Original Article - Endourology/Urolithiasis

ICUrology 2016;57:196-201.
http://dx.doi.org/10.4111/icu.2016.57.3.196
pISSN 2466-0493 • eISSN 2466-054X

INVESTIGATIVE AND CLINICAL UROLOGY
ICUROLOGY

Electronic nutritional intake assessment in patients with urolithiasis: A decision impact analysis

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Purpose: To evaluate a physician's impression of a urinary stone patient's dietary intake and whether it was dependent on the medium through which the nutritional data were obtained. Furthermore, we sought to determine if using an electronic food frequency questionnaire (FFQ) impacted dietary recommendations for these patients.

Materials and Methods: Seventy-six patients attended the Stone Clinic over a period of 6 weeks. Seventy-five gave consent for enrollment in our study. Patients completed an office-based interview with a fellowship-trained endourologist, and a FFQ administered on an iPad. The FFQ assessed intake of various dietary components related to stone development, such as oxalate and calcium. The urologists were blinded to the identity of patients' FFQ results. Based on the office-based interview and the FFQ results, the urologists provided separate assessments of the impact of nutrition and hydration on the patient's stone disease (nutrition impact score and hydration impact score, respectively) and treatment recommendations. Multivariate logistic regressions were used to compare pre-FFQ data to post-FFQ data.

Results: Higher FFQ scores for sodium (odds ratio [OR], 1.02; p=0.02) and fluids (OR, 1.03, p=0.04) were associated with a higher nutritional impact score. None of the FFQ parameters impacted hydration impact score. A higher FFQ score for oxalate (OR, 1.07; p=0.02) was associated with the addition of at least one treatment recommendation.

Conclusions: Information derived from a FFQ can yield a significant impact on a physician's assessment of stone risks and decision for management of stone disease.

Keywords: Clinical decision support systems; Nutrition assessment; Surveys and questionnaires; Urolithiasis

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INTRODUCTION

The prevalence of kidney stones in the United States has risen steadily in recent years and correlates with population dietary changes [1,2]. Nutrition plays an important role in the development and management of stone disease. Relative dietary intake of fluid, sodium, calcium, oxalate, citrate, and animal-based proteins has a marked influence on stone risk [3-8]. Accordingly, an efficient assessment of a patient's nutritional intake is important for the urologist

Received: 28 March, 2016 • **Accepted:** 26 April, 2016
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and may enable an informed assessment and guided recommendations. The traditional office based interview may not adequately assess the patient's nutritional intake, due to time constraints and the detailed nature of a nutritional history. Furthermore, biases may exist both in how a patient wishes to represent themselves, and in how the practitioner presents a question [9].

We sought to determine if a physician's impression of a patient's dietary intake was dependent on the medium through which they obtained the nutritional data. A typical office interview was compared to information obtained via a computerized clinical decision support system (CDSS), which presented a food frequency questionnaire (FFQ). Furthermore, the urologists made recommendations for dietary intervention based on the information ascertained via each method.

MATERIALS AND METHODS

1. Patients and study design

Institutional Review Board approval was obtained (IRB No. 201307045). Over a period of 6 weeks, 76 patients attended the Urolithiasis Clinic at our institution. Demographics for clinic patients are shown in Table 1. Seventy-five of 76 patients gave consent for enrollment. Inclusion criteria consisted of having at least one prior stone episode. Each patient completed: (1) an office-based interview with one of two fellowship-trained endourologists, and (2) a FFQ administered via a CDSS, presented on an iPad. Each urologist made two separate assessments via a Likert-scale-based survey of the significance of a patient's nutritional (nutritional impact score) and hydration factors (hydration impact score) as they pertained to stone disease (Fig. 1). Each assessment was followed by specific recommendations, such as reducing sodium intake, reducing animal protein intake, and increasing fluid intake. The first assessment (pre-FFQ) was made after the office-based interview with the patient but without reviewing the results of the FFQ. The second assessment (post-FFQ) was made after reviewing the patient's FFQ results. The urologists were blinded to their previous assessments. If the urologist modified the nutritional impact score, hydration impact score, or treatment recommendations from the first assessment to the second, we assumed that the FFQ results caused the urologist to believe that nutrition had a greater or lesser impact on the patient's stone disease than previously assessed by the office-based interview.

Table 1. Patient demographics

Variable	Value
Race	
White	86.3%
African-American	11.3%
Other	2.4%
Sex	
Male	53%
Female	47%
Age (yr), median (IQR)	59 (48–68)
BMI (kg/m^2), median (IQR)	30.8 (26.3–35.7)

BMI, body mass index; IQR, interquartile range.

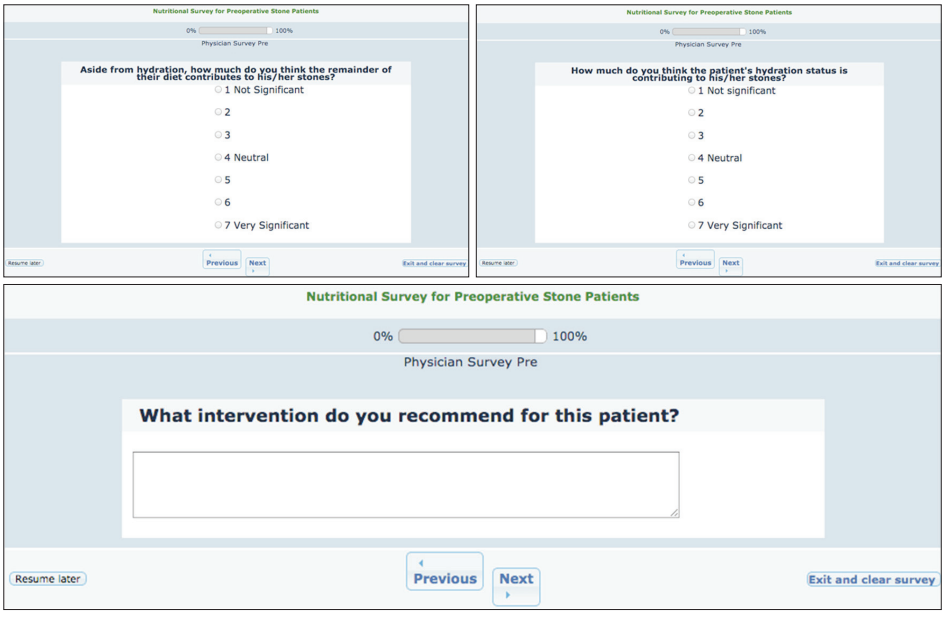

Fig. 1. Survey completed by the urologists. The survey was completed twice for each patient: the first based on the data obtained during an office-based interview, and the second based on the results of the food frequency questionnaire.

2. Food frequency questionnaire

The FFQ used in this study is an 88-question nutritional survey that is similar to prior FFQs that have been validated by previous analyses for accurate assessment of a patient's dietary habits [10-13]. Using the FFQ, our patients recorded nutritional intake of those foods providing substantial quantities of the following: oxalate, animal-based protein, sodium, and calcium. Intake of fruits and vegetables, fluids, and nutritional supplements was also assessed (Fig. 2). Questionnaire results were entered in the FFQ's algorithm, which generated numerical scores corresponding to patient's relative intake in each of the following domains: oxalate, calcium, sodium, purine, and fluids.

3. Statistical analysis

For each patient, we compared pre-FFQ nutritional impact score, hydration impact score, and treatment recommendations to respective post-FFQ data points. Our results were coded into the following binary variables, detailing the presence or absence of: increase in diet score, increase in hydration impact score, any change in treatment recommendations, addition of at least one treatment recommendation, and subtraction of at least one treatment recommendation. A multivariate logistic regression model was fit to determine the impact of the numerical results of each domain in the FFQ (oxalate, calcium, sodium, purine, and fluids) and the aforementioned binary variables. The model controlled for which of the 2 physicians saw the patient. All analyses were performed with SAS 9.4 (SAS Institute Inc., Cary, NC, USA). Statistical significance was defined as a p-value of <0.05.

RESULTS

Between the 2 urologists in the study, there was no significant difference in the average nutritional impact scores or average the hydration impact scores assigned. From pre-FFQ to post-FFQ, the urologist was more likely to increase the nutritional impact score if the patient had higher FFQ scores for sodium (odds ratio [OR], 1.02; p=0.02) or fluids (OR, 1.03, p=0.04). In other words, the physician interpreted a greater contribution of diet to the patient's stone disease when the FFQ indicated higher sodium or fluid intake (Table 2). There was no difference in hydration score rendered by the physician for patients who consumed increased oxalate, calcium, sodium, purine, or fluids (Table 3). A higher FFQ score for oxalate was positively associated with the addition of at least one treatment recommendation (OR, 1.07; p=0.02) (Table 4).

DISCUSSION

Stone disease is among the most common and costly urological conditions, with a lifetime prevalence of approximately 9% [2], and 5-year recurrence rates approaching 50% [14]. In the United States alone, the economic burden of stone disease has been estimated to be over $2 billion annually [15]. Previous studies have underscored the impact of diet on stone formation and the role of dietary interventions in prevention of stone disease [3-8]. Our study revealed that using a FFQ to obtain the diet history impacted how urologists perceived the effects of diet and hydration on stone disease, as well as how urologists treated the stone disease.

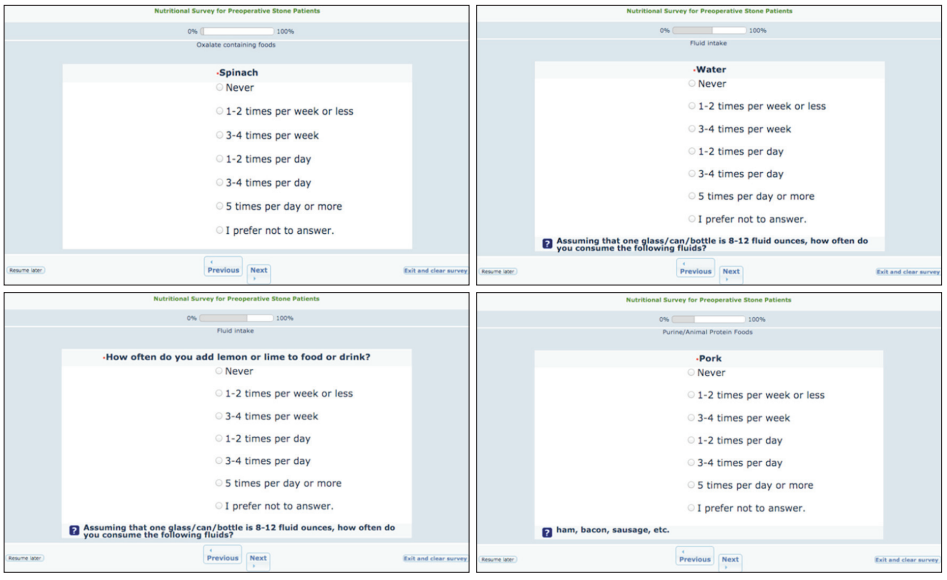

Fig. 2. Sample questions from the food frequency questionnaire.

http://dx.doi.org/10.4111/icu.2016.57.3.196

Table 2. Odds of increase in nutrition impact score

Variable	Odds ratio	95% Confidence limits	p-value
Physician	1.298	0.426, 3.949	0.647
Oxalate	0.989	0.947, 1.033	0.611
Calcium	1.000	0.999, 1.001	0.763
Sodium	1.020	1.004, 1.037	0.017
Purine	0.989	0.964, 1.015	0.399
Fluid	1.031	1.001, 1.062	0.041

Multivariate analysis of factors associated with an increase in the nutrition impact score from pre-FFQ to post-FFQ. Increases in sodium and fluid resulted in higher nutrition impact scores. The factor "physician" signifies variation in scores assigned between the two endourologists in our study.
FFQ, food frequency questionnaire.

Table 3. Odds of increase in hydration impact score

Variable	Odds ratio	95% Confidence limits	p-value
Physician	0.780	0.237, 2.567	0.682
Oxalate	1.017	0.974, 1.061	0.445
Calcium	1.002	0.998, 1.005	0.322
Sodium	1.003	0.987, 1.020	0.704
Purine	1.000	0.976, 1.023	0.974
Fluid	0.991	0.960, 1.022	0.558

Multivariate analysis of factors associated with an increase in the hydration impact score from pre-FFQ to post-FFQ. None of the factors resulted in a statistically significant difference in hydration impact score. The factor "physician" signifies variation in scores assigned between the 2 endourologists in our study.
FFQ, food frequency questionnaire.

Table 4. Odds of additional dietary treatment recommendation

Variable	Odds ratio	95% Confidence limits	p-value
Physician	3.323	0.804, 13.727	0.097
Oxalate	1.068	1.011, 1.129	0.019
Calcium	1.000	0.999, 1.001	0.645
Sodium	1.004	0.983, 1.026	0.686
Purine	1.018	0.990, 1.048	0.211
Fluid	1.012	0.975, 1.052	0.525

Multivariate analysis of factors associated with an additional dietary treatment recommendation from pre-FFQ to post-FFQ. Increased oxalate resulted in more dietary treatment recommendations. The factor "physician" signifies variation in dietary treatment recommendations between the two endourologists in our study.
FFQ, food frequency questionnaire.

Dietary interventions for stone prevention require an individualized nutrition assessment [16]. Therefore, it is important for the urologist to effectively and expeditiously obtain a thorough diet history. Unfortunately, this practice poses challenges based on several factors. Certainly, the modern urologist experiences logistical and time constraints in his or her busy clinical practice. Additionally, some patients may alter their responses to dietary questions in an attempt to represent their habits more favorably. Furthermore, even skilled endourologists and stone experts may not use the most effective questions to obtain the information necessary [17]. Finally, a comprehensive stone clinic, complete with a dietician is favorable, but not feasible in every practice setting [9].

Previous authors have found the FFQ to be an effective tool for obtaining an accurate and objective diet history. As for the method of delivering the FFQ, we believe that the computerized CDSS provides physicians with a relatively bias-free mode of data collection as well as standardized evaluations of the data delivered in a timely fashion [18]. In other medical applications, the CDSS has been shown to improve practitioner performance and patient care, for instance, by reducing medication errors [19-21].

In the present study, we found that the use of the FFQ

as a CDSS can significantly alter the how the endourologist assesses the significance of dietary factors on a patient's stone disease. Moreover, the recommended dietary interventions can change based on the results of the FFQ. In our urolithiasis clinic, nearly all of the patients (75 of 76) were willing to use the FFQ. These findings suggest that the addition of the FFQ to the 24-hour urine collection and other components of the comprehensive stone evaluation may alter the assessment and plan for these patients.

The major limitation of our study is that we did not determine if use of the FFQ leads to improved patient outcomes, such as decreased recurrence rates or increased patient satisfaction. Future studies may be developed to link the use of the FFQ to improved outcomes or patient encounters. While our study may not yet translate into improved patient outcomes, certainly others have shown that the use of CDSS can improve efficiency. Afzal et al. [22] describes the use of CDSS to gather information in a more efficient manner. It is reasonable to hypothesize that improving efficiency may be a key component in improving patient outcomes.

Other studies have also shown that FFQs can play an integral role in assessing urolithiasis patients, especially in a multidisciplinary setting, where a patient's diet may be a key focus in stone prevention. Seamless integration of a FFQ should be a goal of multidisciplinary stone clinics. While our FFQ was reasonably detailed, others have been able to streamline a more lengthy diet questionnaire into a more compact rapid food screener. In regards to assessing renal acid load in stone formers, Trinchieri [23] developed a one page questionnaire which was deemed the LAKE score. This tool was used to rapidly determine a patient's renal acid load. His goal was to make this rapid assessment equivalent to a more lengthy diet questionnaire. In a follow-up study, patients were asked to complete both of these questionnaires, and their LAKE score assessment appeared as good as a lengthier questionnaire in determining renal acid load [24]. While this particular study looked at a different aspect of stone disease, it appears that endourologists are attempting to gain detailed dietary information from their patients while continuing to improve efficiency and streamline their stone clinics. Certainly these approaches may prove worthwhile as we continue to develop this tool in our urolithiasis clinic. We hope that our efforts may ultimately improve the efficiency and quality of care of our endourology patients.

Given the wide body of evidence supporting the use of dietary interventions in preventing stone recurrence [3-8], it is reasonable to hypothesize that recommendations made with potentially more complete and accurate data, obtained using the FFQ, would confer improved outcomes. Randomized-controlled trials are necessary to evaluate the impact of utilizing the FFQ as a CDSS on stone patients to patient outcomes, such as recurrence rates, quality of life, and satisfaction with the clinical experience.

CONCLUSIONS

A self-reported, electronic version of the FFQ may be helpful in the efficient assessment and counseling of patients with stone disease. With prior comprehensive knowledge of a patient's nutritional intake, the urologist may be afforded more time with which to counsel patients regarding intervention and nutritional intake.

CONFLICTS OF INTEREST

The authors have nothing to disclose.

ACKNOWLEDGMENTS

The authors wish to acknowledge the Midwest Stone Institute and the Office of Provost, Diversity and Inclusion Grant, as sources of funding.

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