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The effect of nutritional factors on urolithiasis: A case-control study

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ABSTRACT

Urolithiasis, a prevalent chronic kidney disease affecting all age groups, can be influenced by nutritional factors. The incidence of urolithiasis in Asian countries ranges from 1% to 19.1%, attributed to geographical and lifestyle differences. In Iran, several risk factors, including ethnicity, dietary habits, gender, and age, are associated with urolithiasis. This study aimed to assess the impact of nutritional factors on kidney and urinary tract stone formation. This case-control study enrolled 127 newly diagnosed urolithiasis patients, and 127 matched healthy participants between February to May 2017. Exclusion criteria included diabetes and acute or chronic renal failure. Data were collected using the Food Frequency Questionnaire (FFQ) and analyzed using chi-square and logistic regression tests. Water (95% CI: 0.09-0.89, OR=0.28), natural juices (95% CI: 0.10-0.65, OR=0.53), mineral water (95% CI: 0.05-0.64, OR=0.18), legumes (95% CI: 0.00-0.38, OR=0.032), butter, cream, or peppermint (95% CI: 0.09-0.95, OR=0.30), and ice cream (95% CI: 0.07-0.54, OR=0.203) had a significant protective effect against kidney and urinary tract stone formation. Conversely, tea consumption (95% CI: 1.15-7.99, OR=4.70), beverages (95% CI: 4.45-23.32, OR=23.32), coffee (95% CI: 1.63-11.78, OR=4.39), bread (95% CI: 1.1-10.59, OR=3.37), meat (95% CI: 1.01-8.01, OR=2.85), liver (95% CI: 3.37-488.90, OR=40.58), fish (95% CI: 2.89-216.39, OR=25.03), and various canned foods (95% CI: 1.34-10.25, OR=3.70) were significantly associated with kidney and urinary tract stone risk. These findings showed that the risk of urinary stones formation had a significant relationship with dietary habits. Therefore, the correct dietary pattern and sufficient fluid consumption may play an important role in preventing urinary stones.

KEYWORDS: nutritional factors, urolithiasis, urinary tract stones

INTRODUCTION

Renal stone disease, also known as urolithiasis, is a prevalent chronic condition affecting individuals of all ages [1]. The incidence is 5 to 13 percent in men and 4 to 7 percent in women [2, 3]. Urinary tract stones are an important health problem with a remarkable share in surgeries and kidney failure patients [4]. The annual rate of stone formation in industrialized countries ranges from 1,500 to 2,000 per million individuals, with approximately 25% of patients requiring active stone removal [5]. In a study conducted in Iran in 2005, the prevalence of the disease was reported to be 7.5% [6]. Recurrence of calcium stones is also observed in around 60% of patients within 10 years [7].

The association of urinary stones with diet is somewhat known, but there are controversial cases in this area. For example, while the shortage of protein intake is one of the major causes of endemic rocks in developing countries such as Iran, India, and Turkey, high protein consumption is one of the most important factors in the formation of stones in industrialized countries. It is believed that there is no reason to justify an increase in protein intake and a higher incidence of urinary stones [8]. In the past, patients with calcium kidney stones were advised to limit calcium intake; however, current evidence questions the validity of this issue [9]. Numerous nutritional factors can alter urinary compositions and cause over-saturation, and, as a result, affect the process of stone formation [10]. Too much protein, sodium, calcium, and oxalate sources intake may increase the risk of stone formation in suscep-

tible individuals [11]. Dietary risk factors have a different effect on the formation of urinary stones based on age and sex. It has been reported that calcium, phytate, and sufficient fluid intake are associated with reduced risk of urinary stones in young women, while animal proteins and sucrose are associated with increased risk. In older adults, calcium intake does not have any effect with age increase, but magnesium, potassium, and fluids intake are associated with a reduced risk of developing urinary stones, and vitamin C increases the risk of symptomatic stomachs [12]. Although the role of consuming adequate fluids in preventing the formation and recurrence of urinary tract stones has been reported in limited studies, some studies mentioned that fluid intake in some kidney disease patients exacerbates the homeostasis of the body [13-15]. The best way to control the disease and its complications, especially in developing countries, is to prevent the growth of stones or the formation of new stones [16].

Based on our observations in society, we recognized the need to study the underlying factors contributing to urolithiasis. This study focuses on urolithiasis in Ilam, a province in Iran with a higher prevalence than other provinces. Additionally, meat consumption is relatively higher in Ilam, raising questions about its potential association with urolithiasis. Our study aims to promote awareness among healthcare professionals and the general public about the frequency of fluid and food consumption to prevent kidney and urinary tract stone formation. We also aim to inform educational programs to increase patients' awareness of urolithiasis and its causes to prevent and reduce recurrence.

Given these considerations, health education focusing on dietary and lifestyle modifications for individuals with kidney and urinary tract stones holds promise. In this study, we primarily investigate the association between nutritional factors and the formation of kidney and urinary tract stones, guided by input from health experts. Importantly, there is a dearth of research on the epidemiology of urinary stones, and the fluid intake and diet patterns in urolithiasis patients remain unclear. Furthermore, there is limited information on the preventive effects of fluid consumption on urinary stone formation. Therefore, this study aimed to determine the effect of nutritional factors on the formation of kidney and urinary tract stones in Northeast Iran in 2017.

BACKGROUND

Study design and setting

This case-control study was conducted in Ilam health centers from February to May 2017. A total of 127 patients with urolithiasis and 127 control subjects without kidney stones were included in the study. The control group was selected to match the urinary tract characteristics of the case group. Individuals with diabetes, acute or chronic renal failure, and those on dialysis or under special care were excluded.

Participants

The sample size was calculated using the Cochran formula with a 0.05 error and a 95% confidence interval (1.96) [17]. Patients were recruited from kidney and urinary tract clinics in Ilam City. Age and sex were used as matching criteria to ensure comparability between the case and control groups. The same matching criteria were applied to the control group. Patients were included if they were diagnosed with urinary stones based on ultrasound scans conducted at specialized clinics. Control group subjects were selected from individuals without urinary stones according to their ultrasound examination at specialized clinics. Patients with acute or chronic renal failure, diabetes, dialysis, or people under special care were excluded.

Clinical assessment and data collection

Demographic and disease characteristics were collected for both groups. Physical activity levels were assessed using the Baecke Physical Activity Questionnaire (BQ) [18]. Data were collected through direct interviews conducted by trained experts. The dietary intake pattern was assessed using the Food Frequency Questionnaire (FFQ), which was validated and proven reliable in previous studies [19, 20]. The frequency of consumption was determined for all types of market bread, local bread, meat, rice, liver, chicken and poultry, all types of canned food, fish, eggs, legumes (beans, lentils, etc.), sausages, salami, and burgers, salad, greens, nuts, and dried fruits, all kinds of fruits, milk, whey, yogurt, cheese, butter, cream, snacks, chocolate, all types of cakes and pastries, sugar, tomato, ice cream, shrimp, carbonated beverages, beverages, dough, coffee, natural juices, industrial juices, minerals, water, and tea. Response options ranged from never to rarely, daily, and weekly.

Statistical analysis

Statistical analysis was conducted to assess the relationship between the independent variables and the dependent variable. Binary logistic regression was employed to predict the effect of the independent variables on urolithiasis. Additionally, data were analyzed using the chi-square test and logistic regression model. The analysis was performed using SPSS 20 software, following the necessary data exploration and modeling steps. The dependent variable of interest was the presence of urolithiasis, while the independent variable comprised various nutritional factors. These included types of market bread, local bread, meat, rice, liver, chicken and poultry, all types of canned food, fish, eggs, legumes (beans, lentils, etc.), sausages, salami, and burgers, salad, greens, nuts and dried fruits, all kinds of fruits, milk, whey, yogurt, cheese, butter, cream, snacks, chocolate, all types of cakes and pastries, sugar, tomato, ice cream, shrimp, carbonated beverages, beverages, dough, coffee, natural juices, industrial juices, minerals, water, and tea.

RESULTS

Demographic characteristics

In this study, 254 subjects participated, with 127 subjects included in the case group and 127 in the control group. 180 subjects (70.9%) were male, and 74 (29.1%) were female. The two groups matched regarding age and sex. The demographic characteristics of patients with kidney stones and healthy subjects are shown in Table 1. According to the demographic information, Body Mass Index (BMI) was statistically different between the two groups (p=0.001). The main water consumption in this study was plumbing water, but there is no data about the composition of plumbing water in this city.

Table 1. Demographic characteristics of participants

Variable	Case (n=127)	Control (n=127)	Sig.
Age			
<40	63	63	1.00
40-60	45	45	
60<	19	19	
Gender			
Male	90	90	1.00
Female	37	37	
Occupation			
Worker	19	19	.91
Employee	34	37	
Others	74	71	
Education			
Illiterate	19	12	.36
Low literacy	26	31	
Diploma and university	82	84	
Marital status			
Married	104	98	.35
Single	23	29	
Place of residence			
Urban	99	100	.87
Rural	28	27	
Economic status			
Low	19	23	.788
Medium	78	76	
High	30	28	
Body mass index			
Slim and normal	48	81	.001
Overweight	63	37	
Obese	16	9	
Daily activity			
No activity	23	25	.594
30 minutes	35	32	
One hour	15	22	
More than an hour	54	48	
History of urinary stones in first-degree relatives			.451
Yes	69	63	
No	58	64	

Chi-square test was used to analyze the data. The analysis steps were performed using SPSS 20 software.

Fluid-related factors

The effect of fluid intake and dietary factors on urolithiasis was examined using logistic regression models. The analysis included both crude and adjusted models, controlling for baseline variables such as age, body mass index, physical activity level, geographic region, specific health profession, use of thiazide diuretics, alcohol intake, drinking sugar cola, coffee intake, and dietary intake of calcium, animal protein, sucrose, magnesium, sodium, phosphorus, potassium, vitamin D, and total fluid (Table 2). The type of kidney stones observed in the study was primarily calcium oxalate, with an average size of 10.33±6.31 mm, and the stones were mostly located in the inferior calyx. Variables concerning the frequency of consuming water, tea, soda, natural juices, industrial juices, dough, mineral water, and coffee were entered into the model. Regarding water intake, individuals consuming 4-5 glasses of water daily had a 72% lower risk of kidney and urinary tract stones than those consuming up to one glass (OR=0.28, 95% CI: 0.09-0.89). On the other hand, individuals consuming 4-5 glasses (OR=3.63, 95% CI: 1.15-13.84) or at least 6 glasses (OR=4.70, 95% CI: 1.15-17.99) of tea daily had a higher risk of kidney and urinary tract stones compared to those consuming up to one glass a day.

The consumption of soft drinks or syrup of less than 2 glasses per day did not show a significant effect on the reference level (never). However, weekly and daily consumption of soft drinks significantly increased the odds ratio of developing kidney and urinary tract stones (daily: OR=23.32, 95% CI: 4.45-23.32; weekly: OR=2.50, 95% CI: 1.01-6.40). Weekly and rare consumption of natural juices showed a significant protective effect against kidney and urinary tract stones (weekly: OR=0.53, 95% CI: 0.10-0.65; rare: OR=0.21, 95% CI: 0.09-0.54). Similarly, weekly and rare consumption of industrial juices was associated with a lower risk of kidney and urinary tract stones compared to never consuming them (weekly: OR=0.18, 95% CI: 0.07-0.46; rare: OR=0.19, 95% CI: 0.08-0.44).

Daily consumption of mineral water compared to the reference level (never) as a significant protective factor reduced the odds ratio of kidney and urinary stones up to 82% (95% CI: 0.05-0.64, OR=0.18). On the other hand, weekly and daily consumption of coffee increased the odds ratio of developing kidney and urinary tract stones (weekly: OR=4.39, 95% CI: 1.63-11.78; daily: OR=2.13, 95% CI: 0.98-4.65). The variables were categorized into four groups: never (<1 glass per day), rarely (2-3 glasses per day), weekly (4-5 glasses per day), and daily (at least 6 glasses per day).

Dietary-related factors

A logistic regression model was employed to investigate the association between diet type and the risk of urolithiasis, as shown in Table 3. The frequency of consuming various food items such as market bread, meat, liver, fish, various canned foods, beans, butter, cream, cereal, and ice cream was included in the model.

Table 3 demonstrates the relationship between dietary factors and the risk of developing kidney and urinary tract stones. Daily consumption of market bread showed a significant difference compared to the reference level (never), with individuals who never consumed market bread being more likely to develop kidney and urinary tract stones (OR=3.37, 95% CI: 1.01-10.59). Regarding meat consumption, individuals who consumed meat daily had a higher likelihood of developing stones compared to those who consumed meat rarely (OR=2.85, 95% CI: 1.01-8.01). Similarly, daily (OR=40.58, 95% CI: 3.37-488.90) and weekly (OR=3.50, 95% CI: 1.49-8.26) liver consumption increased the odds of kidney and urinary tract stones compared to never consuming liver.

The odds ratios for kidney and urinary tract stones were higher in individuals who consumed fish daily (OR=25.03, 95% CI: 2.89-216.39), weekly (OR=13.50, 95% CI: 3.71-49.10), and rarely (OR=7.19, 95% CI: 2.12-24.39) compared to those who never consumed fish. Weekly consumption of canned food also had a significant effect, with individuals who consumed canned foods weekly being more likely to develop kidney and urinary

Table 2. Relationship between fluid intake and the risk of developing kidney and urinary tract stones

Variable	Case (n=127)	Control (n=127)	Crude OR (95% CI)	Adjusted OR (95% CI)
Water			1	1
One glass per day>	23	8		
2-3glasses per day	41	30	0.47(0.18, 1.20)	0.48(0.15, 1.58)
4-5glasses per day	34	55	0.21(0.08, 0.53)*	0.28(0.09, 0.89)*
At least 6 glasses per day	29	34	0.29(0.11, 0.76)*	0.39(0.11, 1.32)
Tea			1	1
One glass per day>	7	17		
2-3 glasses per day	36	51	1.71(0.64, 4.55)	1.85(0.50, 6.84)
4-5 glasses per day	39	32	2.96(1.09, 8.01)*	3.63(1.15, 13.84)*
At least 6 glasses per day	45	27	4.04(1.48, 11.01)*	4.70(1.15, 17.99)*
Soft drink			1	1
Never	37	42		
Rarely	45	58	0.88(0.48, 1.58)	0.97(0.43, 2.20)
Weekly	27	24	1.27(0.63, 2.58)	2.50(1.01, 6.40)*
Daily	18	3	6.81(1.85, 24.98)*	23.32(4.45, 23.32)*
Natural juice			1	1
Never	43	16		
Rarely	40	49	0.30(0.14, 0.61)*	0.21(0.09, 0.54)*
Weekly	38	57	0.24(0.122, 0.50)*	0.53(0.10, 0.65)*
Daily	6	5	0.44(0.11, 1.66)	0.45(0.07, 2.85)
Industrial juice			1	1
Never	55	21		
Rarely	36	65	0.21(0.11, 0.40)*	0.19(0.08, 0.44)*
Weekly and daily	36	41	0.33(0.17, 0.65)*	0.18(0.07, 0.46)*
Dough			1	1
Never	12	5		
Rarely	34	18	0.78(0.24, 2.58)	1.88(0.37, 9.40)
Weekly	48	70	0.28(0.09, 0.86)*	0.48(0.11, 2.04)
Daily	33	34	0.40(0.12, 1.27)	0.93(0.20, 4.27)
Mineral water			1	1
Never	49	24		
Rarely	39	48	0.39(0.20, 0.75)*	0.59(0.26, 1.33)
Weekly	28	26	0.52(0.25, 1.87)	0.97(0.37, 2.52)
Daily	11	29	0.18(0.08, 0.43)*	0.18(0.05, 0.64)*
Coffee			1	1
Never	65	83		
Rarely	30	29	1.32(0.72, 2.41)	2.13(1.98, 4.65)*
Weekly and daily	32	15	2.72(1.36, 5.45)*	4.39(1.63, 11.78)*

Chi-square test and logistic regression model were used to analyze the data. The analysis steps were performed using SPSS 20 software.

tract stones than those who never consumed them (OR=3.70, 95% CI: 1.34-10.25).

Daily and weekly consumption of legumes had a significant effect on the reference level (never) so that the odds ratios of individuals consuming legumes weekly (95% CI: 0.01-0.93, OR=0.10) or daily (95% CI: 0.00-0.38, OR=0.032) were less likely to have kidney and urinary tract stones than people who never eat legumes.

The consumption of butter and cream exhibited a significant protective effect, reducing the risk of kidney and urinary tract stones. Individuals who consumed cream and butter daily had a 70% lower risk of developing these stones than those who never consumed them (95% CI: 0.09-0.95, OR=0.30). Similarly, when examining ice cream consumption, the odds ratios for daily and weekly intake were 0.203 (95% CI: 0.176-0.544, OR=0.203), indicating a decreased likelihood of kidney stones and urinary tract issues. Even rare consumption of ice cream showed a reduced risk, with an odds ratio of 0.233 (95% CI: 0.090-0.605, OR=0.233), compared to individuals who never consumed it.

DISCUSSION

According to the findings of this study, fluid consumption had a significant relationship with the formation of kidney and urinary tract stones. Increasing fluid intake reduces the concentration of compounds that can lead to deposition in the urine. On the other hand, it reduces the free crystalline particles in the urine [21]. There is also evidence that adequate fluid intake can prevent the recurrence of urinary stones [13, 14, 22]. This study indicated

that people who drank four to five glasses of water a day were less likely to have urinary stones than those who drank one glass of water a day, consistent with the results of Sorensen *et al.* [23]. In his study, Anderson showed that the risk of recurrence of stones in people with minimum water consumption is 41% higher compared to people with maximum water consumption [4].

Diet can change urine chemistry and affect stone formation. Studies have reported varying calcium and oxalate levels in patients, with some showing high levels and others showing low levels [24-27]. In conclusion, calcium and oxalate are risk factors connected with stone formation and urinary stones [28-31]. Studies showed that calcium can increase the rate of excretion and absorption and bind to oxalate in the gut [30, 31].

Previous research has demonstrated that consuming cola and carbonated beverages can lead to increased oxalate secretion, which contributes to the formation of calcium oxalate stones [22]. Demographic studies in Iran have identified the consumption of carbonated beverages and beverages as risk factors for urinary stones. In addition, tea consumption is also known as a risk factor [32]. Anderson's research findings indicated that consuming cola-containing drinks, which are high in phosphorus content, could potentially contribute to the formation of calcium oxalate stones [16]. The study also found that increased tea consumption (4-5 glasses per day) and daily and weekly consumption of soft drinks increased the chances of developing kidney and urinary tract stones. The findings of this study showed that the usual consumption of liquids such as natural juices, industrial juices, and minerals decreased the risk of kidney and urinary tract stones, and this is consistent with the results of another study reporting that a fluid-rich diet reduces the risk of developing urinary tract stones [33].

Table 3. The relationship between the frequency of dietary intake type and the risk of developing kidney and urinary tract stones

Variable	Case (n=127)	Control (n=127)	Crude OR (95% CI)	Adjusted OR (95% CI)
Market bread types			1	1
Never	7	22		
Rarely	9	16	1.76(0.54, 5.74)	1.90(0.43, 8.32)
Weekly	7	14	1.57(0.45, 5.45)	1.01(0.21, 4.78)
Daily	75	104	4.35(1.77, 10.72)*	3.37(1.01, 10.59)*
Meat			1	1
Rarely	19	34		
Weekly	67	76	1.57(0.82, 3.02)	1.29(0.56, 2.97)
Daily	41	17	4.31(1.94, 9.57)*	2.85(1.01, 8.01)*
Liver consumption			1	1
Never	18	35		
Rarely	80	69	1.85(0.81, 4.23)	2.12(0.73, 6.18)
Weekly	21	22	2.25(1.17, 4.33)*	3.50(1.49, 8.26)*
Daily	8	1	15.55(1.80, 14.33)*	40.58(3.37, 488.90)*
Fish			1	1
Never	6	30		
Rarely	70	59	5.93(2.31, 15.22)	7.19(2.12, 24.39)*
Weekly	43	36	5.97(2.23, 15.94)*	13.50(3.71, 49.10)*
Daily	8	2	20.00(3.37, 5.22)*	25.03(2.89, 216.39)*
Canned food types			1	1
Never	38	48		
Rarely	54	66	1.03(0.59, 1.80)	0.89(0.43, 1.88)
Weekly	35	13	3.40(1.58, 7.31)*	3.70(1.34, 10.25)*
Legume			1	1
Never	9	2		
Rarely	28	13	0.47(0.09, 2.53)	0.25(0.02, 2.59)
Weekly	83	96	0.19(0.04, 0.91)*	0.10(0.01, 0.93)*
Daily	7	16	0.09(0.01, 0.57)*	0.032(0.00, 0.38)*
Butter, cream or kaymak			1	1
Never	25	12		
Rarely	38	22	0.82(0.34, 1.97)	0.955(0.32, 2.86)
Weekly	46	55	0.40(0.18, 0.88)*	0.57(0.21, 1.60)
Daily	18	38	0.22(0.09, 0.55)*	0.30(0.09, 0.95)*
Ice-cream			1	1
Never	41	18		
Rarely	48	57	0.37(0.18, 0.72)*	0.233(0. 090, 0.605)*
Weekly and daily	38	52	0.032 (0.16, 0.64)*	0.203(0.176, 0.544)*

Chi-square test and logistic regression model were used to analyze the data. The analysis steps were performed using SPSS 20 software.

Moreover, other studies indicated that mineral water containing calcium and magnesium could serve as a preventive and therapeutic agent for kidney and urinary tract stones [34, 35]. Aras *et al.* also found that the consumption of lemon juice could be a potential treatment for patients with urinary calcium stones [36], supporting the findings of the current study. In a meta-analysis by Wang *et al.*, coffee consumption reduced the risk of renal and urinary tract stones [37]. This was inconsistent with the present study revealing that increased coffee intake enhanced the risk of developing renal and urinary tract stones. In a study conducted by Borghi *et al.*, increasing fluid intake to 2 liters of urine resulted in a significant reduction in calcium and oxalate concentrations and reduced the rate of recurrence of stones [38].

It is widely acknowledged that increasing fluid intake is beneficial for patients with urinary stones. However, limited information is available regarding the specific effects of different beverages on the formation of urinary stones [39]. This study showed that coffee consumption was high in our study sample, and drinking coffee was more common in patients with stones. In addition, there was a significant difference in tea intake. Some studies reported that drinking coffee and alcoholic beverages reduce the risk of stones, and consuming beverages containing bicarbonate increases the risk of associated stone formation [39, 40].

The findings regarding tea consumption are also inconsistent. In Curhan's study, consuming various types of tea, coffee, and alcoholic beverages (with or without caffeine) was associated with a reduced risk of urinary stones, while no relationship was found between the consumption of bicarbonate beverages and the risk of urinary stones [39]. The heterogeneity in our study compared to other studies may be attributed to differences in the frequency of fluid consumption based on drinking habits and lifestyle in the respective locations.

According to our findings, dietary intake was significantly correlated with the formation of urolithiasis. Daily consumption of various types of market bread increased the odds ratios of urinary stones, which aligns with the results reported by Trinchieri [41]. However, Khani *et al.* found no significant correlation between bread consumption and kidney and urinary tract stones, which is inconsistent with the present study [42]. Furthermore, our study revealed that daily meat consumption increases the risk of kidney and urinary tract stones, consistent with the findings of Nguyen *et al.* [43], who observed a direct correlation between meat protein intake and kidney stones.

Liver consumption had a significant relationship with the risk of developing renal and urinary tract stones, although this relationship has not been directly mentioned in previous studies. However, Neun *et al.* reported that the consumption of animal protein can increase the risk [44]. Chard *et al.* observed a significant relationship between fish consumption and the risk of renal stone formation [45], consistent with our findings. Additionally, our study revealed that the consumption of canned foods was significantly associated with the risk of kidney and urinary tract stone formation, with weekly consumption increasing the risk, in line with Lekcharoensuk *et al.* [46].

Our study demonstrated that regular consumption of legumes reduced the risk of developing kidney and urinary tract stones. Our findings contradict the study by Dai *et al.* [47], which observed a positive relationship between legume consumption and kidney stone formation in women. The disparity may be due to differences in food consumption patterns, lifestyle, and the larger number of healthy individuals in our study. Similarly, our study showed that daily consumption of butter, cream, or kaymak decreased the odds ratio of urolithiasis, contrasting with the results of Khani *et al.* [42]. The discrepancy may be attributed to variations in food consumption patterns, lifestyle, and the larger number of healthy individuals in our study.

Furthermore, our study revealed that the consumption of ice cream reduced the chance of developing kidney urolithiasis. This finding contrasts with the findings of Khani *et al.* [42], who did not find a significant correlation between ice cream consumption and urinary stones in their research.

The heterogeneity in findings across these studies may be attributed to differences in food consumption frequencies and lifestyle habits among the study populations. It is important to note that diet plays a significant role in determining urine chemistry and can influence the risk of stone formation. Numerous studies have explored different diets and their lithogenic and prophylactic effects, particularly in calcium oxalate urolithiasis. Among the diets studied, those with high and low amounts of calcium and oxalate, either separately or combined, have been the most extensively examined [24-27]. Several excellent reviews analyzed the impact of dietary calcium and oxalate on the urinary risk factors linked to the formation of calcium oxalate stones [28-31]. These studies have provided valuable insights into the relationship between dietary and urinary risk factors.

Evidence from these studies suggests that calcium restriction can improve oxalate absorption and excretion while increasing calcium intake can bind more oxalate in the intestine and reduce its presence in the urine. This mechanism is supported by two large prospective studies showing a reduced risk of stone formation with increased dietary calcium intake [30, 31]. On the other hand, other studies have demonstrated a direct correlation between dietary oxalate and oxalate excretion [28].

In our study, the statistical population was divided into healthy individuals and patients, excluding other groups of patients with conditions such as acute or chronic renal failure, diabetes, dialysis patients, or those under special care. In a study by Nouvenne *et al.* in 2014, the effect of unhealthy eating habits on the formation of urinary stones was high. Urinary factors, such as high protein diets and significant urinary citrate levels in patients, were identified as important risk factors for kidney stone formation [44].

Our study had some limitations, such as the length of the Food Frequency Questionnaire (FFQ), which was time-consuming and sometimes led to incomplete responses from patients [38, 39]. Additionally, there were challenges related to patient recall of information, limitations in data collection, non-cooperation from some participants, and the inclusion of elderly individuals.

CONCLUSION

The findings of this study emphasize the significant impact of dietary factors on the occurrence of kidney and urinary tract stones. It is evident that careful adherence to specific dietary patterns can substantially reduce the prevalence of these conditions.

ACKNOWLEDGMENTS

Conflict of interest

The authors declare no conflict of interest.

Ethical approval

The study was approved by the Ethical Committee of Ilam University of Medical Sciences (Ethics code: (ir.medilam.rec.1395.204), and the study protocol conformed to the ethical guidelines of the 1975 Declaration of Helsinki.

Consent to participate

All participants, including patients, the control group, and illiterate participants, provided written consent approved by the ethical committee of Ilam University of Medical Sciences. Legal guardians signed the consent form for illiterate participants in this study.

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Data availability

The data for this study is available upon request.

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Authorship

ES and AK were responsible for the conception and design of the study, as well as writing the paper. They also contributed to research supervision. KS analyzed and interpreted the data. ES, ENA, and KM contributed to the final approval of the version to be published.

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