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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

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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.

(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.

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

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.

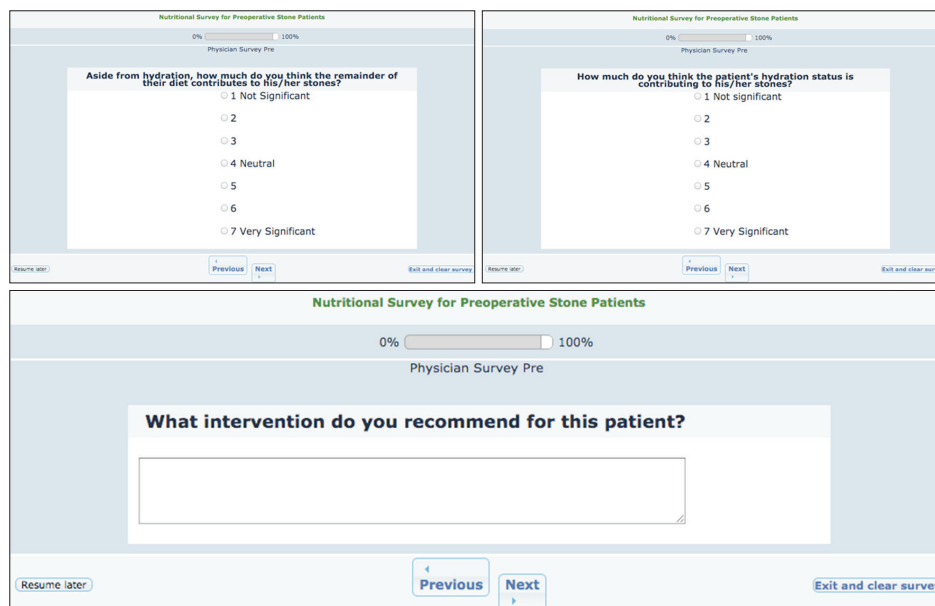


Fig. 1. Survey completed by the urologists. The survey was completed twice for each patient: the first based on the data obtained during an office-based interview, and the second based on the results of the food frequency questionnaire.

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.

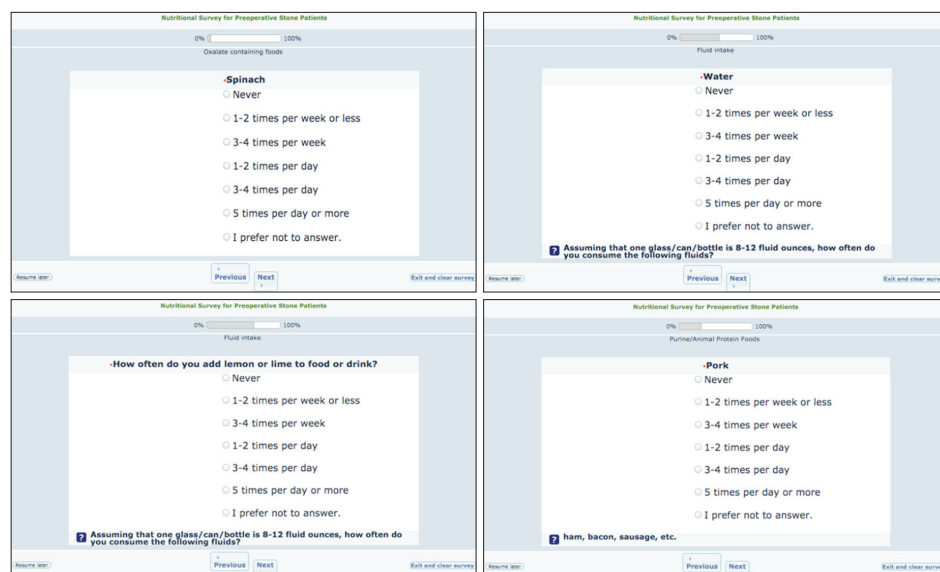


Fig. 2. Sample questions from the food frequency questionnaire.

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.

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REFERENCES

1. De SK, Liu X, Monga M. Changing trends in the American diet and the rising prevalence of kidney stones. *Urology* 2014;84:1030-3.
2. Scales CD Jr, Smith AC, Hanley JM, Saigal CS; Urologic Diseases in America Project. Prevalence of kidney stones in the United States. *Eur Urol* 2012;62:160-5.
3. Curhan GC, Willett WC, Knight EL, Stampfer MJ. Dietary factors and the risk of incident kidney stones in younger women: Nurses' Health Study II. *Arch Intern Med* 2004;164:885-91.
4. Curhan GC, Willett WC, Rimm EB, Stampfer MJ. A prospective study of dietary calcium and other nutrients and the risk of symptomatic kidney stones. *N Engl J Med* 1993;328:833-8.
5. Delvecchio FC, Preminger GM. Medical management of stone disease. *Curr Opin Urol* 2003;13:229-33.
6. Fellstrom B, Danielson BG, Karlstrom B, Lithell H, Ljunghall S, Vessby B. Dietary habits in renal stone patients compared with healthy subjects. *Br J Urol* 1989;63:575-80.
7. Parivar F, Low RK, Stoller ML. The influence of diet on urinary stone disease. *J Urol* 1996;155:432-40.
8. Siener R. Impact of dietary habits on stone incidence. *Urol Res* 2006;34:131-3.

9. Wertheim ML, Nakada SY, Penniston KL. Current practice patterns of urologists providing nutrition recommendations to patients with kidney stones. *J Endourol* 2014;28:1127-31.
10. Baer HJ, Blum RE, Rockett HR, Leppert J, Gardner JD, Sutor CW, et al. Use of a food frequency questionnaire in American Indian and Caucasian pregnant women: a validation study. *BMC Public Health* 2005;5:135.
11. Blum RE, Wei EK, Rockett HR, Langeliers JD, Leppert J, Gardner JD, et al. Validation of a food frequency questionnaire in Native American and Caucasian children 1 to 5 years of age. *Matern Child Health J* 1999;3:167-72.
12. Rockett HR, Breitenbach M, Frazier AL, Witschi J, Wolf AM, Field AE, et al. Validation of a youth/adolescent food frequency questionnaire. *Prev Med* 1997;26:808-16.
13. Wei EK, Gardner J, Field AE, Rosner BA, Colditz GA, Sutor CW. Validity of a food frequency questionnaire in assessing nutrient intakes of low-income pregnant women. *Matern Child Health J* 1999;3:241-6.
14. Ljunghall S, Danielson BG. A prospective study of renal stone recurrences. *Br J Urol* 1984;56:122-4.
15. Pearle MS, Calhoun EA, Curhan GC; Urologic Diseases of America Project. Urologic diseases in America project: urolithiasis. *J Urol* 2005;173:848-57.
16. Penniston KL, Nakada SY. Diet and alternative therapies in the management of stone disease. *Urol Clin North Am* 2013;40:31-46.
17. Kubena KS. Accuracy in dietary assessment: on the road to good science. *J Am Diet Assoc* 2000;100:775-6.
18. Hunt DL, Haynes RB, Hanna SE, Smith K. Effects of computer-based clinical decision support systems on physician performance and patient outcomes: a systematic review. *JAMA* 1998;280:1339-46.
19. Garg AX, Adhikari NK, McDonald H, Rosas-Arellano MP, Devereaux PJ, Beyene J, et al. Effects of computerized clinical decision support systems on practitioner performance and patient outcomes: a systematic review. *JAMA* 2005;293:1223-38.
20. Kaushal R, Shojania KG, Bates DW. Effects of computerized physician order entry and clinical decision support systems on medication safety: a systematic review. *Arch Intern Med* 2003;163:1409-16.
21. Kawamoto K, Houlihan CA, Balas EA, Lobach DF. Improving clinical practice using clinical decision support systems: a systematic review of trials to identify features critical to success. *BMJ* 2005;330:765.
22. Afzal M, Hussain M, Ali T, Hussain J, Khan WA, Lee S, et al. Knowledge-based query construction using the CDSS knowledge base for efficient evidence retrieval. *Sensors (Basel)* 2015;15:21294-314.
23. Trinchieri A. Development of a rapid food screener to assess the potential renal acid load of diet in renal stone formers (LAKE score). *Arch Ital Urol Androl* 2012;84:36-8.
24. Trinchieri A. A rapid food screener ranks potential renal acid load of renal stone formers similarly to a diet history questionnaire. *Urolithiasis* 2013;41:3-7.