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Exploring the correlation between nutritional deficiencies and the occurrence of gallstones and gallbladder stasis in women after childbirth

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Abstract:

Objective: "Fat fertile forty females" have historically been linked to gallstones (GS). Yet, young, impoverished, multiparous females in Pakistan frequently appear to have GS. The goal of this research was to ascertain the impact of insufficient food intake on females' frequency of GS and gallbladder (GB) stasis after childbirth.

Methods: At Mayo Hospital in Lahore, this research was carried out. Women who had normal childbirth were assessed six weeks after giving birth. The patient had a thorough medical assessment, anthropometric measures, nutritional analysis, and laboratory testing. Following a typical fatty food, an ultrasound was performed to determine if GS, sludge, and the fraction of ejection were present. The same methodology was used to evaluate 22 female participants who were in the same age range.

Results: The average age of the cases in research including 81 people was determined to be 25.6 years, with a standard variation of 3 years. The research examined several variables between volunteers and postpartum women (PPW). The mean fasting gallbladder (GB) volume, gallbladder ejection fraction (GBEF), and residual gallbladder volume after 60 minutes were all considerably greater in postpartum women than in volunteers (p-value < 0.001). The average body mass index (BMI) of postpartum women with GB standstill was found to be 21.4 with a standard deviation of 3.7, as opposed to those without stasis, who had an average BMI of 23.8 with a standard deviation of 3.6 (p=0.013). Additionally, postpartum women with GB standstill ingested considerably less protein than those without it, with an average intake of 58 grams and a standard deviation of 10 (p-value < 0.001) as opposed to 69.4 grams and a standard deviation of 16.8 for those without stasis. Lower calorie consumption and lower BMI were shown to be independent predictors of decreased GBEF. It was shown that postpartum women (n=8) with gallstones

(GS) in their gallbladders tended to consume diets low in protein more often (100% vs. 71% in those without GS; p=0.004). Additionally, they had lower serum ferritin levels (20.3 ± 10.5 µg/L against 41.7 38 g/L in those without GS; p=0.001) and were more likely to have had numerous pregnancies (75% compared to 22% in those without GS).

Conclusions: Postpartum women were more likely to have GS and GB stasis when their diets were insufficient in protein, had low serum ferritin levels, and had poor nutritional status. Reduced GBEF was independently predicted by lower BMI and decreased calorie consumption.

Keywords: gallstone, gallbladder, postpartum

Introduction:

About 10% of people in the West and 5% of people in underdeveloped nations like Pakistan suffer from cholelithiasis, a prevalent health issue [1]. Substantial incidence and several potentially fatal consequences, including gallbladder cancer, are linked to gallstone (GS) disease. Gallstones have historically been associated with fatty, fertile women in their forties. The majority of those we treat with gallstones in Pakistan, however, are slender, undernourished, multiparous young females with poor socioeconomic levels. Identifying potential risk elements that cause gallstones in such individuals will help with the occurrence of preventative measures and give insight into the etiology of gallstone disease.

Gallstones (GS) are almost two times as prevalent in females as in males, and they also appear earlier in females than in males. Parity is a significant risk factor for GS, and the majority of cases occur during pregnancy or immediately after delivery [2,3]. Due to changes in hormones and nutritional excessive behavior, pregnancy is linked to both gallbladder stasis and elevated cholesterol absorption in the gallbladder [3,4]. Pregnancy is linked to increased nutritional needs, which, if not addressed properly, might lead to deficient conditions. Women in India experience substantial malnutrition as a consequence of the country's significant gender imbalance in both the social and economic realms.

Figure 1: Gallbladder Stasis

It has been shown that iron deficiency promotes cholesterol GS production. 30% of adult prairie dogs that were given an iron-deficient diet for 8 weeks had GS, and 80% of them produced cholesterol monohydrate particles in their gallbladder [5]. Due to reduced 7-hydroxylase function and decreased GB neuronal synthase of nitric oxide function caused by a lack of iron in GB stasis and bile cholesterol overabundance of bile, accordingly, are caused6. Additionally linked to a higher risk of GS are hypercholesterolemia and a high-fat diet [6,7].

There hasn't been any research on how these elements interact with food in the development of GS in postpartum women. To determine the incidence and contributing elements of GS, GB sludge, and GB stasis in females after delivery, we designed this research.

Methods:

Study Design: The Mayo Hospital in Lahore, Pakistan, conducted prospective research from 2019 to 2023. The study's primary population of interest was postpartum mothers who had given birth to a single live infant after thirty-six weeks of gestation. They were classified as study cases since these ladies visited the postpartum clinic. The individuals who took part were chosen based on a set of factors, which included eliminating those with a diagnosis of cholecystectomies, frequent pancreas inflammation biliary distress syndrome, recent usage of particular drugs, and pregnancy complications like restricted intrauterine growth, congenital defects, stillbirths, and numerous gestations. Additionally, a control group of normal young females with no gallstones or ultrasonography sludge was included.

Participants' demographic data, employment and religious affiliations, socioeconomic standing, weight gain, parity, and pregnancy results, throughout pregnancy, were all obtained. Using a meal frequency questionnaire, an in-depth nutritional evaluation was carried out, and dietary recommendations for the consumption of fat and protein were specifically taken into account. Gallstones, jaundice, cholestasis, and biliary colic were all seen during pregnancy. Physical exams and lab tests were performed, and measurements of the subjects' BMI, weight, height, weight, waist/hip ratio, hip and waist circumferences, and other blood tests were taken.

Using real-time ultrasound imaging, a GI radiologist evaluated the function of the gallbladder (GB). An overnight fast was required for the study, and the ellipsoid technique was used to measure the GB volume. Following the subjects' consumption of a common fatty meal, GB emptying was assessed. Following a meal, ultrasound pictures of the GB were taken at particular intervals, allowing the calculation of variables such as basal volume, a fraction of ejection at various periods, and the duration for the greatest constriction. Participants were categorized as having a static gallbladder (GB) if their gallbladder ejection fraction (GBEF) was less than 40%, while those with a sluggish GB had a delayed time to maximal ejection (beyond 45 minutes). It also determined the patterns of typical GB contraction in female volunteers who had no problems with their gallbladders.

Statistical Analysis: SPSS v.27 was used to analyze the data. Between patients and controls, the features of GB emptying were contrasted. Gallstones, gallbladder sewage, and gallbladder inactivity were examined using a single-variable approach. For categorical data, the Chi-square test was utilized, and for continuous data, the Student’s t-test. Where applicable, Paired t, Fisher's exact, and Mann-Whitney U tests were utilized. Ordinal variables were handled using gamma statistics. A p-value of 0.05 or below was considered significant.

Results:

There were 22 controls and 81 cases in the research. The mean age of the cases was 25.6 years with 3 SD, while the mean age of the controls was 22.3 years with 6.1 SD. Primiparas, or first-time moms, made up 73% of the patients, the bulk of the cases. Patients who had just given birth had a mean BMI of 23.98 ± 4.1. 18 of the patients were obese, 3 were overweight, and 2 were underweight, while the other cases all had normal BMIs. However, none of the twelve individuals had gestational diabetes; they all had pregnancy-related hypertension. Biliary colic, which afflicted 10% of patients, was the most typical biliary symptom during pregnancy. 6.2% of the instances of cholestasis during pregnancy were marked by pruritus (itching), and in one case, jaundice. Gallstones run in the family in three of the instances.

Table 1: Comparing the gall bladder function using ultrasound (USG) in women after childbirth who have a healthy condition

Characteristics	**Gallbladder stasis**	**Gallbladder volume left over after 60 minutes**	**Fasting volume in the gallbladder**	**Gallbladder ejection percentage**
Controls	0%	5.8 ± 1.3	16.5 ± 5.2	63.4 ± 8.5
Post-partum	25%	11.2 ± 6.4	21.88 ± 10.7	54.5 ± 17
p	0.009	0.001	0.002	0.001

The gallbladder ejection fraction (GBEF) was found to be considerably lower in cases compared to controls (54.5 17 vs 63.4 8.5), and cases also had greater fasting and residual gallbladder volumes at 60 minutes. Comparing cases to controls, gallbladder stasis, and slow gallbladder were more prevalent. (Table 1)

Lower BMI, lower body weight, smaller waist and hip circumferences, thinner triceps and biceps fold, less everyday calories, everyday cholesterol, and everyday protein intakes, as well as medical indications of inadequate nutrition like hyperpigmented knuckles, cheilitis, often leg cramps, and weakness in the proximal muscles were all factors linked to gallbladder stasis.

The importance of protein consumption was also discovered, as people who had low protein consumption had greater gallstone frequency and poorer gallbladder ejection percentage than those with regular protein consumption. Lower values were linked to worse ejection fraction, according to a linear regression study that found BMI and total calorie consumption to be separate predictors of GBEF. Compared to postpartum women without gallstones, those with gallstones were prone to have related sludge. Gallstone patients had lower serum ferritin levels, were more likely to be multiparous, and had previous experiences of biliary distress during pregnancy. Although the occurrence of gallstones was greater in multiparous women than in primiparous women, there was no discernible change in the lipid profile or gallbladder ejection percentage between the two groups.

Table 2: Various variables linked to GB stasis in postpartum female

Characteristics	**Controls**		**Postpartum**		**p**
	Mean	**SD**	**Mean**	**SD**	
Height	156	6.6	153	7.7	0.141
Weight	57.9	8.5	50.8	11.5	0.004

Hip measurement	96	7	90	9	0.003
Waist Measurement	86	9.7	79	13	0.014
BMI	23.8	3.6	21.4	3.7	0.013
Biceps fold width	10.3	4.1	7.7	2.5	0.001
Triceps fold measurement	21	5.3	18	5	0.035
Daily consumption of protein	69.4	16.8	58	10	0.001
Consumption of all fats	104.6	33	84.9	20	0.015
Consumption of all calories	2636	521	2237	289	0.001

Table 3: Gallstones and postpartum female risk factors

Characteristics	**Without gall stones**		**With gall stones**		**p**
	Mean	**SD**	**Mean**	**SD**	
Daily consumption of protein	67.4	16.6	60.7	9.49	0.115
Consumption of all fats	100	32.8	91	17.2	0.22
Consumption of all calories	2567	515	2266	269	0.19
Levels of Serum ferritin	41.7	38	20.3	10.5	0.001
Multi-parity	22%		75%		0.001

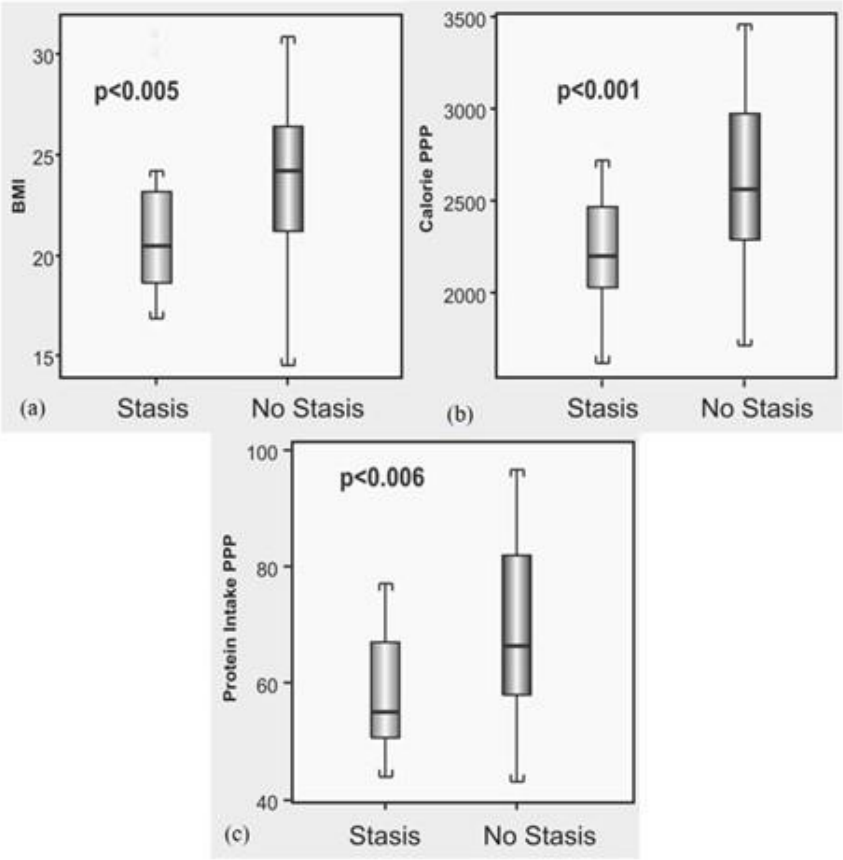

Figure 2: Different factors related to gallbladder stasis

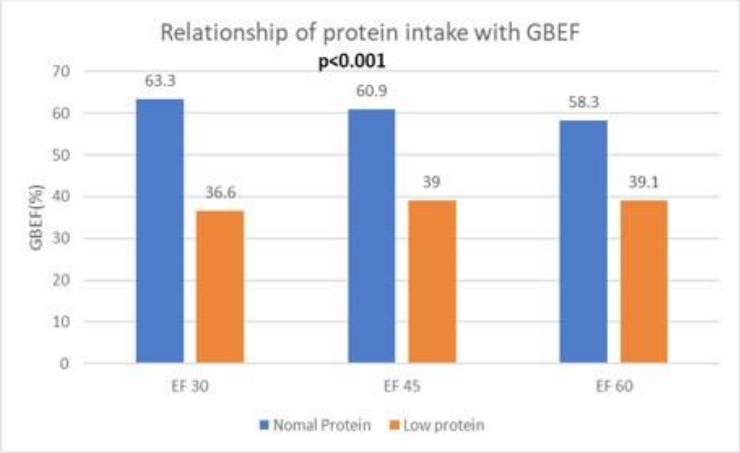

Figure 3: Influence of low protein consumption on GBEF

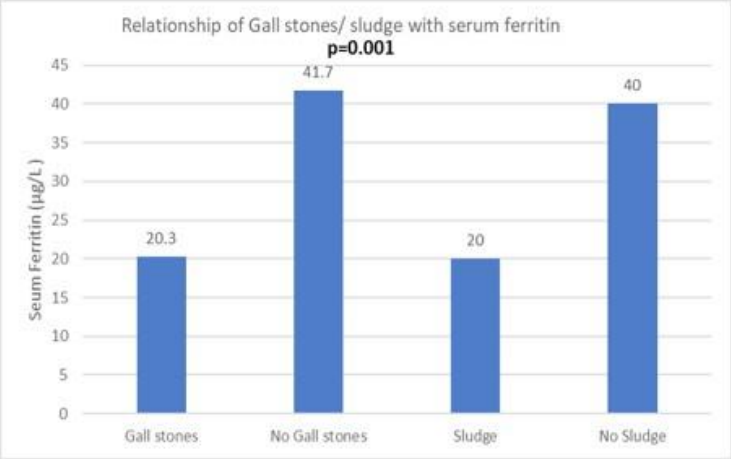

Figure 4: Connection between serum ferritin levels and sludge or GS

Discussions:

We discovered that postpartum females had a greater incidence of gallbladder stasis six weeks after birth, as well as a lower ejection percentage, larger baseline gallbladder volumes, and a slow reaction to fatty meals. In comparison to patients without a standstill, postpartum females with GB stasis were shown to possess less average daily consumption of protein, lower body weight, and lower BMI. Gallstone frequency amongst our new mothers (10%) was comparable to that seen in other studies conducted in the West (2–12%) [8,9]. In our investigation, sludge was present at a rate of 5%, which is consistent with previous data [10]. Although earlier research has indicated that in women who are pregnant average basal levels are around 70% greater than those of non-pregnant supervises, the volumes revert to baseline as soon as two weeks after delivery [11,12]. Yet, at just six weeks after giving birth, our patients showed higher volumes and stasis, which could have been related to their diet's lack of protein, low BMI, or concurrent lack of iron.

The majority of the study group, we discovered, consumed more fat and less protein than what was advised for women in the postpartum period [9]. Gallstones and GB stasis are two other conditions linked to low protein consumption. Protein acts as a separate stimulant to release CCK. Accordingly, a low-protein diet may be linked to abnormally low CCK release, which might cause a buildup of stasis and contribute to an increase in gallstone development. CCK levels have previously been shown to be lower and stomach emptying to be delayed in rats given a prolonged low-protein meal compared to rats given a high-protein high in protein [15]. Reduced smooth muscle response to cholecystokinin (CCK) may also be a consequence of low protein consumption. Low consumption of vegetable protein together with an energy-balanced diet has been linked to an elevated likelihood of cholecystectomy in previous research [13].

The blood ferritin levels of patients with GS or sludge were considerably lower than those of patients without sludge or GS, according to our research. The frequency of iron insufficiency was alarmingly high, which could have been related to poor adherence to oral iron, low foundation iron status before the index pregnancy, concurrent worm infestation, poor dietary availability of iron, more than one pregnancy with inadequate separation, and vegetarian diet [14]. The etiology of gallstones has been linked to several processes, including iron deficiency [15]. According to research, 30% of adult male prairie dogs that had an iron-deficient diet for eight weeks formed gallstones, and 80% of them formed lipid anhydrous crystals in their bile [16]. In addition, it was shown that gallstone patients had higher levels of biliary transferrin, a

powerful catalyst for the formation of cholesterol crystals [17]. A further investigation revealed that iron shortage causes the gallbladder's neuronal nitric oxide synthase levels to decline, which increases the risk of gallbladder stasis [18]. According to research, individuals with iron-deficient anemia had a greater risk of developing gallstones and reduced GB motility, which led to a larger residual volume [19]. Compared to individuals without GS or sludge, participants in our research had lower ferritin levels. In our research, iron insufficiency was not linked to changed GB ejection percentage or GB stasis. It does, however, need to be validated in more extensive multicentric studies because of the limited sample size.

The vast majority of individuals in our research had normal BMIs. A study discovered that obesity was a standalone contributory element for gallstone disease in prior research [3]. Given that a significant part of our GS patients has normal BMIs, it is likely that malnutrition and an unbalanced diet, instead of pure obesity during pregnancy, are the main factors in the etiology.

In comparison to those without gallstones, those with GS had a greater mean parity (2.70 ± 1.25 vs. 2.0 ± 1.09) and were more likely to be multiparous. As was discovered in several investigations [2,20], multiparity predisposes to GS. Although the prevalence of gallstones was greater among multiparous women than among primipara women, it was also considerably higher among primipara women than was predicted. Gallstones are more likely to form in multiparous women than in nulliparous ones, according to research. ($p=0.01$) [21]. The incidence of gallstones was also shown by another study to be 19% in multiparous females as opposed to 8% in nulliparous women [22]. Thus, there was a tendency for the risk of gallstones to rise with increasing parity, and this discovery is consistent with past investigations. Our multiparous ladies may put our patients at risk for various nutritional deficits due to their poorly spaced pregnancies. Gall bladder stasis and the development of gall stones are more common in postpartum women due to a variety of local cultural practices, such as diets heavy in fat, poor in protein, and low in iron.

The long-term effects of changed GB mobility and GB stasis were not documented in our investigation via patient follow-up. The implications of the findings on a broader scale need bigger, prospective multicentric investigations since certain groups, such as those with sludge or gall stones, were tiny.

Conclusions:

After delivery, females who are undernourished, multiparous, iron-deficient, and who consume a diet low in protein are more likely to have gallbladder stasis, develop gallstones, and produce sludge. Therefore, it would be important to make sure that pregnant women and women recovering from childbirth are advised to eat a balanced diet full of proteins and iron.

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