31-40 (Rahman et al., 2022). The distribution across different education levels showed no significant association with GS indicating that the 36.9% of participants had little or no education, 13.8% had a high school degree, 36.3% had a bachelor's degree, and

13.1% had a master's degree. Hence, the findings as shown in Figure 1 suggest that educational attainment does not significantly impact the occurrence of GS in this sample. The employment status and GS incidence indicated a statistically significant association between employment status and the presence of GS. Among the participants, the highest number were unemployed, comprising 59.4% of the sample. Those who were employed accounted for 21.9%. Students represented 13.8%, while retirees were the least represented at 5.0%. The findings are parallel to the study conducted in Karachi revealed that unemployed and housekeeper individuals experienced a 2.5 times higher incidence of GS than other employment categories. The higher prevalence of GS among unemployed individuals in both studies suggests that factors such as stress and diet, which may be more prevalent in unemployed individuals, could contribute to the increased risk of GS (Bilal et al., 2016). The cross-tabulation of household income and the incidence of GS showed that the occurrence of GS varies considerably across different income levels as presented in Figure 1. These findings are supported by the research that found that individuals with higher socioeconomic status have an elevated risk of GS. This increased risk is attributed to lifestyle factors such as diet and physical activity, which are more prevalent in higher-income groups (Ruhl and Everhart, 2011).

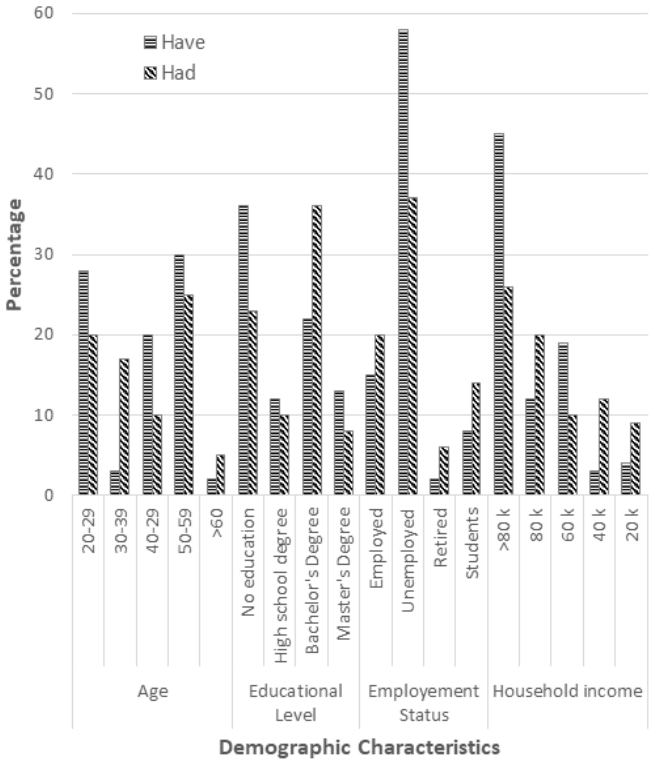

Figure 1. Effect of Demographic characteristics on GS formation.

Anthropometric measurement: The anthropometric measurements were analyzed and the results illustrated that the BMI and GS incidence were statistically significant as shown in Figure 2. Among the 160 participants, 21.9% are classified as normal weight, 18.8% as underweight, 27.5% as overweight, and 31.9% as obese. The high percentage of obese and overweight individuals among those with GS underscores the well-documented risk that obesity poses for GS formation. This increased risk is primarily due to higher cholesterol levels in bile and reduced gallbladder motility, which facilitate stone formation. The results are consistent with the Liu et al. (2018) who stated that the higher BMI, WC, and waist-to-hip ratio (WHtR) significantly increased GSD risk in both genders. In males, BMI and WC together were the best predictors, while in females, BMI and WHtR were most predictive.

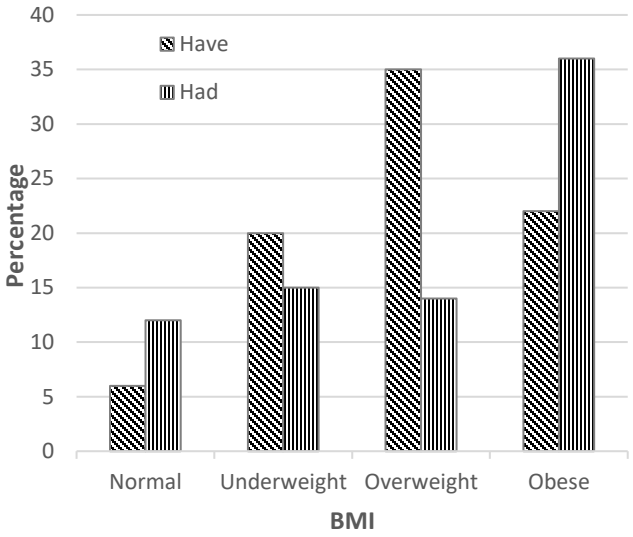

Figure 2. Effect of anthropometric measurements on GS incidence.

Medical conditions: The relationship between diabetes and the incidence of GS, showed a statistically significant association. Among the 160 participants, 70% had diabetes, while 30% did not. The study aligns with the findings of Aune and Vatten, (2016) who reported that individuals with diabetes had a markedly higher risk of developing GS compared to those without diabetes. The study attributed this increased risk to metabolic changes related to diabetes, such as elevated cholesterol levels and decreased gallbladder motility, which contribute to GS formation. A significant association was observed between fatty liver disease and the presence of GS. The data in Figure 3 shows that 42.5% of participants were diagnosed with fatty liver, whereas the remaining 57.5% did not have this condition. These results are parallel to a large-scale cohort study involving Korean adults. Results indicated that individuals with nonalcoholic

fatty liver disease NAFLD had a 26% higher risk of developing GS compared to those without NAFLD. Additionally, increased severity of NAFLD was positively associated with a higher incidence of GS, suggesting a dose-response relationship between the two conditions (Chang et al., 2018). It was also observed that radiation therapy is not a contributing factor to the current cases of GS among these participants because none of the participants (100%) have received radiation therapy in the abdominal area.

Figure 3 highlights a significant link between family history and GS illustrating that among the 160 participants, 31.9% reported a family history of GS disease, suggesting a potential genetic predisposition. The current findings are supported by a Swedish study using nationwide records and found that 36.0% of 660,732 diagnosed patients had familial cases. Of these, 14.0% had both (SIR 2.58), 50.9% was having parental history (SIR 1.62), and 35.1% having a sibling history (SIR 1.75). Spousal risk was somewhat elevated (SIR 1.18), whereas siblings with several afflicted siblings had a significantly elevated risk (SIR > 10). These findings imply that genetic factors play a role in familial clustering and that family histories should to be taken into account when providing counseling in medical settings (Hemminki et al., 2017). The analysis shown in **Figure 3**, reveals a significant association between frequent episodes of indigestion or abdominal discomfort and the presence of GS. Among the participants, 59.4% reported experiencing these symptoms, which are commonly linked to GS disease. The frequent diarrhea and the presence of GS were also significantly correlated. Among the participants, 63.1% reported a history of frequent constipation or diarrhea, conditions that can influence bile composition and gallbladder function, potentially contributing to GS formation.

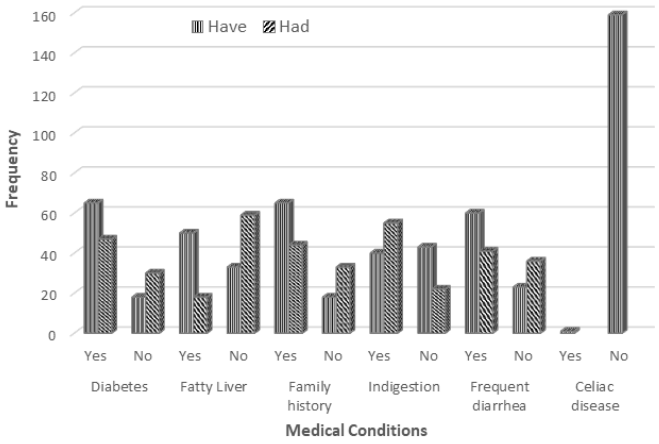

Figure 3. Effect of medical conditions on GS incidence.

Nutrition knowledge and diet history: A significant association between knowledge of dietary balance and the incidence of GS illustrating that only 18.13% were aware of a balanced diet, while 81.88% were not among the 160 participants. Jessri and Rashidkhani, (2015) reported that individuals with a better understanding of balanced diets had a lower incidence of GS. The study concluded that dietary education could significantly reduce the risk of GSD by promoting healthier eating habits that prevent the formation of cholesterol-rich bile. The daily water intake and the incidence of GS indicated a statistically significant association. The data demonstrates no significant difference in the prevalence of GS among those who drink fewer than 4 glasses, 4-8 glasses, or more than 8 glasses of water daily. Whereas meal-skipping habits among participants reveals a significant association as shown in Figure 4. The results show that 37 participants who reported skipping meals frequently (42.5%) had GS, while 50 participants who did not skip meals (57.5%) also had GS.

It was also observed that the breakfast type and the incidence of GS did not show a significant association as shown in Figure 4. Among participants with GS or a history of GS, 37.5% consumed pratha chai, 25% had anda pratha, 6.0% had toast chai, 6.0% had roti with dahi or lassi, and 6.0% had other combinations. This implies that while certain high-fat breakfast items might theoretically contribute to GS formation due to increased cholesterol levels in bile, the current data does not show a strong enough statistical relationship. A statistically significant association between wheat-based chapatti consumption and the incidence of GS was observed. Campos-Perez et al. (2022) investigated the effects of high carbohydrate diets on gallbladder volume and cholesterol crystal formation in mice. The study concluded that a high intake of carbohydrates might contribute to the development of GS by enhancing the formation of crystals and changing biliary motility. Among the 160 participants, those who do not use multigrain flour have a higher prevalence of GS (54.9%) compared to those who do use multigrain flour (25%). Results are supported by Goswami and Rohit, (2018) study which highlighted food low in glycemic index like multigrain flour have protective effect on GS development. The percentage of participants with GS is highest among those who consume rice 2-4 times per week (66.7%), followed by those who consume rice 1-3 times per month (61.1%), once a week (57.1%), 5-6 times per week (48.6%), and daily (22.6%). Hence, this research indicates that high-carbohydrate diets can influence bile composition and GS risk. The findings align with a study that found the diets high in refined carbohydrates, such as white rice, are linked to an increased risk of GS. The study suggests that these diets can lead to higher cholesterol levels in bile, promoting GS formation (Di Ciaula et al., 2019).

The data as shown in Figure 4 indicates that tea consumption is prevalent among the participants, with 45.0% consuming 3-4 cups per day and 40.6% consuming 1-2 cups per day. Only 5.0% do not consume tea. While high tea consumption may be associated with cultural habits, its direct influence on GS

formation has been a subject of interest. The current results are supported by a case-controlled study conducted in Sindh. The findings indicated that consuming more than one cup of tea per day significantly increased the risk of GS (Channa, 2008). Consuming fiber-rich foods showed a significant association with the incidence of GS. The results are consistent with a meta-analysis that found the higher fruit and vegetable consumption is associated with a reduced risk of GSD. Analysis of data from over 33,000 GS patients and 153,000 participants showed that increasing fruit and vegetable intake decreased GS risk by 4% and 3% per 200 grams per day, respectively. The study concluded that regular consumption of fiber-rich foods declines the risk of GS development (Zhang et al., 2019). 3.1% of participants said they ate red meat one to three times a month, 18.1% once per week, 25.6% two to four times a week, 40.6% five to six times a week, and 12.5% every day. According to studies, eating too much red meat and animal fat raises the risk of cholesterol GS because of the gut microbiota, dietary L-carnitine, and the trimethylamine in red meat, which disrupt bile acid transporters. (Weimin et al., 2023). The study indicated a statistically significant association between the frequency of red meat consumption and the incidence of GS among the study participants. The current findings are parallel to a study conducted in Islamabad in which higher red meat consumption was notably linked to GSD, with cases consuming an average of 222g per week compared to 210g among controls (Kiani et al., 2020). The data on poultry consumption among participants shows frequent consumption, with 32.5% consuming poultry several times a week, 18.8% once a week, and 17.5% 2-4 times per week. Poultry, when consumed healthily, is generally considered less likely to influence GS risk significantly compared to red meat.

The significant link between street food consumption frequency and GS incidence was observed. This finding highlights the potential impact of high-fat diets on GS formation. Its results are parallel to the values of Park et al. (2017) indicating that most residents consume street vendor foods, which hold significant socio-economic importance despite their risks. Dairy products are consumed regularly by a significant portion of participants. Of those surveyed, 31.3% consume dairy products daily. Additionally, 28.1% of participants consume dairy products 5-6 times per week, 10.6% 2-4 times per week, 20.6% once a week, and 9.4% 1-3 times per month. The results are supported by a study conducted among Iranian women, an unhealthy diet, including high consumption of high-fat dairy products, solid fats, baked potatoes, red and processed meats, eggs, snacks, and refined grains, was linked to a higher risk of GS (Jessri and Rashidkhani, 2015). Frequent consumption of sugary and high-calorie snacks is observed among participants, with 23.1% eating them 2-4 times per week, 17.5% 5-6 times per week, and 22.5% once a week. Additionally, 8.8% consume these snacks 1-3 times per month and 27.5% daily. The data shows that higher consumption frequency correlates with a greater incidence of GS. The findings align with a study that examined the relationship between GSD risk and ultra-processed food (UPF) consumption in three sizable cohorts. It was discovered that a higher risk of GSD is linked to a higher UPF intake, especially from sugar-sweetened particularly artificially sweetened beverages (Uche-Anya et al., 2024). The findings are contradictory to the research that found the higher fast-food consumption, particularly pizza, is significantly associated with an increased risk of non-alcoholic fatty liver disease. The results suggest that frequent intake of fast food, which includes high-calorie and sugary items, may also contribute to GS risk, reflecting the broader impact of dietary patterns on liver and gallbladder health (Doost Mohammadi et al., 2019).

Figure 4 indicates A significant association between cooking method used and the incidence of GS among the study participants. Among 160 participants, 58.8% use Dalda, 37.5% use oil, and 3.8% use ghee as their primary cooking medium. The data shows that Dalda is associated with a higher incidence of GS. Our results align with a study which found that diets high in saturated fats, like those found in ghee, can increase cholesterol saturation in bile, promoting GS formation (Kiani et al., 2020). The study also identified a statistically significant association between specific weight management diets and GS. Data shows that out of 160 participants, 13.1% had adhered to specific weight management diets, while 86.9% did not. This implies that those who adhere to particular diets might be at varying risks of GS development in comparison to people who don't. According to a 1-year trial of a commercial weight-loss program, adults following a very low-calorie diet (VLCD) were three times more likely than those following a low-calorie diet (LCD) to develop symptomatic GS that required hospitalization or cholecystectomy. Even when VLCD caused more weight loss, the risk of GS were much higher (Johansson et al., 2014). The results indicates that there is no statistically significant association between taking dietary supplements and the incidence of GS among the study participants. Among 160 participants, 13.8% reported using dietary supplements, while 86.3% did not. The role of dietary supplements in the prevention or risk of GS is a topic of ongoing research. The current findings are contradictory to study which suggest that certain supplements, such as vitamin C, may help prevent GS formation, others indicate that inappropriate use of supplements could potentially disrupt bile composition and affect gallbladder function (Walcher et al., 2009).

Rapid weight loss and GS incidence: Among 160 participants, 61.3% experienced rapid weight loss, while 38.8% did not, which indicates a statistically significant association with GS incidence as shown in Figure 5. This considerable result suggests that those who have experienced

rapid weight loss are more likely to develop GS compared to those who have not. Studies have shown that significant and quick reductions in body weight can lead to an increased concentration of cholesterol in the bile, which can precipitate the formation of GS. The findings are supported by a study that found rapid weight loss after bariatric surgery is strongly associated with a high incidence of GS, affecting 71% of participants (Stenberg et al., 2022).

Activity level: The activity level and the presence of GS is shown in Figure 6, indicates a statistically significant association. The results align with the study involving approximately 260,000 participants found a negative correlation between GS condition and physical exercise. A lower risk of GS was linked to physical activity, as evidenced by cohort studies showing a pooled relative risk (RR) of 0.85 and case-control studies showing an odds ratio (OR) of 0.64. Both men and women benefited similarly, indicating that higher levels of physical activity may protect against GS formation (Zhang et al., 2017).

Pregnancy and hormones: Figure 7 indicates a strong correlation between past pregnancy history and the incidence of GS. Data shows that 64.4% had been pregnant, while 35.6% had not. This suggests that pregnancy is a significant risk factor for the development of GS. The findings align with a study which revealed that the prevalence of GS during pregnancy was 3.6%, with the highest prevalence reported in

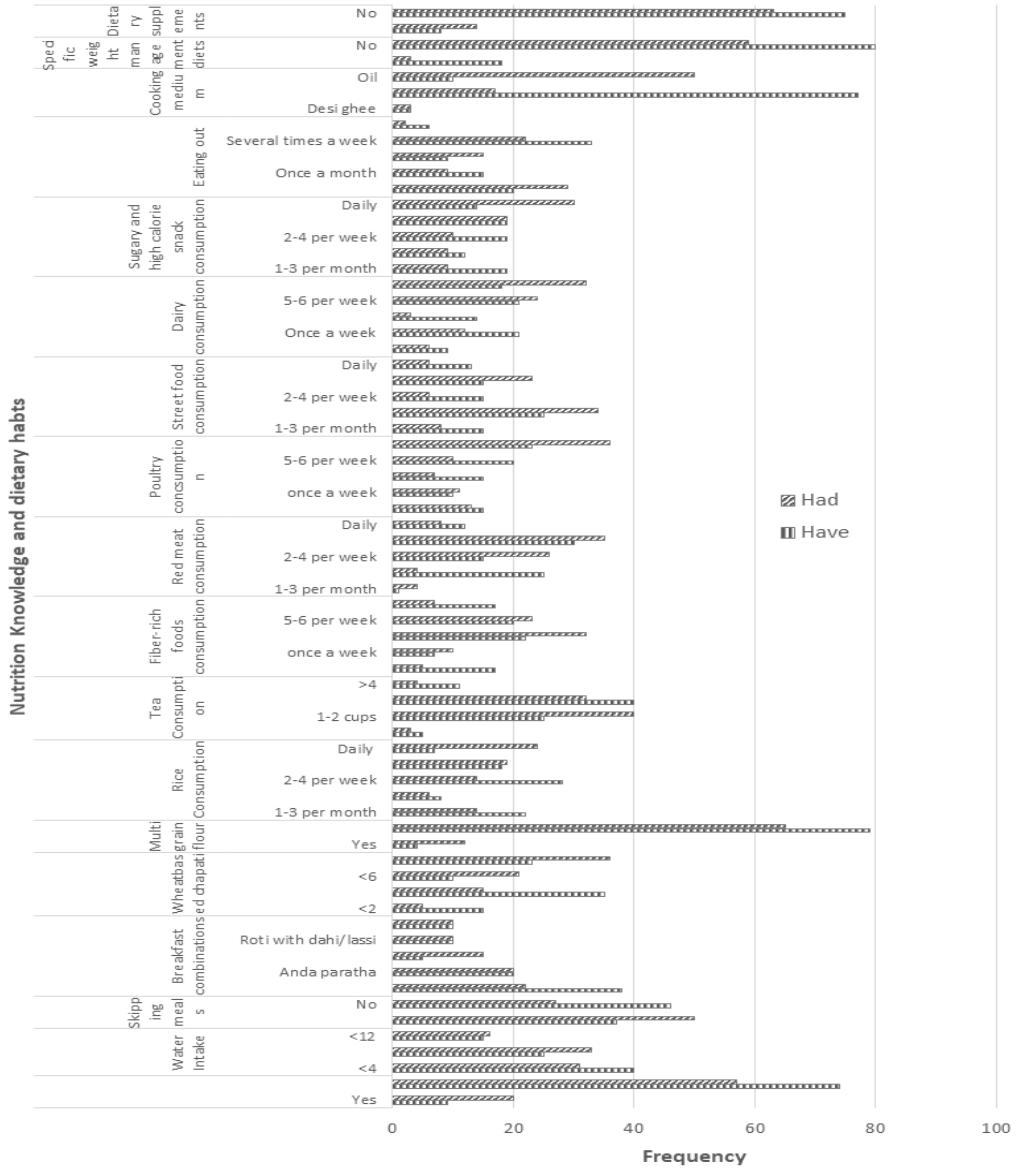

Figure 4. Nutrition knowledge and dietary habits.

America at 6.8% (Salari et al., 2023). A significant association was also observed between multiparity (having multiple pregnancies) and the incidence of GS. The analysis shown in Figure 7 reveals that 35.6% had experienced multiparity, while 64.4% had not. Abeysuriya et al. (2022) reported older maternal age was linked to a larger percentage of GS along with biliary sludge (above 30 years), multigravidity, and being in the third trimester.

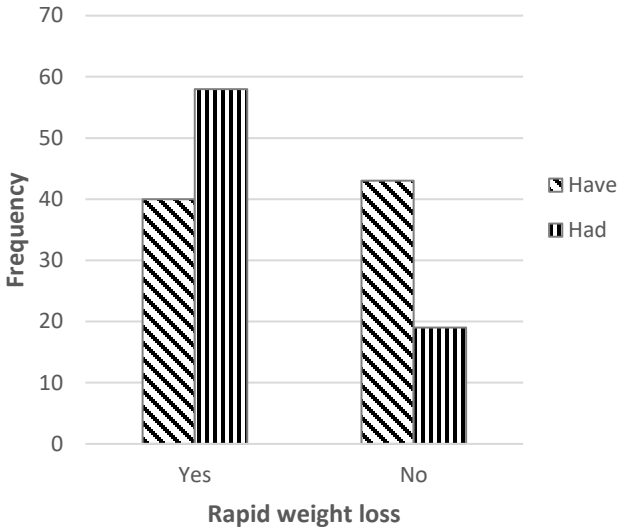

Figure 5. Effect of rapid weight loss and GS incidence

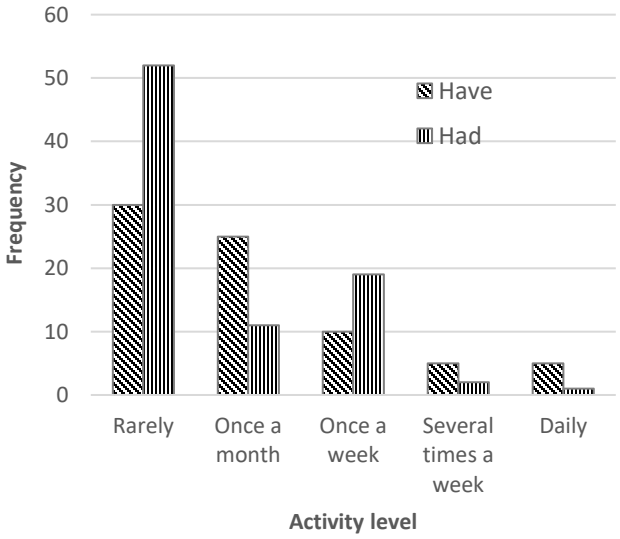

Figure 6. Effect of activity level on GS incidence.

The use of oral contraceptives or hormone replacement therapy also significantly affect the incidence of GS as shown in Figure 7. This suggests that the use of these hormonal therapies is linked to a higher risk of gallbladder stones development. The findings align with a cohort investigation that discovered a higher prevalence of GS among women using oral contraceptives compared to non-users. This study highlights how hormonal contraceptives, which elevate estrogen levels, can increase cholesterol amount in bile and reduce gallbladder motility, contributing to GS formation (Lai et al., 2022).

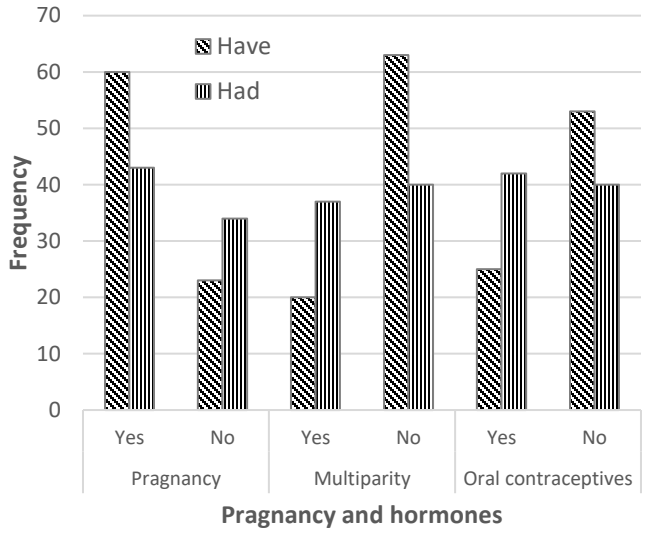

Figure 7. Effect of pregnancy and hormones on GS incidence.

Conclusion: This study identified several key determinants of cholelithiasis among adults in Faisalabad. High consumption of red meat, street food, high-fat dairy products, sugary snacks, obesity, and rapid weight loss, along with unemployment, hormonal factors from pregnancy and contraceptive use, were significantly associated with GS formation. According to these results, changes in diet and way of life are crucial for lowering the risk of GS. Hence, reducing the intake of red meat, high-fat dairy products, sugary snacks and choosing the healthier cooking oils instead of those high in saturated fats, such as Dalda could significantly reduce the risk of GS formation.

SDGs addressed: SDG 3 – Good Health and Well-being; SDG 2 – Zero Hunger (Nutrition-related targets);SDG 5 – Gender Equality; SDG 12 – Responsible Consumption and Production

Policy referred: National Health Vision Pakistan (2016–2025); Pakistan Dietary Guidelines for Better Nutrition (2018); Sustainable Development Goals (SDG-aligned policies).

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