



## Preventive behaviors in recurrent kidney stone and barriers to performing these behaviors

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### Abstract

Incidence and recurrence of kidney stones is increasing worldwide. There are certainly many barriers in performing health behaviors like preventive behaviors in recurrent kidney stones. This study was conducted with the aim to investigate preventive behaviors in recurrent kidney stones and barriers to performing these behaviors. In this study, 210 patients referred to 3 health centers were selected as participants. Data collection tool was a questionnaire, comprising personal details and questions to evaluate preventive behaviors from recurring kidney stones and obstacles to perform such behaviors, which was completed in the form of interviews. Mean score of recurrence preventive behaviors was  $38.75 \pm 7.85$  out of 70, and mean score of perceived obstacles was  $34.07 \pm 7.39$  out of 60. There was an inverse and significant correlation between preventive behavior and perceived obstacles. The least recurrent preventive behavior was consulting nutritionist about the use of fruit and vegetables according to stone type, and lack of drinking water at least 2 to 3 liters daily was reported as the next behavior. Lack of knowledge of appropriate diet to prevent kidney stone recurrence was the biggest obstacle that people faced in during performing these behaviors. Through educating patients with kidney stone and their families, with emphasis on diet associated to type of kidney stone and importance of regular intake of water reduced recurrence of the disease or at least the interval between recurrences increased.

**Keywords:** Barrier, Behavior, Kidney, Prevention, Recurrence

### Introduction

Kidney stone is the most well-known urinary tract disorder, which has always been a matter of concern as an old health problem [1]. The annual incidence of stone formation in industrialized countries has been reported 1500 to 2000 cases per million people [2]. The rate of stone formation has been reported different in various parts of the world; in North America 1-3%, Europe 3-9%, Asia 1-5%, and Saudi Arabia 20% [3]. The highest number of patients

with endemic form is in the Middle East and Southeast Asia, which is why these areas are known as the "stone belt". In geographical terms this belt start from Egypt and Turkey in the west and end to Indonesia in the east, which includes Iran as well [1]. In a study conducted in Iran in 2005, prevalence of this disease was reported 5.7% [4]. In terms of prevalence of stone formation, 12% of men and 5% of women experience stone formation at least once in their life (men are 2-3 times

more than women). In human, stone formation occurs in the second to fifth decades of life [5]. A large number of referrals to emergencies consist of patients with kidney stone, so that, according to a survey in the United States, annually 1100. 100 visits to emergency are patients with kidney stone diagnosis, which require diagnostic and treatment procedures [6]. Although, recent advances in nephrology, modern diagnostic and medical methods have reduced morbidity induced by kidney and urinary tract stones, long-term complications such as recurrence of stone and kidney failure can involve patients in the future [7]. This disease also leads to impairment in the function of patients, which consequently impose the burden of social, economic, and personal costs. Thus, attention and recognition of risk factors in preventing incidence and recurrence of kidney stones is highly important. One of these factors is reduced urine volume following excessive sweating and reduced water consumption [8]. Obesity and weight gain increase risk of kidney stone formation and; this elevated risk is higher in obese women compared to obese men [9]. Prevalence of stones is higher in warmer climates [10]. The change in socio-economic status that leads to change in food habits, not only affects prevalence of stone, it also affects on stone site and composition [11]. In addition to high levels of urinary stones, recurrence rate is also high, so nearly 60% of those who make one stone, will make another stone within the next 10 years. The rate of new stone formation in patients with history of stone is approximately one stone in every 2 to 3 years [12]. In Iran, mean recurrence of stone has been reported 16% after one year, 33% after 5 years, and 53% after 10 years [4]. Recurrence of kidney stone not only causes pain and despair in patients, it also imposes considerable economic burden associated with loss of daily income and health care costs [13]. The expenses of eliminating stones in patients with recurrent stone, using minimal invasive urology procedures are considerable. Thus, actions to prevent stone recurrence are much more cost effective [14]. Intake of ample liquids and water is an effective

strategy that is recommended for prevention of stone formation. Large amounts of liquids cause increased volume of urine and reduce load of the solution, resulting in prevention of formation of stone nucleus [15]. Studies indicate the risk of recurrence of stone in people in lower quarter of water consumption is 41% more than those in the upper quarter [16]. Borghi et al, found that increased intake of liquids, as much as to cause urine volume to reach 2 liters, led to significantly reduced calcium and oxalate concentration and stone recurrence rate [17]. Given the difficulties associated with treatment of urinary stones and costs incurred, modifying dietary pattern can be a simple and inexpensive means to reduce burden of this disease on the individual and society [18]. Prevention of kidney stone recurrence for a long time after treatment and sometimes to the end of life is necessary. In many patients a piece of stone may still remain in kidney these patients require special attention in relation to prevention of recurring kidney stone [19]. Dehghani et al. investigated state of patients with urinary stones in Shahid Rahnemoon hospital in Yazd during 1995-1998 and considered that environmental factors and warm climate are effective in earlier onset of urinary stones [20]. Various studies have considered preventive behaviors such as: keeping body mass index at an appropriate level, adequate physical activity [21], balanced intake of calcium and low consumption of salt [22,23], low intake of animal proteins [24,25], balanced nutrition and adequate daily intake of liquids (2-3 liters), especially for those who have heavy exercise and activities are important for prevention of stone formation [21].

The concept of perceived obstacles has been introduced in many theories of: behavior change in health education [26], trans-theoretical model [27], and social cognitive theory [28]. The health belief model denotes construct of perceived obstacles in the framework of "expected value". It means that the more perceived obstacles are for conducting desired behavior, the less

likelihood of incidence of that behavior is [26]. On the other hand, according to the opinion of researchers, perceived obstacles are the most important dimension in expressing or predicting health preservation behaviors [29]. Perceived obstacles are potential features that act as an obstacle to conducting a behavior; and they are studied in two aspects:

*Cost-benefit:* This relates to individual's assessment of benefit of behavior. The answer of individual to this question is whether performing a behavior is worth the costs incurred, or the time spent?

*Side effects:* The negative aspect of behavior for the person may be potentially unpleasant, painful, distressing, inappropriate, or time consuming. These problems, as negative aspects of behavior are as obstacles and they affect on performing behavior by person [26]. Morowatisharifabad, Shakibazadeh, Aghamolae, Karimi, Rahae and Mosca concluded about relationship of behavior and perceived barriers that there was a negative and significant correlation between perceived barriers and behavior adopted [30-37]. To perform a health behavior like preventive behavior from recurrence of kidney stones, there are certainly many barriers. Any study has yet been conducted in relation to kidney stone recurrence preventive behavior and barriers to performing this behavior. Thus, recurrence of kidney stones can be prevented considering to performing preventive actions, this study investigates preventive behaviors from recurrence of kidney stones and barriers to performing these behaviors in people with history of kidney stone.

## Method

This research was a cross-sectional study. According to formula proposed by Tabachnick and Field, minimum sample size needed for such studies is calculated by  $N=50+8m$  [38], where, N is the sample size and m is the number of independent variables. Given the above formula, 210 patients referred to three specialized health centers affiliated to Yazd University of Medical Sciences, in the form

of proportional representation (proportional to number of referrals to nephrology and urology departments in each center); 107 patients (50%), 40 patients (19%) and 63 patients (30%) respectively, were randomly selected from the above centers. Sampling method was such that researcher would spent two days a week in each of the above centers, and after explaining objectives of study and completion of consent form by each of the patients qualified for entry into the study, questionnaire was completed through an interview.

Study inclusion criteria were: minimum of at least once experience of kidney stone diagnosed by the doctor, aged over 15 years, resident in Yazd province, Iran, and consent to take part in the study. Those referred for the first time, the very old and unable to understand and answer questions, and patients referred to in pain and discomfort were excluded from this study.

Tools used for collection of data were as follows:

Underlying and demographic details questionnaire, including: age, gender, education level, occupational status, household size, family history of kidney stone, first time afflicted, number of times of affliction, and economic status of study subjects was recorded according to their own viewpoint. The height and weight indices were recorded and BMI was calculated.

Preventive behaviors from recurrence of kidney stone were assessed by 14 questions and with 5-point Likert scale. Possible attainable score was in the range of 14-70 marks. These behaviors included: restricted use of salt, restricted animal protein intake, drinking 2-3 liters of water daily, consumption of dairy products, more water intake when perspiring, timely treatment of urinary tract infection, drinking water before feeling thirsty, minimum daily physical activity of 30 minutes, and consulting nutritionist to receive appropriate diet program for stone. Higher scores attained indicated performing more Preventive behaviors from recurrence

of kidney stone. This 12-item scale included barriers to performing kidney stone recurrence preventive behaviors, including: costly diet program for prevention of recurrence of kidney stone, lack of knowledge of appropriate diet, lack of access, physical barriers, and etc. Items were scored according to 5-point Likert scale. Possible attainable score ranged 12-60. Higher scores attained indicate more barriers to performing Preventive behaviors from kidney stone recurrence. To determine face validity of the questionnaire, 10 copies of the questionnaire were issued to 5 PhDs (and PhD students) of health education, all with experiences in the field of health belief model, 3 nephrology specialists and subspecialists, 1 urology specialist and 2 dieticians, and they were requested comment on factors associated with preventive behaviors from kidney stone recurrence based on health belief model in relation to appearance of the questionnaire. Modifications were made to the questionnaire in accordance with their views and finally face validity of the questionnaire was thus provided and confirmed. After assessment of content validity to determine reliability of

the questionnaire, a preliminary study was conducted on 20 people that qualified for entry in the study and coefficient of Cronbach's Alpha (internal consistency of variables) was calculated 0.87 for preventive behaviors and 0.73 for perceived barriers.

Collected data was entered into computer in code form and they, were analyzed with SPSS-16 software using independent T-test, variance analysis with Tukey post hoc test, Pearson correlation coefficient and Chi-squared.

**Results**

Study subjects were aged between 16 and 84 years, with mean age of 42.51±12.92 years. 45.2% were female and 54.8% were male (men to women ratio were 1.21:1). In terms of education, 54.8% were illiterate and under high school Diploma, 32.9% were with Diplomas and 11.4% were with higher Diploma and above. In terms of occupation, housewife and freelance had the most frequency (Table 1).

Mean BMI was 26.4±4.38, with 63.3% of people being obese and over-weight. 52.9% of study subjects had family history of kidney

**Table 1** Frequency distribution of demographic details in study subjects

Variable	Variable value	Number	Percentage	Mean ±SD
Age	Under 30	44	21	42.5±1.29
	30-50	108	51.4	
	Older than 50	58	27.6	
Gender	Male	115	54.8	
	Female	95	45.2	
Education	Illiterate	35	16.7	
	Under diploma	82	39	
	Diploma	69	32.9	
	Higher diploma and above	24	11.4	
Household size	1-4	114	54.3	4.62±1.94
	4-6	66	31.4	
	>6	30	14.3	
Economic status	Poor	44	21	
	Average	145	69	
	Good	21	10	
Occupation	Unemployed	7	3.3	
	Housewife	82	39	
	Employee	15	7.1	
	Freelance	45	21.4	
	Driver	23	11	
	Laborer	26	12	
	Retired	12	5.7	

stone. Most people (48.6%) had kidney stone history of 2 to 3 times. Related data to other underlying variables are presented in Table 2.

Among areas of preventive behavior from recurrence of kidney stone, drinking more water when perspiring and intensive activity

**Table 2** Frequency distribution of underlying variables in study subjects

Variable	Variable value	Number	Percentage	Mean ± SD
BMI	<18.5	5	2.4	26.4±4.38
	18.5-24.99	72	34	
	25-29.99	99	47.1	
	≥30	34	16.2	
Family history of kidney stone	History	111	52.9	
	No history	99	47.1	
Frequency of kidney stone affliction	1	57	27.1	3.7±3.25
	2-3	102	48.6	
	>3	51	24.3	
Time since first affliction with kidney stone (years)	≤1	43	20.5	6.78±6.75
	<1≤5	80	38.1	
	<5≤10	43	20.5	
	>10	44	21	
Current status of renal stone	Stone	106	55.5	
	No stone	104	49.5	

were the most frequent, and treatment of urinary infection, restricted salt use, and restricted sweets and sugar products came next. The least frequent were consulting dietician or physician about use of fruit and vegetables

and also appropriate diet to kidney stone and drinking 2-3 liters of water regularly per day. Mean score of recurrence preventive behavior was 38.75±7.85 out of attainable range 14-70. Data associated with other behaviors are

**Table 3** Frequency distribution of performing status of preventive behaviors in study subjects

Performing status of preventive behaviors	Always		Often		Sometimes		Rarely		Never		Item Mean
	N	%	N	%	N	%	N	%	N	%	
Drinking more water when sweating and doing intensive activity	43	20.5	79	37.6	47	22.4	29	13.8	12	5.7	3.53
Urgent treatment of urinary infection	45	21.4	56	26.7	55	26.2	44	21	10	4.8	3.39
Restricted salt intake	40	19	72	24.3	35	16.7	45	21.4	18	8.6	3.33
Restricted use of sweets and sugar products	40	19	50	33.8	42	20	42	27.6	20	9.5	3.15
Minimum of 30 minutes exercise and walking daily	31	14.8	42	20	53	25.2	64	30.5	20	9.5	3
Use of 2-3 glasses of milk and yogurt daily	19	9	47	22.4	65	31	59	28.1	20	9.5	2.93
Not to forget water intake in all situations	17	8.1	36	17.1	84	40	62	29.5	11	5.2	2.93
Drinking water regularly and before feeling thirsty	28	13.3	33	15.7	46	21.9	53	25.2	50	23.8	2.69
Restricted use of animal proteins (red meat, fish and chicken) to 2-3 times per week	17	8.1	37	17.6	53	25.2	59	28.1	44	21	2.63
Visiting renal specialist minimum of once a year	19	9	24	11.4	48	22.9	67	31.9	52	24.8	2.48
Consulting physician if taking any medication or supplement	12	5.7	29	13.8	40	19	40	31.9	62	29.5	2.34
Drinking minimum of 2-3 liters of water daily	21	10	18	8.6	27	12.9	53	25.2	91	43.3	2.16
Consulting dietician to regulated diet according to type of stone	10	4.8	16	7.6	34	16.2	34	38.6	69	32.9	2.12
Consulting dietician about use of fruit and vegetables according to type of stone	7	3.3	13	6.2	35	16.7	35	36.7	78	37.1	2.01



presented respectively from highest mean to lowest in Table 3.

As order of mean items can be seen from table 4, lack of knowledge of appropriate diet for prevention of recurrence was the biggest barrier felt by people in performing preventive behaviors from kidney stone recurrence, and unpleasantness of complying with the

diet and disinterest in drinking water came next down the line, while lack of access to healthy water was the least barrier reported by subjects. Mean score of perceived barriers was  $34.07 \pm 7.39$  out of attainable range 12-60. The T-test showed significant difference between gender and perceived barriers and also preventive behaviors from recurrence

**Table 4** Frequency distribution of answers and mean score of perceived barriers items in study subjects

Answers to items of perceived barriers	Totally agree		Somewhat agree		No comment		Somewhat disagree		Totally disagree		Item Mean
	N	%	N	%	N	%	N	%	N	%	
Lack of awareness of diet	83	39.5	79	37.6	16	7.6	26	12.4	6	2.9	3.98
Unpleasant of complying diet	52	24.8	63	30	30	14.3	47	22.4	18	8.6	3.4
Dislike to drink 2-3 liters of water daily	45	21.4	79	37.6	13	6.2	41	19.5	32	15.2	3.30
Lack of family support to comply with diet	31	14.8	59	28.1	12	5.7	63	30	45	21.4	2.84
Cost of diet	17	8.1	59	28.1	35	16.7	70	33.3	29	13.8	2.83
Lack of exercise facilities	32	15.2	49	23.3	13	6.2	80	38.1	36	17.1	2.81
Lack of access to proper dietary model	15	7.1	55	26.2	35	16.7	75	35.7	30	14.3	2.76
Insufficient time for exercise	26	12.4	51	24.3	14	6.7	81	38.6	38	18.1	2.74
Difficulty of exercise due to poor physical condition	29	13.8	36	17.1	13	6.2	67	31.9	65	31	2.5
Not drinking sufficiently due to problems of frequent urinating	26	12.4	34	16.2	12	5.7	65	31	73	34.8	2.4
Inability to drink water due to disease	11	5.2	49	23.3	14	6.7	62	29.5	74	35.2	2.32
Lack of access to healthy drinking water	5	2.4	31	14.8	22	10.5	80	38.1	72	34.3	2.12

of kidney stone, so that perceived barriers were observed more in women and preventive behaviors more in men (table 5). This test revealed no significant difference between perceived barriers based on family history of kidney stone and the person's current state (healthy or with stone). Also, no significant

difference was found between preventive behavior based on family history of kidney stone and person's current state (healthy or with stone).

Pearson correlation test showed a direct and significant relationship between perceived barriers and age ( $P=0.007$ , and  $r=0.178$ ) in

**Table 5** Perceived barriers and preventive behavior from recurrence of kidney stone according to gender in study subjects

	Female		Male		Total		T-test result
	Mean	SD	Mean	SD	Mean	SD	
Perceived barriers	35.48	6.8	32.9	7.67	34.07	7.39	0.012
Preventive behaviors	37	7.59	40.2	7.8	38.75	7.85	0.003

this study. A direct and significant relationship was also found between preventive behavior from recurrence of kidney stone and frequency of kidney stone affliction ( $P=0.038$ , and  $r=0.143$ ). Also, age was found to have direct and significant relationship with frequency of kidney stone ( $P=0.032$ , and  $r=0.148$ ) and with BMI ( $P=0.000$ , and  $r=0.243$ ).

According to the findings, mean of perceived barriers was reported different in terms of education level ( $P=0.000$ ), so that in the illiterate group, mean of perceived barriers was significantly higher than in higher educated group ( $38.8\pm 5.25$ ). A significant difference was also observed in perceived barriers according to economic status ( $P=0.007$ ) and perceived barriers were significantly higher in poorer economic status barrier compared to good or moderate economic status ( $37.04\pm 7.07$ ). There was an inverse and significant relationship between perceived barriers and preventive behavior ( $P=0.000$ , and  $r=-0.31$ ).

## Discussion

According to the results obtained in the present study aimed to investigate preventive behavior from recurrence kidney stone and barriers to performing this behavior, people studied in terms of preventive behaviors from kidney stone recurrence were in a moderate level while perceived level of barriers in these behaviors was relatively high. Clearly, it seems these barriers can impede performance of these behaviors.

Men to women ratio with kidney stone according to the results was 1.21:1. This ratio was reported 1.98:1 by Shirazi *et al.* [39], 2-3:1 by Eric and *et al.* [5], and 1.56:1 by Trencher *et al.* [40]. An epidemiological study in Yazd by Dehghani *et al.* in 1998 by reviewing patients' files with urinary stone in Rahnemoon hospital revealed ratio of men to women 1.98:1 [20]. In more than half study subjects (63.3%), BMI was higher than the normal range. This result was reiterated in studies by Hassapidou [41], Shirazi [37], and Foladi *et al.* [42].

In the present study, the highest percentage of people (51.4%) was in age range between 30 and 50 years, which was approximately in line

with previous studies [41, 42]. In the present study, mean score of behavior was 38.75 in possible attainable score of 14 to 70. This meant that on average, 55.1% of study subjects performed preventive behaviors. Mean score of perceived barriers to performing preventive behaviors was 34.07 out of possible 12-60 range. This figure shows that people with history of kidney stone felt many barriers in performing preventive behaviors which is in agreement with findings of Shakibazadeh & Rashidian [32] in relation to perceived barriers relationship with self-care performance in patients with diabetes type II. However, these findings are different to the findings by Moravati-Sharifabad and Rohani-Tonekaboni. In the aforementioned study, patients scored less than half attainable marks for perceived barriers, which meant that perceived barriers to preventive behaviors from recurrence of kidney stone are higher than barriers to self-care diabetes. Moreover, the differences may have been induced by use of different diagnostic tools or the difference in type of behaviors in these studies. As was observed in the results section, the biggest barrier felt by people was lack of knowledge of appropriate diet to prevent recurrence of kidney stones. Steve *et al.* [43] also in their study concluded that people have poor knowledge of kidney stone and its suitable diet and also importance of intake of more liquids to prevent recurrence of stone. One of the reasons for lack of knowledge in the present study could be due to level of education of these people, so that more than half study subjects were illiterate or educated to less than high school diploma level (69.47% of women, and 44.34% of men). In the study by Shirazi *et al.* [39], patients with urinary stones were less educated compared to those in control group. Krieger *et al.* in a case-control study found risk of urinary stone reduced with higher education level; possible reason for this reduction was considered to be due to dietary differences and behavioral habits resulting from increased knowledge with higher level of education [44].

According to the results of present study,

there is an inverse and significant relationship between perceived barriers and preventive behaviors. This finding is in agreement with majority of studies concerned with relationship between perceived barriers and preventive behaviors [30-37] and it is very logical that by reducing barriers could increase behavior performance significantly. Other findings from this study showed that perceived barriers to perform preventive behaviors from kidney stone recurrence was significantly higher in women compared to men. This can be attributed to women's lower education level compared to men. Also mean performance of preventive behavior from kidney stone recurrence was lower in women compared to men, which confirms the inverse relationship between preventive behavior and perceived barriers.

Other barrier to performing preventive behaviors from kidney stone recurrence was unpleasantness of complying with dietary regime and lack of desire to drink sufficient water. These barriers are due to lack of knowledge about importance of drinking water and complying with dietary regime to prevent recurrence of kidney stone. These barriers could be rooted in people's lifestyle and food habits in a particular region. Non-observance of health behaviors due to lack of knowledge can be seen in any society, and correct or incorrect behavior is considered part of culture which requires qualitative studies in this area. The least frequency in performing preventive behaviors was associated with consulting dietician or physician about use of fruit and vegetables and also appropriate diet to type of kidney stone. Evidence revealed that many physicians did not establish an effective relationship with patients in their medical experience [5]. This shows the need for allocating adequate time to patients, as well as consideration for patient's feelings by the physician. In addition to attention to kidney stone disease, physicians should also consider the patient and his lifestyle and teach correct behaviors to the patient through discovering wrong habits in patient's life. In this area, one of limitations in this study was lack of assessment of patient satisfaction with physician's consultation and behavior.

However, method of data collection through interviews may have interfered with interpretation of results and the interviewee may have given answers he thought pleasing to the interviewer despite being unreal.

### **Conclusion**

This study showed, despite preventive behavior from recurrence of kidney stone being at a moderate level, still barriers to performing these behaviors are so many that can impede performing these behaviors. Thus, eliminating barriers in performing these behaviors as much as possible seems necessary for conducting correct behaviors by people. The construct of perceived barriers can be used as a model for educational interventions to create action. Therefore, reducing perceived barriers especially lack of knowledge must take priority in performing preventive program. Also, through educating patients with kidney stone in their first experience and through modification of habits and food patterns with emphasis on importance of drinking water and consultation with dietician and intake of appropriate diet to type of stone, it is possible to reduce recurrence of disease or at least increase recurrence intervals.

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### **Contributions**

Study design: MMA, PR, HR, AM

Data collection and analysis: MMA, PR, AM

Manuscript preparation: MMA, PR.

### **Conflict of interest**

"The authors declare that they have no competing interests."



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