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The role of hydration in kidney stone prevention and managem

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Abstract

Background: Epidemiologic studies have suggested that daily fluid intake that achieves at least 2.5 L of urine output per day is protective against kidney stones. However, the precise quantitative nature of the association between fluid intake and kidney stone risk, as well as the effect of specific types of fluids on such risk, are not entirely clear. **Aim and Objective:** To determine the relationship between the type and frequency of fluid intake and the formation of kidney stones. **Materials and Methods**: In a case-control study, 50 newly diagnosed patients with urinary stones and the same number of healthy people were studied. The control group was matched with cases in terms of age and gender. Patients with diabetes and acute or chronic renal failure were excluded from the study. Data were collected using INSKAP-HQ-Tot questionnaire. Chi-square and correlation coefficient were used to analyze the data. **Results:** The results of this study showed that the frequency of water intake (P = 0.04), tea (P = 0.03), drink (P = 0.005), natural fruit juice (P = 0.031), industrial juices (P = 0.045), Mineral water (P = 0.052), yogurt drink (P = 0.055) and coffee (P = 0.022) was associated significantly with the risk of renal and ureteral stones ($p < 0.05$). **Conclusion:** The findings of this study showed that the risk of urinary stones formation has a significant relationship with the type and quality of fluid intake. Therefore, the precise use of fluid intake can prevent the formation of kidney stones.

Keywords: kidney stones, fluid intake, prevention, hydration

Introduction

Kidney stone is a common disease that has become increasingly prevalent over the past 2 decades. [1] Currently, the kidney stone prevalence rate worldwide is approximately 1.7% to 8.8%. [2-3] It is more likely for men aged 60 to 69 to develop a kidney stone. [4] Kidney stones can have serious clinical and economic consequences. Indeed, patients who suffer from large stones usually need surgical treatment, and in the year 2000, the cost of kidney stones was approximately $2.81 billion in the United States alone.[5]

Increased fluid intake may help prevent the formation of stones by diluting urine concentration, decreasing urine acidity, and by taking away excess salt. [6-7] These beneficial effects, however, may be offset by the tendency of increased fluid intake to dilute stone inhibitors such as magnesium, pyrophosphate, and glycosaminoglycan.[8,9] A recent meta-analysis, [10] based on the results of 2 randomized trials, concluded that high water intake decreased the long-term risk of kidney stone recurrence by approximately 60%. However, pooled evidence from only 2 studies is not conclusive. Additionally, data on the association between specific beverage types and risk of stone formation are sparse.

In a study conducted by Borghe et al in two similar groups, followed by a follow-up of 5 years, 12.1% of patients with high daily water intake had kidney stones recurrence, while in other subjects under study without any treatment this was 27%, which was statistically significant. The study also showed that patients treated with water had on average afflicted from recurrence after 38.7 months, while patients without water use had recurrence after 25.1 months [11] .

Using mineral water to compensate for lost water through the lungs, skin, urine and stool, in addition to hydration, the patient can have a greater effect on the contents of the urine and consequently the risk of stoning, due to the presence of substances such as calcium, bicarbonate and magnesium [12] . In the past, people with stoning kidney were advised to consume high levels of water with low calcium and this was due to the fact that most of the kidney stones were calcium stones and hypercalciuria was the most common metabolic disorder in these individuals. However, recent studies have questioned the above-mentioned theory [13] and have shown an inverse relationship between water hardness and kidney stone disease [14] .

In this regard, the role of using adequate fluids in preventing the formation and recurrence of urinary stones has been reported in various studies [12] . Although there is ample evidence of the effect of daily consumption of 2 liters of water in primary prevention of urinary stones, this working procedure has not yet been implemented as a public health policy. However, other studies also indicate the cost of its effectiveness [15] . Considering the fact that the pattern of fluid consumption in healthy people and people with urinary stones is unclear, and there is also little information about the effect of the use of fluids on the prevention of urinary stones, the aim of this study was to determine the relationship between the type and frequency of fluid intake and the formation of kidney stones.

Materials and Methods

This study was a case-control one in which 50 patients with urinary tract stones and 50 subjects, matched in terms of age and sex with the case group, as control group were entered into the study as participants. The study was done consciously and with the consent of the people. The pattern of food intake was gathered using the INSKAP-HQ-Tot standard questionnaire whose validity and reliability were confirmed in previous studies. Frequency of consumption was related with carbonated beverages, non-alcoholic malt beverage, dough, coffee, natural juices, industrial juices, mineral water and tea. Answers to questions were in the range including: never, rarely, daily, and weekly. Data were collected on demographic and disease characteristics in both case and control groups. Patients were selected from among clients of specialized

clinics during whose ultrasound were first identified kidney stones. Patients with acute or chronic renal failure, diabetics, dialysis patients, or under special care were excluded. The control group was selected at the same time period and in specialized clinics from among those without kidney stones based on ultrasound examination. The method of obtaining information from the subjects was conducted by direct interview by trained experts. Then, the data were entered into SPSS software version 23. They were analyzed using descriptive statistics, chi-square and correlation coefficient.

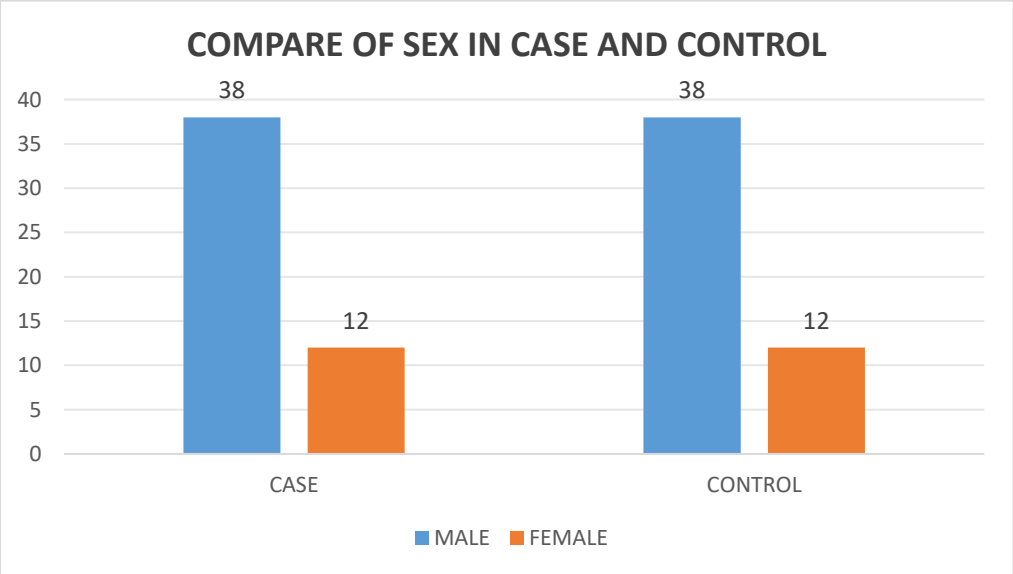
Observation and Results

The findings of this research showed that out of 254 people of the case (n=50) and control (n=50), 76 people (76%) were man and 24 people (24%) were women. The two groups were matched in terms of age and sex in the groups under study. The demographic characteristics of patients with kidney stones and healthy subjects have been shown in Table 1. Out of the demographic information, BMI was statistically different between the two groups (p = 0.001).

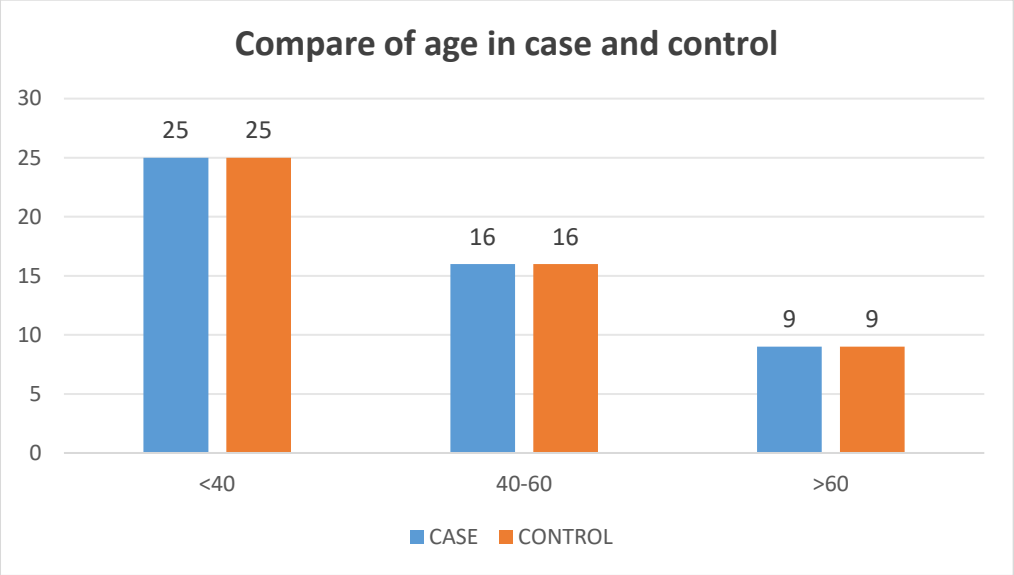
Table 1. Demographic characteristics of patients with kidney stones and healthy people

Variable		Case		Control n= 50(%)		p- value
		n= 50	(%)	n= 50	(%)	
Age:	<40	25	50	25	50	0.1
	40-60	16	32	16	32	0.1
	>60	9	18	9	18	0.1
Occupation:	Manual worker	9	18	9	18	0.1
	Employee	13	26	11	22	0.638
	Other and Academic	27	54	30	60	0.541
marital status:	Married	49	98	48	96	0.55
	Single	1	2	2	4	0.552
Gender:	Male	38	76	38	76	0.1
	Female	12	24	12	24	0.1
Living place:	City	35	70	38	76	0.49
	Village	15	30	12	24	0.49
The economic	Weak	9	18	11	22	0.617
	Medium	26	52	25	50	0.841

situation:	Good	**15**	**30**	**14**	**28**	**0.825**
Body Mass Index:	Lack of weight and normal	**16**	**32**	**27**	**54**	**0.026**
	Overweight	**22**	**44**	**13**	**26**	**0.0587**
	Obese	**12**	**24**	**10**	**20**	**0.631**
Daily activity:	No activity	**11**	**24**	**13**	**26**	**0.638**
	30 minute	**13**	**26**	**10**	**20**	**0.477**
	one hour	**17**	**34**	**19**	**38**	**0.674**
	More than an hour	**9**	**18**	**8**	**16**	**0.787**
History of urinary stones in first degree relatives:	Yes	**27**	**54**	**26**	**52**	**0.841**
	No	**23**	**46**	**24**	**48**	**0.841**



Graph no. 1 compare of gender between case and control



Graph no. 2: compare of age in case control

Table 2. relationship between fluid intake frequency and the risk of formation of kidney stones

Variable		Case	Control	Statistic of Chi square ($\chi 2$)	p- value
		n= 50	**n= 50**		
Water	<1 glass per day	**8**	**5**	**2.891**	**0.0408**
	(2 to 3 glasses) per day	**15**	**13**		
	(4 to 5 glasses) per day	**17**	**20**		
	(at least 6 glasses) per day	**10**	**12**		
Tea	<1 glass per day	**4**	**8**	**3.233**	**0.0357**
	(2 to 3 glasses) per day	**17**	**18**		
	(4 to 5 glasses) per day	**10**	**9**		

	(at least 6 glasses) per day	**19**	**15**		
	(never)	**14**	**16**	**5.26**	**0.0156**
Beverage	(rarely)	**13**	**18**		
	(weekly)	**12**	**8**		
	(daily)	**11**	**8**		
	(never)	**14**	**5**	**18.748**	**0.0031**
Natural fruit juice	(rarely)	**16**	**17**		
	(weekly)	**14**	**18**		
	(daily)	**6**	**10**		
	(never)	**20**	**16**	**1.588**	**0.0451**
Industrial fruit juice	(rarely)	**16**	**17**		
	(daily) and (weekly)	**14**	**17**		
	(never)	**6**	**3**	**4.809**	**0.0186**
Dough	(rarely)	**13**	**9**		
	(weekly)	**25**	**32**		
	(daily)	**9**	**6**		
	(never)	**7**	**9**	**2.235**	**0.0525**
Mineral water	(rarely)	**15**	**17**		
	(weekly)	**19**	**18**		
	(daily)	**9**	**6**		
	(never)	**25**	**32**	**7.615**	**0.022**
Coffee	(rarely)	**13**	**12**		
	(daily) and (weekly)	**12**	**6**		
	(never)	**15**	**13**	**2.084**	**0.0555**
Malt	(rarely)	**13**	**16**		
	(weekly)	**17**	**14**		
	(daily)	**5**	**7**		
	(never)	**6**	**5**	**0.9.7**	**0.823**
Milk	(rarely)	**11**	**9**		
	(weekly)	**18**	**20**		
	(daily)	**17**	**16**		

Table 2 shows the association between the frequency of fluid intake and the risk of kidney stones formation. Frequency of water intake was obtained among the groups under study. According to the information obtained, the distribution of water usage

frequency in the two groups seems different, so that the water intake frequency by maximally one glass per day in the case group is of more density. Chi-square test was used to determine the correlation between water use frequency and kidney stones, the results of which are presented in Table 2. As can be seen, according to Chi-square statistics (p <0/05), there is a relationship between the frequency of water use and the formation of kidney stones.

As shown in the table, the frequency of tea drinking has been reported among the groups under study. According to the information obtained, the distribution of tea intake frequency in both groups seems to be different, so that the tea intake times at least 6 glasses per day in the case group is of more density. As can be seen, according to Chi-square statistics (p <0/05), there is a relationship between the frequency of tea drinking and the formation of kidney stones. According to the information obtained, the distribution of the frequency of consumption of beverages in both groups seems different, so that the frequency of consumption of beverages on a weekly and daily basis in the case group is of more density. The Chi-square test was used to determine the relationship between the frequency of drinking use and the formation of kidney stones.

Table 2. As can be seen, according to Chi-square statistics (p <0/05), there is a relationship between the frequency of drinking use and the formation of kidney and stones. The correlation coefficient of that the high frequency of consumption of beverages increases the risk of the formation of kidney stones (P <0.05). According to Table 2, the frequency of intakes of natural fruits juices in both groups seems to be different, so that the lack of consumption or low consumption of natural fruit juices in the case group is of more density. Chi-square test was used to determine the correlation between the frequency of natural fruit juices and the formation of kidney stones. The results are presented in Table 2. As can be seen, according to Chi-square statistics (p <0/05), there is a relationship between the frequency of consumption of natural fruit juices and the formation of kidney and urinary tract stones. The correlation coefficient showed that normal consumption of natural fruit juices reduced the risk of kidney stones (P <0.05).

The frequency of consumption of industrial fruit juices among the groups under study has been given in Table 2. Since the frequency of more than 20% of the cells was less than 5, the weekly and daily classes were merged. According to the obtained data, the distribution of water consumption frequency of industrial fruits in different groups seems to be different, so that the lack of consumption of industrial fruit juices in the case group is of more density, while the low or high consumption of natural fruit juice in the control group is of higher density. Chi-square test was used to check the correlation between the consumption frequency of industrial fruit juices and the formation of kidney stones. The results are shown in Table 2. As can be seen, according to Chi-square statistics (p <0/05), there is a relationship between the frequency of consumption of industrial fruit juices and the formation of kidney and urinary tract stones. The correlation coefficient also showed that non-consumption of industrial fruit juices increases the risk of the formation of kidney stones, and their usual consumption reduces the risk of the formation of kidney and urinary tract stones (P <0.05).

According to the obtained data, the distribution frequency of dough usage in both groups seems different, so that the lack of consumption or low consumption of dough in the case group is of more density, whereas weekly and daily consumption of dough in the control group has a higher density. As shown in Table 2, according to Chi-square statistics (p <0/05), there is a relationship between the frequency of dough usage and the formation of kidney and urinary tract stones. The value of correlation coefficient showed that non-consumption or low consumption of dough increases the risk of the formation of kidney and urinary tract stones and their usual consumption reduces the risk of the formation of kidney stones (P < 0.05)

According to Table 2, the distribution frequency of mineral water intake in both groups is different, so that the absence of mineral water in the case group is of more density, while the daily intake of mineral water in the control group is of greater density. As can be seen, according to Chi-square statistics (p <0/05), there is a relationship between the frequency of mineral water use and the formation of kidney stones. The correlation coefficient showed that low consumption frequency of mineral water intake increases the risk of the formation of kidney stones, and its usual or high consumption reduces the risk of the formation of kidney stones (P <0.05).

Table 2 shows the frequency of coffee intake among the groups under study. Since the frequency of more than 20% of the cells was less than 5, the weekly and daily classes were merged. According to the information obtained, the distribution of coffee intake frequency in both groups seems to be different, so that weekly and daily coffee intake in the case group is more densely charged. As can be seen, according to Chi-square statistics (p <0/05), there is a relationship between the frequency of coffee consumption and the formation of kidney stones. The correlation coefficient also showed that high coffee consumption frequency increased the risk of kidney stones (P <0.05).

Table 2 shows the frequency of malt consumption among the groups under study. According to the data, the distribution of drinking malt frequency is similar in both groups. As can be seen, according to Chi-square statistics (p > 0.05), there is no relationship between the frequency of consumption of malt drinks and the formation of kidney stones. The correlation coefficient was 0.03, which is not significant at the 5% level (P > 0.05). According to the information obtained, the distribution of milk intake frequency is similar in both groups. A chi-square test was used to check the relationship between the frequency of milk consumption and the formation of kidney stones. The results are presented in Table 2. As can be seen, according to Chi-square statistics (p > 0.05), there is no relationship between the frequency of milk consumption and the formation of kidney stones. The correlation coefficient was 0.03, which is not significant at the 5% level (P > 0.05).

Discussion

According to the findings of this study, fluid use showed a significant relationship with the formation of kidney and urinary tract stones (p <0.05). Increasing fluid intake reduces the concentration of compounds that can be sedated in the urine. On the other hand, it decreases the free crystalline particles staying time in the urine [16]. There is also some evidence indicating that adequate fluid intake prevents the recurrence of kidney stones [11]. In the present study, the frequency of the use of water, tea, natural

juice, industrial juice, mineral water, dough, beverages, and coffee showed a significant relationship with the risk of the formation of kidney stones ($p < 0.05$). In the present research, it has been shown that low water consumption increases the risk of the formation of kidney stones, or, in other words, the usual use of it reduces the risk of the formation of kidney stones, which is also consistent with the results of the study done by Matthew et al. [17]. Anderson, in his research, showed that the risk of recurrence of stones in people who are in the lower quartile is 41% higher than those in the upper quartile [18]. In external studies, it has been shown that the consumption

of colas and carbonated beverages, by increasing the oxalate secretion, tends to produce oxalate calcium stones [19]. Demographic studies in Iran have also recognized the use of cola and carbonated drinks as a risk factor for urinary stones, as well as tea consumption [20]. Anderson's research results showed that consumption of cola-containing drinks, due to their high phosphorus content, increases urinary oxalate secretion, probably causing calcium oxalate stones [21]. In our study, it was also found that increasing the frequency of use of tea and drinks increases the risk of the formation of kidney stones. The findings of this research showed that the usual consumption of liquids such as natural juice, industrial juice, and mineral water reduces the risk of the formation of kidney stones. This is consistent with the results of the study by Hesse et al., who stated that a diet with high-grade liquids reduces the risk of developing urinary stones [22]. Rogers also found in his research that mineral water containing calcium and magnesium plays a role as a prophylactic and therapeutic agent for kidney and urinary tract stones [23–24].. In a prospective study conducted by Aras et al., it was found that the use of lemon juice can be a substitute for the treatment of patients with urinary calcium stones [25]. This is consistent with our study. In a study done by Karhan et al., it was suggested that a calcium-based diet reduces the risk of kidney stone formation [26]. This is consistent with the current study, which states that the usual consumption of dough containing calcium reduces the risk of the formation of kidney and urinary tract stones. In a meta-analysis study carried out by Wang et al., coffee consumption reduced the risk of developing kidney and urinary stones [27]. It was not consistent with the present study, which indicates that increased coffee intake increases the risk of kidney and urinary tract stone formation. In a study conducted by Borghi et al., it was found that increasing fluid intake to the extent that urine volume reaches 2 liters leads to a significant reduction in calcium and oxalate concentrations and reduces the rate of recurrence of stones [11].

Although the fluid intake in stone patients should be increased, there is still little information about the effect of different beverages on urinary stones [28]. The results of this research indicate that coffee consumption in our population under study was high, and coffee intake is more common in patients with stones; besides, there was a significant difference in the frequency of tea drinking. In some research, the consumption of coffee and alcoholic beverages has been associated with a reduction in a reduction in the risk of stone formation, while the consumption of beverages containing bicarbonate has an increased risk of stone formation [29]

Our study is also supported by Ali Khorshidi et al. Chi-square and correlation coefficients were used to analyze the data. Results: The results of this study showed that the frequency of water intake ($P = 0.003$), tea ($P = 0.008$), drink ($P = 0.005$), natural fruit juice ($P = 0.001$), industrial juices ($P = 0.001$), mineral water ($P = 0.001$),

yogurt drink (P = 0.008), and coffee (P = 0.015) was associated significantly with the risk of renal and ureteral stones (p <0.05). [30] The findings are different in relation to tea. In Curhan's research, the use of tea, coffee, and alcoholic beverages (with or without caffeine) was associated with a reduction in the risk of urinary stone formation, while there was no relationship between the consumption of drinks containing bicarbonate and the risk of urinary stone formation [28].

Conclusion

The implication of this study is that fluid intake can prevent the emergence of diseases related to kidney stones to a considerable extent. In order to prevent the development of kidney stones, scientific and accurate food programs are necessary; they can be avoided by observing them.

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