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Dietary Characteristics of Patients with Urolithiasis in Georgia

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ABSTRACT

Background: Disturbances in dietary behavior play a significant role in the development of urolithiasis. It is also important to emphasize that individual constitutional characteristics should be carefully considered when assessing potential risk. In Georgia, the actual dietary intake of patients with urolithiasis has not yet been studied.

Objectives: Therefore, the present study aims to evaluate nutritional patterns of individuals with urolithiasis before diagnosis, with the ultimate goal of developing and implementing effective preventive measures.

Methods: The study population consisted of patients aged 18 or older with urolithiasis at the National Urology Center in Tbilisi. A total of 318 patients were surveyed. A quantitative, observational research design was employed, based on dietary analysis methodologies.

Results: The proportion of protein in total daily energy intake did not differ by sex: 20.7% [16.0–26.5] in men and 20.7% [13.9–31.1] in women (p=0.883). In both groups, the median exceeded the recommended range of 11–14%. Similarly, the proportion of total fat in daily energy intake did not differ significantly between men (35.1% [30.2–42.4]) and women (37.3% [25.4–49.9]) (p=0.594). In both groups, however, the median exceeded the recommended level of 30%. Carbohydrates accounted for 43.7% [34.3–50.4] of total daily energy intake in men and 38.2% [26.4–51.0] in women; the difference was not statistically significant (p=0.079). In both sexes, however, the median proportion of carbohydrate intake was lower than the recommended range of 56–58%. Daily total energy intake was 1535.65 [1162.45–1985.45] kcal/day in women (n=172) and 1682.65 [1397.40–1945.10] kcal/day in men (n=146).

Conclusions: The present study provided important findings that may serve as a basis for practical dietary recommendations for patients with urolithiasis in Georgia. The results highlight the importance of dietary modification in the population, particularly for individuals predisposed to stone formation or with other internal or environmental contributing factors.

Keywords: Dietary intake; nutrition; prevention; urolithiasis.

BACKGROUND

Urolithiasis is a multifactorial disease, with diet among the most influential risk factors in its development. A substantial body of evidence has accumulated indicating the role of dietary imbalances in the pathogenesis of urolithiasis. Published findings, however, are sometimes contradictory and mutually exclusive. According to recent studies linking nutritional status to stone formation and recurrence, excess food intake increases the body's supply of lithogenic substances (such as calcium, uric acid, and oxalates).[1] During obesity, urinary pH is lower, and increased urinary excretion of sodium, uric acid, and calcium is observed. These factors contribute to the development of urolithiasis.[2] Lee et al. demonstrated a significant association between obesity and biochemical abnormalities in urine.[1] The authors also showed that correcting these abnormalities helps prevent stone formation recurrence.

In a separate study, Wang et al. demonstrated that nutritional status and immune function play a critical role in the pathogenesis of kidney stone formation. The underlying mechanism may be explained through the roles of albumin and lymphocytes. Serum albumin serves as a marker of long-term nutrient reserves, with a biological half-life of approximately 21 days.[3] Beyond its nutritional significance, albumin exhibits antioxidant, anti-inflammatory, and calcium ion–binding properties. Reduced serum albumin levels exacerbate oxidative stress, which appears to be a principal factor contributing to nephrolithiasis.[4]

Recent studies have indicated that the association between the Prognostic Nutritional Index (PNI) and stone formation is stronger in men with low cholesterol levels. This finding has been corroborated by additional research.[5,6]

Investigators have also examined the impact of cola and carbonated beverage consumption on stone formation. Such intake increases oxalate excretion, thereby promoting the development of calcium oxalate stones.[7,8]

Furthermore, the effects of consuming bread, meat, liver, fish, legumes, cream, butter, and kaymak on stone formation have been studied.[9-15]

However, the results of these investigations remain inconsistent and mutually contradictory.

According to another study, excessive daily protein consumption was not associated with stone formation. According to the authors, excess dietary protein should be considered a physiological regulatory response rather than a pathophysiological response to excessive protein intake. It is noteworthy, however, that protein-induced hypercalciuria may represent a potential risk factor for stone development. Despite this, only "probable evidence" of its association with urolithiasis has been reported.[16,17]

The authors further emphasize that urinary protein excretion and dietary protein intake are not directly related; in other words, a protein-rich diet does not lead to increased albuminuria. Establishing such a connection would require at least a two-year study. Large observational investigations have

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highlighted the role of dietary acid load, assessed by the ratio of animal protein to potassium intake. These findings suggest that consumption of foods with an alkaline effect (i.e., a higher fruit- and vegetable-to-protein ratio) influences stone formation. Conversely, intake of acid-producing foods lowers urinary pH, thereby facilitating the development of several types of stones, predominantly calcium oxalate. The higher the urine pH, the greater the excretion of citrate, which counteracts stone formation.[18]

In the study, the authors noted that obesity and metabolic syndrome interact with urolithiasis risk factors to elicit a myriad of body responses that promote stone formation.[19] Of the obese population, about 1 in 10 had the metabolically healthy phenotype. These metabolically healthy but obese individuals are insulin-sensitive, have normal blood pressure, a favorable lipid profile, a lower proportion of visceral fat, less liver fat, and normal glucose metabolism despite excessive body fat.[20] However, as waist circumference increased, the proportion of metabolically healthy individuals among those with obesity decreased.[21] This study confirms that abdominal adiposity exerts a more detrimental impact on human health than fat accumulation in other regions of the body.

In another study, a unique subset of individuals termed metabolically obese but normal weight (MONW) was identified.[22] These young women are potentially at increased risk for the development of metabolic syndrome despite their young age and normal body mass index. Despite similar body mass index between groups, MONW women showed higher percent body fat, lower fat-free mass, lower physical activity energy expenditure, and lower peak oxygen uptake than non-MONW women. Plasma cholesterol levels were higher in MONW women, whereas no differences were noted for other blood lipids, ghrelin, leptin, adiponectin, and resting energy expenditure. MONW women had lower dietary restraint scores than non-MONW women, but no differences were noted in disinhibition, hunger, dietary intake, and emotions.

Consequently, disturbances in dietary behavior play a significant role in the development of urolithiasis. It is also important to emphasize that individual constitutional characteristics should be carefully considered when assessing potential risk.

In Georgia, the actual dietary intake of patients with urolithiasis has not yet been studied. Therefore, the present study aims to evaluate nutritional patterns in individuals with urolithiasis prior to diagnosis, with the ultimate goal of developing and implementing effective preventive measures.

METHODS

The study population consisted of patients aged 18 or older with urolithiasis at the National Urology Center in Tbilisi. A total of 318 patients were surveyed. A quantitative, observational research design was employed, based on dietary analysis methodologies.

Data collection and dietary assessment

Information on dietary intake was collected using a structured questionnaire developed by the research team. The questionnaire included information on:

- Demographic characteristics
- Body Mass Index (BMI)
- Dietary patterns and meal frequency
- Daily water consumption

A comprehensive dietary assessment was also conducted using the standard 24-hour dietary recall method. To ensure accurate estimation of food portion sizes, the Atlas of Food Products and Meal Portions was used;[23] food items were presented in their actual dimensions. Food consumption was evaluated with the main food groups. Consumption frequency was categorized into five distinct levels:

- Every day/almost every day
- 3-5 times a week
- 1-3 times a week
- 1-2 times a month
- Never

Nutritional and energy value analysis

The energy and nutritional value of the diet was calculated using a specialized software program and tables specifically compiled by our research team for Georgian dishes.[24]

The analysis included the following nutrients:

1. Macronutrients (proteins, fats, carbohydrates)
2. Dietary fiber

In addition, the overall energy value of the diet was assessed.

The proportions of major nutrients in total energy intake (proteins %, fats %, carbohydrates %) were also calculated. Consumption levels were evaluated in accordance with the physiological norms for energy and nutrient intake established for the population of Georgia .25

Statistical analysis

We analyzed the data using SPSS (Statistical Package for the Social Sciences), version 27. Descriptive statistics were used to summarize central tendency and variability. As the data were not normally distributed (confirmed with appropriate tests), results are reported as the median (Me) and interquartile range (IQR) [Q25; Q75], corresponding to the 25^{th}-75^{th} percentiles. Comparative analyses were conducted to examine differences between two independent groups (e.g., men vs women). For non-normally distributed continuous or ordinal variables, we used the Mann–Whitney U test. Statistical significance was set at $p<0.05$.

RESULTS

Compared with women (n=172), men (n=146) exhibited a significantly higher absolute daily protein intake, with median values of 84.35 g/day [66.60-109.50] versus 61.90 g/day

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[51.35-97.85], respectively. This difference was statistically significant (p=0.025, Mann-Whitney U test).

Men had a higher absolute daily carbohydrate intake than women, with median values of 182.95 g/day [127.20-237.40] versus 142.50 g/day [99.40-186.75], respectively. This difference was statistically significant (p=0.004, Mann-Whitney U test).

In contrast, no statistically significant difference was observed between men and women in absolute daily fat intake: 68.30 [52.50-79.80] g/day and 64.00 [43.35-88.80] g/day, respectively (p=0.712) (Tab.1).

TABLE 1. The daily intake of proteins, total fat, and carbohydrates (absolute values)

Parameter	Norms of physiological requirements (men/women)	Men (n=146) Me [Q25; Q75]	Women (n=172) Me [Q25; Q75]	p (Mann-Whitney U)
Protein, g/d	75–114 / 60–90	84.35 [66.60; 109.50]	61.90 [51.35; 97.85]	0.025
Total fat, g/d	72–127 / 57–100	68.30 [52.50; 79.80]	64.00 [43.35; 88.80]	0.712
Carbohydrates, g/d	301–551 / 238–435	182.95 [127.20; 237.40]	142.50 [99.40; 186.75]	0.004
Note: Data are presented as median (Me) and interquartile range [Q25; Q75].				

The proportion of protein in total daily energy intake did not differ by sex: 20.7% [16.0–26.5] in men and 20.7% [13.9–31.1] in women (p=0.883). In both groups, the median exceeded the recommended range of 11–14%.

Similarly, the proportion of total fat in daily energy intake did not differ significantly between men (35.1% [30.2–42.4]) and women (37.3% [25.4–49.9]) (p=0.594). In both groups, however, the median exceeded the recommended level of 30%.

Carbohydrates accounted for 43.7% [34.3–50.4] of total daily energy intake in men and 38.2% [26.4–51.0] in women; the difference was not statistically significant (p=0.079). In both sexes, however, the median proportion of carbohydrate intake was lower than the recommended range of 56–58% (Tab.2).

TABLE 2. Intake of proteins, total fats, and carbohydrates (percentage of daily energy intake)

Parameter	Norms of physiological requirements (men/women)	Men (n=146) Me [Q25; Q75]	Women (n=172) Me [Q25; Q75]	p (Mann-Whitney U)
Protein, %	11-14	20.7 [16.0; 26.5]	20.7 [13.9; 31.1]	0.883
Total fats, %	30	35.1 [30.2; 42.4]	37.3 [25.4; 49.9]	0.594
Carbohydrates, %	56-58	43.7 [34.3; 50.4]	38.2 [26.4; 51.0]	0.079

Daily total energy intake was 1535.65 kcal/day [1162.45-1985.45] in women (n=172) and 1682.65 kcal/day [1397.40-1945.10] in men (n=146). According to the Mann-Whitney U test, the difference between the sexes was not statistically significant (U=11047, Z=−1.847, p=0.065) (Tab.3).

TABLE 3. Total daily energy intake by sex (kcal/day)

Parameter	Women (n=172) Me [Q25; Q75]	Men (n=146) Me [Q25; Q75]	p (Mann–Whitney U)	U	Z
Total energy intake (TOTALCAL), kcal/day	1535.65 [1162.45; 1985.45]	1682.65 [1397.40; 1945.10]	0.065	11047	-1.847
Note: Values are presented as median [25th percentile; 75th percentile]. Between-group differences were assessed using the Mann–Whitney U test (two-tailed).					

Dietary Fiber

Dietary fiber intake in the surveyed population was insufficient. For example, the median daily intake was 11.2 g/day [7.4–13.8], corresponding to 55.5% of the physiological requirement for adults (20–25 g/day). No sex-related differences were observed: 10.7 g/day [7.3–13.3] in men and 11.5 g/day [7.9–13.9] in women (p=0.372). The proportion of individuals meeting the recommended intake was low, with 10.9% of men and 11.5% of women achieving the standard (p=1.0).

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Evaluation of the frequency of consumption of the main food groups

The frequency of consumption of major food groups is presented in Tab.4. Only 47.9% of respondents reported consuming vegetables, while 29.1% reported consuming fruits and berries. Intake was insufficient not only in terms of frequency but also in quantity, with a median of 307 g/day [221.1–437.9], compared with the recommended 400 g/day for vegetables. Nuts were largely absent from the diet, with only 10.6% of participants consuming them daily.

TABLE 4. Frequency of consumption of the main meal groups

Main meal groups	Do not eat/ 1-2 times a month	1-5 times a weak	Daily/almost daily
Cheese	25.8	54.8	19.4
Cottage cheese	46.2	38.7	15.1
Sour cream	60.2	33.3	6.5
Milk	34.3	42.0	23.7
Sweets	43.0	41.9	15.1
potatoes	46.2	49.5	4.3
Legumes	76.3	17.2	6.5
Fruits	16.3	44.8	39.1
Vegetables	4.3	47.8	47.9
Nuts	58.5	30.9	10.6
Bread	27.6	36.2	36.2

Low consumption frequency was observed for several staple food groups. Pasta was consumed two or fewer times per month by 41.9% of respondents. Bread and bakery products were included in the daily diet of 36.2% of participants, while cereals were consumed daily by only 25.5%. Legume intake was particularly low: the majority of respondents (76.3%) either did not consume legume-based dishes at all or consumed them rarely (38.7%). Only one in four participants reported regular legume consumption, and just 6.5% consumed legumes daily.

A high frequency of regular dairy product consumption was observed (75.6%). Specifically, 66.7% of respondents regularly consumed milk, while 53.3% consumed fermented dairy products, including yogurt. A minority (12.9%) reported never consuming liquid dairy products. The majority of participants (63.4%) preferred low-fat options. Cottage cheese was included in the daily diet of 15.1% of respondents and consumed regularly by 53.8%; notably, 52.7% reported consuming cottage cheese with ≥5% fat content. Cheese was a popular food item, with 74.2% of respondents consuming it regularly and one in five consuming it daily; however, most participants (64.5%) preferred cheese with ≥25% fat content. Higher-fat dairy products, such as sour cream and cream, were consumed less frequently: only 6.5% consumed them daily, and 39.8% regularly. Among these, sour cream was preferred over cream by 53.7% of respondents.

The main source of animal protein was poultry, which was consumed regularly by 87.0% of patients and daily by 5th of patients. In contrast, beef contributed a relatively small share to the diet: only 13.2% of participants consumed beef daily, while 13.1% did not include it at all, and 51.9% consumed it infrequently (1–2 times per month). Thus, poultry was significantly more prevalent in the daily diet compared with beef (19.3% vs. 4.3%, p=0.003).

Fish was consumed regularly by only half of the patients (53.8%). The share of individuals who did not consume fish was 14.0%.

Meat products are a source of saturated fats. Some respondents either did not consume them at all or included them rarely in their diet (11.3% and 53.6%, respectively). However, 35.1% consumed them daily. 17.7% of the surveyed patients did not consume sweets, and 22.6% consumed them rarely. These products were regularly present in the diet of 57.0% of the patients. As for sweetened beverages, regular intake was reported by 42.6% of participants.

It is noteworthy that 95.7% of respondents reported using exclusively vegetable oils and fats derived from them in meal preparation.

DISCUSSION

We analyzed the actual dietary intake of adult patients with urolithiasis. Their diet was characterized by excessive consumption of total protein and fat, accompanied by insufficient intake of carbohydrates and dietary fiber. To date, no similar study has been carried out in Georgia. Most international publications examining the dietary patterns of patients with urolithiasis report comparable nutritional imbalances, noting that excessive protein intake and a deficiency of plant-based foods are important dietary factors contributing to the development of urinary stone disease.[1,2]

In the present study, poultry was identified as the most common source of animal protein. Other sources included beef, pork, sausages and processed meats, smoked meat products, eggs, and cheese.

High total fat intake was also prevalent among respondents. While a subset of patients had fat consumption within the recommended range, the majority exhibited a pronounced imbalance in dietary structure. Both the absolute amount of fat and its proportion of total caloric intake were disrupted. Animal fats, namely saturated fatty acids, predominated over mono- and polyunsaturated fatty acids, and the omega-3 to omega-6 ratio was also imbalanced.

About carbohydrates, they were predominantly represented by starches and added sugars. The vegetables in respondents' diets were mostly consumed in processed form. These findings are consistent with results from similar studies conducted in other countries.

The present study provided important findings that may serve as a basis for practical dietary recommendations for patients with urolithiasis in Georgia. Although recent studies have yielded conflicting results, with some questioning the role of excessive animal protein intake in the development of urolithiasis,[1-3] other research indicates that nutrition in

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combination with other factors leads to the formation of stones in the kidneys.[9]

According to the authors,[26] an isolated episode of lithiasis in adulthood may be considered an occasional event. Many patients, however, continue to form stones throughout their lives at varying frequencies. This, the authors continue, can be associated only with the presence of stable predisposing factors that cause a net increase in the risk of recurrence. In these situations, once any acute urinary tract calculus-related problem is resolved, the specialist must investigate the metabolic situation to provide detailed advice. The authors noted that, in fact, in these patients with a genetic background of increased lithogenic risk, dietary mistakes may have a greater influence than in non-predisposed subjects.

CONCLUSIONS

This study presents an assessment of the actual dietary intake of adult patients with urolithiasis in Georgia. The findings demonstrate similarities between the dietary patterns of these patients and those reported in other countries with the same condition. Although the need for dietary correction to prevent non-communicable diseases is widely emphasized, individual dietary habits remain unchanged and continue to deviate from international recommendations. The results highlight the importance of dietary modification in the population, particularly for individuals predisposed to stone formation or with other internal or environmental contributing factors.

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