Methods for the Dietary Assessment of Adult Kidney Stone Formers: A Scoping Review

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Abstract

Background Kidney stones are a frequent and potential severe condition, affecting 5-10% of the European population. Causes are multifactorial, diet in particular plays a major role in the formation and management of kidney stones. The aim of this scoping review is to assess the methods used to study the diet of adult kidney stone formers.

Methods We conducted a systematic search in Medline Ovid SP, Embase, Cinahl, Cochrane (CENTRAL), Web of Sciences databases on June 10th 2020. Self-report methods (such as food frequency questionnaires or 24-h dietary recalls), objective nutritional biomarkers and controlled diets were considered. We analyzed the selected publications based on the origin of participants, study design and dietary assessment methods used.

Results We screened 871 publications and included 162 publications. Most studies included participants from North America and Europe and were observational. Short and cost-effective tools such as food frequency questionnaires and other questionnaires were the most frequently used. Moreover, food diary was a frequently selected method to study the diet of kidney stone

formers. New technologies (e.g online questionnaires, phone applications, connected tools) were rarely used.

Conclusion Accurate reporting of the methods used in nutritional studies is of key importance to interpret results and build evidence. Capturing long-term dietary intake is still a challenge for nutritional epidemiology. A combination of self-report methods with objective dietary biomarkers and new technologies probably represents the best way forward.

Keywords

Kidney stones – dietary assessment – nutritional epidemiology – scoping review

Supplementary Information Full search equations; **Fig. 7** Number of publications per study with a FFQ; **Table 1** Description of included studies

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Author contributions OB and MB had the idea for the article. OB, MB and CL worked on the methodology of the review. TK, AB and CL did the selection of the publications and data extraction. CL analyzed the data and drafted the original manuscript. All authors critically revised the work and approved the final manuscript.

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Declarations

Conflict of interest The authors declare they have no financial interests. OB is on the Editorial Board of the Journal of Nephrology.

Ethics approval Ethics approval was not required for this scoping review.

Introduction

Kidney stones are one of the most common diseases of the urinary tract, with a prevalence estimated at 5-10 % in Europe [1]. This prevalence has been increasing in the last decades, with changes in nutritional and lifestyle habits or global warming as possible causes [1, 2]. Many studies have explored the association between diet and kidney stones, establishing dietary risk and protective factors [3-6].

Kidney stones are of great concern for public health because of their associated morbidity and cost [1, 7]. Efficient preventive measures, including dietary recommendations, are thus becoming more and more important [8]. In this context, nutritional studies are of key importance to learn more about the impact of diet on kidney stones.

There are two main categories of dietary assessment methods. First, self-report methods are based on participants' reports of their dietary consumption. These methods are based on recall (e.g. food frequency questionnaires (FFQ), 24-h dietary recalls) or based on real-time recordings (e.g. food diaries) [9-13]. Second, objective nutritional biomarkers are measured in biological samples such as blood, urine or nails [9-14]. Each method has strengths and limitations and different tools explore different aspects of food consumption [9-13].

The aim of this scoping review [15] is to assess the methods used to study the diet of adult kidney stone formers and provide a better understanding of how researchers conducted nutritional studies. This may help guiding further research and improving the quality of evidence in this field [16].

Methods

The PRISMA-ScR checklist was used for reporting [17].

Search strategy

We identified key words and prepared search equations specific to a database with the help of a librarian (Thomas Brauchli). We first defined the target population using terms such as "urolithiasis, kidney stone, urine calculi". We then introduced the concept of dietary assessment with terms such as "nutrition assessment, diet records, eating, fluid consumption", indicating more specifically methods of interest "24h recall, food frequency questionnaire, online questionnaire, photo app". We finally added terms to exclude animal and pediatric studies "not animals, not infant, child".

A systematic search of Medline Ovid SP, Embase, Cinahl, Cochrane (CENTRAL), Web of Sciences databases was conducted on June 10th 2020 by TB using those search equations. We did not include a time limit and we considered only articles written in English (full equations in Supplementary material).

We added seven publications of interest by "hand-searching" [6, 18-23]. Furthermore, as the search equations did not include metabolomics, we conducted a focus search in PubMed with the terms "metabolomics" and "kidney stones" in January 2021. This search gave 16 results, two publications were selected and added to the review [24, 25].

Eligibility criteria

We selected publications that studied the diet of adult kidney stone formers. We were specifically interested in the dietary assessment methods and considered self-report methods (such as FFQs or 24-h dietary recalls), objective nutritional biomarkers and controlled diets (participants ingested a known amount of food and fluids) as this is another way of knowing the dietary intake of participants. Moreover, we added terms in the search equations to identify new technologies such as online questionnaires, phone applications or connected tools.

We included only studies in adult (>18 years old) stone formers. We considered kidney stone formers with associated conditions, such as diabetes or obesity. We excluded studies focusing on struvite stones, as their formation differs significantly from the other stone types. We also excluded comments, editorials or letters.

Study selection

Two reviewers (AB and CL) did a first selection based on titles and abstracts using the online collaborative platform Rayyan (Rayyan Systems Inc.). When a disagreement occurred, discussion between the two reviewers was usually sufficient to reach a consensus. A third reviewer (OB) helped resolve the situations where an agreement could not be obtained.

After this first selection, two reviewers (TK and CL) screened the full-texts and extracted data from the publications. The final decision to include a publication was based upon agreement between the two reviewers (TK and CL).

Data extraction

Data from a publication was extracted by only one reviewer (TK or CL) using a standardized extraction table in Microsoft Office Excel version 2016. The team (OB, MB, TK and CL) discussed together the items chosen for the extraction table. The extraction table was then first tested on a subset of publications and some items were added or clarified. The final extraction table included:

- data relative to the identification of the paper: title, author, journal, year of publication, country
- data relative to the design of the study: type of study, start and end dates, total study duration, name of the cohort and duration of follow-up if applicable, selection and matching criteria for case-control studies

- data relative to the participants: number of participants, number of patients/controls, age, sex (proportion male/female), BMI, ethnicity
- data relative to the method used: for self-report methods, details about duration and recurrence of record; for objective biomarkers, details about measured variables; elements of diet investigated; validation of the tool
- a short summary of the aims and principal results of the study

Data synthesis

We summarized the characteristics of the studies based on the origin of participants, study design and methods used. We described the methods in terms of number of publications. For the 24-h urine collections and other timed-urine samples, if the value of at least one of the sodium, potassium, urea, oxalate, citrate excretions or urinary volume was reported in a publication, we considered that a urinary biomarker was available. For spot urine, we considered pH in addition to the previously mentioned values. For the blood samples, if the value of at least one of the items glucose, lipid profile, micronutrients (vitamins and minerals), ferritin, albumin, urea or uric acid was given in the publication, we considered that a blood biomarker was available.

We then described in more details the characteristics of the 24-h urine collections. For this description, we worked in terms of studies and not publications. Thus, if at least one publication related to the same study described a 24-h urine collection, we considered that it was available in the study.

Results

We included 162 publications in this review. Several publications were related to the same study, this selection represents 122 independent studies (see **Table 1** in the

Supplementary material)**. Fig. 1** shows the selection process for the included publications. In most publications, participants were recruited in North America (n=64 publications, 40%) and Europe (n=53 publications, 33%), whereas Asia (n=25 publications, 15%), South America (n=10 publications, 6%), the Middle East (n=7 publications, 4%) and Africa (n=3 publications, 2%) were less represented (**Fig. 2**).

The design was observational in 122 publications (75%) and interventional in 40 (25%). **Fig. 3a** shows the number of publications for the different types of observational studies. We split the design of observational studies into cross-sectional studies (n=48 publications, 39%), cohorts (n=39 publications, 32%) and case-control studies (n=35 publications, 29%). **Fig. 3b** represents the number of publications for the different types of interventional studies, split into randomized controlled trials (RCT) (n=11 publications, 27%) and other studies with an experimental setting but without randomization, labelled as quasi-experimental (n=29 publications, 73%).

Self-report dietary assessment methods were described in 155 publications (96%) (**Fig. 4)**. In this category, FFQs were the most frequently used (n=73 publications, 47%) and 24-h dietary recalls the least frequently used (n=8 publications, 5%). As shown in **Fig. 7** (Supplementary material), 30 publications using a FFQ were related to the Nurses' Health Study I, II and Health Professionals Follow-Up Studies.

There are different types of FFQs. Some FFQs look only at the frequency of consumption, whereas semi-quantitative FFQs look at the frequency as well as the portions consumed. For FFQs without details about portions, it is still possible to obtain dietary intake by applying standard size portions [26]. However, semi-quantitative FFQs allow for a more precise estimation of the daily intakes. The authors described the FFQs as semi-quantitative in 53 publications (including the 30 publications related to the NHS and HPFS studies that used

similar FFQs). In two publications, only the beverages were quantified. In one publication, another self-report method was used to obtain the quantities and combined with the FFQ to generate the intake and in 3 publications, the investigators reported the frequency of consumption and not the intake. Finally, in the other publications (n=14), we could not determine if the FFQ was semi-quantitative or if a standard size portion had been applied afterwards to generate the intake. This shows the importance of precisely describing the method used. It also calls for a standardization of the description of such method.

Food diaries were used in 47 publications (30%) and other questionnaires in 27 publications (17%). Food diaries were collected for a period of 7 days in 8 publications (17%), 4 days in 5 publications (11%), 3 days in 24 publications (51%) and 1 day in 5 publications (11%). Participants were placed under controlled diets in 25 publications (15%). Only a few studies (n= 4 publications, 2%) used regional or national food distribution data or household food purchases registries to study the diet.

The value for at least one urinary biomarker was indicated in 95 publications (59%), with 24-h urine collections for 85 publications (89%), other timed-urine for 6 publications (6%) and spot urine samples for 4 publications (4%). The three metabolomic studies included urine samples. The value for at least one blood biomarker was indicated in 45 publications (28%).

In the following sections, we considered the 24-h urine collections in terms of studies and not publications**. Fig. 5a** indicates the number of studies with and without 24-h urine collections and **Fig. 5b** shows the repartition of the different types of collections performed: single collection and repeated consecutive or non-consecutive collections. Twenty-four hours urine collections were available in 81 studies (66%) and 41 studies (34%) did not have 24-h urine collections.

Most studies with 24-h urine had repeated collections: 11 studies (14 %) had repeated consecutive and 44 studies (54 %) had repeated non-consecutive collections. All 11 studies with repeated consecutive collections were performed during two consecutive days. In four studies, both repeated consecutive and repeated non-consecutive collections were done. Concerning the non-consecutive repeated collections, the time interval between the collections was not always reported and when reported, it was highly variable and depended on the study design. Finally, 31 studies (38%) had a single 24-h urine collection.

Fig. 6 shows the number of studies with results on 24-h urinary biomarkers. Excretion rate was reported for sodium (55 studies), potassium (42 studies), urea (24 studies), oxalate (60 studies), citrate (55 studies) and urinary volume (59 studies).

Discussion

To the best of our knowledge, this is the first scoping review addressing the methods used to evaluate the diet of kidney stone formers. We identified reviews on dietary assessment methods but those were not focused on kidney stone formers [16, 27, 28].

Short and self-addressed dietary assessment methods, such as FFQs or other questionnaires were preferred over methods that need more time or resources, such as 24-h dietary recalls. Previous reviews [16, 27, 28] also showed that FFQs were the most common choice to evaluate dietary intake and that 24-h dietary recalls were less often performed.

FFQs and other questionnaires consist of a pre-established and close-ended set of questions about food and beverage consumption [12] and are developed for a specific research question and a given population [12]. A questionnaire developed for a study can focus on certain aspects of the diet or be more general, depending on the aim of the study [11]. Validity of FFQs on different populations can thus be limited due to cultural specificities and their

validity should be assessed before using them in a new setting [9, 29, 30]. Methods for the validation of FFQs are described in the literature [29, 31].

On the 73 publications that used FFQs, 54 (74%) specified that the FFQ was validated (of which 30 publications were linked to the same study and used the same FFQ) and 19 publications (26%) did not. Few details on the development and validation process were provided for other questionnaires. Overall, the description of the method used varied across studies. Details on the development of FFQs and other questionnaires, in particular for which population they were developed or their validity, were not available for all studies. This calls for the development of guidelines on how to prepare, validate and report FFQs in future studies.

Food diaries and 24-h dietary recalls seem to be rarely used to evaluate dietary intake in nutritional studies [16, 27] but are often used as references in validation studies [28]. We found that food diaries were used in nearly a third of the studies. Pragmatic aspects arising from 24-h urine collection performed in stone formers might favor this method. Indeed, when collected simultaneously, it is possible to compare nutritional data from the food diaries and urinary objective biomarkers measured in 24-h urine collections.

We included specific terms in the search equations for new technologies such as "online questionnaire* OR photo app* OR photo phone app* OR smart bottle*". Several studies mentioned online questionnaires or web applications but overall, even in the more recent papers, new technologies do not seem to be frequently used for the dietary assessment of kidney stone formers. As diet and its links to various health issues are increasingly studied nowadays, new technologies could help improve dietary assessment [32, 33]. It would be interesting to follow the use of those tools in kidney stone research in future reviews.

Twenty-four hour urine collections are used for the metabolic evaluation of kidney stone formers [8] and are often done in both clinical and research settings. In most studies included in our review, 24-h urine collections were available, but the type of collection varied (single, repeated consecutive or non-consecutive). It is important to check the quality and completeness of the collections before analyzing their composition and measuring objective nutritional biomarkers [34]. Several criteria exist to assess the quality of 24-h urine collections [35-37]. We observed that the criteria used to evaluate the quality and completeness of the 24-h urine collections varied across studies.

We considered 24-h urinary nitrogen, sodium, potassium, volume, oxalate and citrate as objective nutritional biomarkers. 24-h urinary nitrogen (referred as urea in our review), sodium and potassium are accurate proxies for the dietary intake of protein, sodium and potassium, respectively [38-41]. Urinary oxalate is mainly derived from endogenous metabolism [42, 43] but a previous study showed that dietary consumption could contribute up to 50 % of the urinary oxalate excretion [43]. Similarly, diet has an impact on citrate excretion [44] and dietary interventions can be used in case of hypocitraturia [45]. Finally, urinary volume was found to correlate with volume intake [46].

We found that oxalate and citrate excretions were frequently assessed, while urea was rarely reported [38]. Overall, the choice of biomarkers in 24-h urine collections is not standardized and still a matter of debate [47]. New urinary biomarkers are identified [44] and metabolomic studies are promising. For instance, a study identified a urinary amino acid profile specific to kidney stone formers [25].

Overall, self-report methods, especially FFQs and other questionnaires, are widely used in research. Indeed, FFQs are a timesaving and cost-effective method that can be easily administered to a large number of participants [12]. Yet, as mentioned previously, these types

of questionnaires cover only a set of pre-determined foods and beverages and should be validated before use [12]. On the other hand, food diaries or 24-h dietary recalls require more resources but can capture in detail foods and beverages consumed over a short period [9]. However, a single day diary or recall does not give a good representation of usual dietary intakes [9]. Moreover, all those self-report methods are subject to error and biases [9, 48], for instance when measuring protein or total energy intake [48, 49]. Some recommendations have been developed to correct for possible sources of errors when using those methods, for instance combining with objective biomarkers or using statistical methods to generate the usual intake [9, 48, 50]. The 24-h dietary recalls are considered the least biased of this category and the best instrument to measure dietary intake as well as look at associations between diet and health, but they need to be repeated several times to provide better insight on usual dietary intakes [10].

There are different types of objective nutritional biomarkers [9-12, 14]. Recovery biomarkers, such as 24 h urinary nitrogen, sodium or potassium, are directly related to dietary intake [9-11, 38-40]. However, investigators identified that 24-h urine values of sodium and potassium do not reflect well individual sodium and potassium intake, unless repeated collections are performed [41]. Other objective biomarkers such as predictive (e.g 24-h urinary fructose and sucrose) or concentration (e.g fatty acids measured in adipose tissues or vitamins in blood) biomarkers are correlated with the intake but can be affected by individual metabolism [9, 11]. Objective biomarkers are thus an interesting tool to validate or measure more precisely the dietary intake [9, 11, 14] but, those markers still have limitations and for now, only a limited number are available. Recommendations for future research are to combine several methods, either two self-report methods such as FFQs and 24-h dietary recalls or self-report methods and objective biomarkers [10-12].

The metabolic evaluation of kidney stone formers in clinical practice is complex and includes medical and nutritional history to identify environmental, metabolic and genetic risk factors but also laboratory analyses (24-h urine and serum, stone composition) [8, 51-53]. Guidelines have been published regarding indications for the metabolic evaluation and recurrence prevention [53] depending on the population (high-risk or low-risk stone formers) and the type of stone.

Many studies were conducted in North America or in Europe and knowledge in this domain mostly comes from large American cohorts [54-56]. However, diet is highly variable across populations [9, 30, 57, 58] and it would be important to check if the same dietary recommendations are valid in other countries.

Furthermore, most studies had an observational design and among interventional studies, there were few RCTs. Interventional nutritional studies are more difficult to conduct as blinding and randomization are not always feasible. It is difficult to plan and maintain RCTs over long periods. RCTs also usually do not reflect real-life settings and have therefore limited external validity.

Finally, many studies in our review relied on punctual dietary assessment, with cross-sectional studies or single 24-h urine collections and did not evaluate diet longitudinally. This is a clear limitation for usual food intake evaluation. Indeed, long-term diet is an important exposure for surveillance and epidemiology to study health-related outcomes [9].

We included various study designs to have an overview of the literature and considered many research questions and approaches. With the different methodologies in our selection, certain methods can be appropriate for a given purpose but not for another. Hence, we cannot draw a general conclusion concerning the different methods that would be

applicable to all study designs. Moreover, we conducted a systematic search of the literature but it is possible that we missed some publications of interest.

Conclusion

Given the role of diet in kidney stone formation, it is important to know how research is conducted in this field to inform future studies. Self-report methods and especially FFQs are the most frequently used and knowledge in this field is mainly based on observational data and Western diets. Overall, we observed that there is heterogeneity in the methodology description.

We thus want to stress the importance of precisely reporting the methodology used to collect dietary data, as it is a key element to interpret the results and build evidence. In addition, it is important to evaluate the impact of different diets on stone formation and when possible try to implement longitudinal or interventional studies. Finally, the combination of self-report methods with objective dietary biomarkers, including blood and urine metabolomic analyses, as well as smartphone applications to take pictures of meals will represent the best way forward.

References

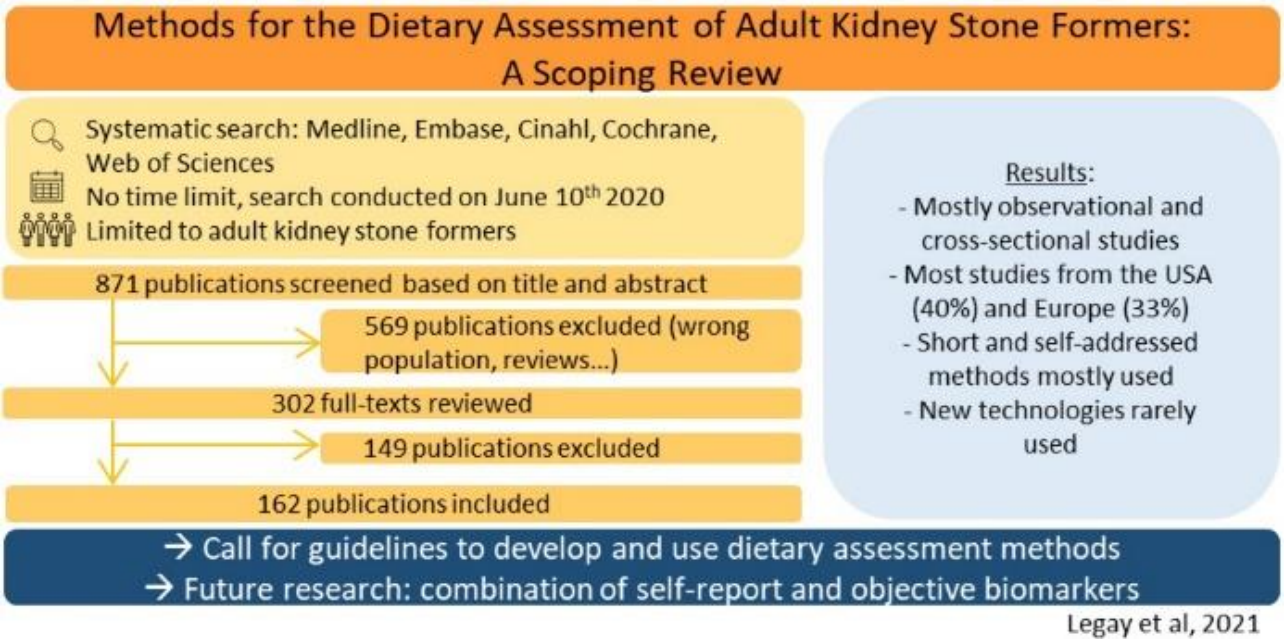
1. Thongprayoon C, Krambeck AE, Rule AD (2020) Determining the true burden of kidney stone disease. Nature reviews Nephrology 16:736-746 https://doi.org/10.1038/s41581-020-0320-7
2. Romero V, Akpinar H, Assimos DG (2010) Kidney stones: a global picture of prevalence, incidence, and associated risk factors. Reviews in urology 12:e86-96
3. Curhan GC, Willett WC, Rimm EB, et al (1993) A prospective study of dietary calcium and other nutrients and the risk of symptomatic kidney stones. The New England journal of medicine 328:833-838 https://doi.org/10.1056/nejm199303253281203
4. Taylor EN, Stampfer MJ, Mount DB, et al (2010) DASH-style diet and 24-hour urine composition. Clinical journal of the American Society of Nephrology : CJASN 5:2315-2322 https://doi.org/10.2215/cjn.04420510
5. Turney BW, Appleby PN, Reynard JM, et al (2014) Diet and risk of kidney stones in the Oxford cohort of the European Prospective Investigation into Cancer and Nutrition (EPIC). European journal of epidemiology 29:363-369 https://doi.org/10.1007/s10654-014-9904-5
6. Littlejohns TJ, Neal NL, Bradbury KE, et al (2020) Fluid Intake and Dietary Factors and the Risk of Incident Kidney Stones in UK Biobank: A Population-based Prospective Cohort Study. European urology focus 6:752-761 https://doi.org/10.1016/j.euf.2019.05.002
7. Pearle MS, Calhoun EA, Curhan GC (2005) Urologic diseases in America project: urolithiasis. The Journal of urology 173:848-857 https://doi.org/10.1097/01.ju.0000152082.14384.d7
8. Goldfarb DS, Arowojolu O (2013) Metabolic evaluation of first-time and recurrent stone formers. The Urologic clinics of North America 40:13-20 https://doi.org/10.1016/j.ucl.2012.09.007
9. Kirkpatrick SI, Baranowski T, Subar AF, et al (2019) Best Practices for Conducting and Interpreting Studies to Validate Self-Report Dietary Assessment Methods. Journal of the Academy of Nutrition and Dietetics 119:1801-1816 https://doi.org/10.1016/j.jand.2019.06.010
10. Thompson FE, Kirkpatrick SI, Subar AF, et al (2015) The National Cancer Institute's Dietary Assessment Primer: A Resource for Diet Research. Journal of the Academy of Nutrition and Dietetics 115:1986-1995 https://doi.org/10.1016/j.jand.2015.08.016
11. Naska A, Lagiou A, Lagiou P (2017) Dietary assessment methods in epidemiological research: current state of the art and future prospects. F1000Research 6:926 https://doi.org/10.12688/f1000research.10703.1
12. Shim JS, Oh K, Kim HC (2014) Dietary assessment methods in epidemiologic studies. Epidemiology and health 36:e2014009 https://doi.org/10.4178/epih/e2014009
13. Ziegler P, Briefel R, Clusen N, et al (2006) Feeding Infants and Toddlers Study (FITS): development of the FITS survey in comparison to other dietary survey methods. Journal of the American Dietetic Association 106:S12-27 https://doi.org/10.1016/j.jada.2005.09.033
14. Potischman N (2003) Biologic and methodologic issues for nutritional biomarkers. The Journal of nutrition 133 Suppl 3:875s-880s https://doi.org/10.1093/jn/133.3.875S
15. Arksey H, O'Malley L (2005) Scoping studies: towards a methodological framework. International journal of social research methodology 8:19-32

16. Kirkpatrick SI, Vanderlee L, Raffoul A, et al (2017) Self-Report Dietary Assessment Tools Used in Canadian Research: A Scoping Review. Advances in nutrition (Bethesda, Md) 8:276-289 https://doi.org/10.3945/an.116.014027
17. Tricco AC, Lillie E, Zarin W, et al (2018) PRISMA Extension for Scoping Reviews (PRISMA-ScR): Checklist and Explanation. Annals of internal medicine 169:467-473 https://doi.org/10.7326/m18-0850
18. Borghi L, Schianchi T, Meschi T, et al (2002) Comparison of two diets for the prevention of recurrent stones in idiopathic hypercalciuria. The New England journal of medicine 346:77-84 https://doi.org/10.1056/NEJMoa010369
19. Nouvenne A, Meschi T, Guerra A, et al (2009) Diet to reduce mild hyperoxaluria in patients with idiopathic calcium oxalate stone formation: a pilot study. Urology 73:725-730, 730.e721 https://doi.org/10.1016/j.urology.2008.11.006
20. Nouvenne A, Meschi T, Prati B, et al (2010) Effects of a low-salt diet on idiopathic hypercalciuria in calcium-oxalate stone formers: a 3-mo randomized controlled trial. The American journal of clinical nutrition 91:565-570 https://doi.org/10.3945/ajcn.2009.28614
21. Nouvenne A, Ticinesi A, Allegri F, et al (2014) Twenty-five years of idiopathic calcium nephrolithiasis: has anything changed? Clinical chemistry and laboratory medicine 52:337-344 https://doi.org/10.1515/cclm-2013-0618
22. Meschi T, Maggiore U, Fiaccadori E, et al (2004) The effect of fruits and vegetables on urinary stone risk factors. Kidney international 66:2402-2410 https://doi.org/10.1111/j.1523-1755.2004.66029.x
23. Hiatt RA, Ettinger B, Caan B, et al (1996) Randomized controlled trial of a low animal protein, high fiber diet in the prevention of recurrent calcium oxalate kidney stones. American journal of epidemiology 144:25-33 https://doi.org/10.1093/oxfordjournals.aje.a008851
24. Duan X, Zhang T, Ou L, et al (2020) (1)H NMR-based metabolomic study of metabolic profiling for the urine of kidney stone patients. Urolithiasis 48:27-35 https://doi.org/10.1007/s00240-019-01132-2
25. Primiano A, Persichilli S, Ferraro PM, et al (2020) A Specific Urinary Amino Acid Profile Characterizes People with Kidney Stones. Disease markers 2020:8848225 https://doi.org/10.1155/2020/8848225
26. Køster-Rasmussen R, Siersma V, Halldorsson TI, et al (2015) Missing portion sizes in FFQ--alternatives to use of standard portions. Public health nutrition 18:1914-1921 https://doi.org/10.1017/s1368980014002389
27. Kirkpatrick SI, Reedy J, Butler EN, et al (2014) Dietary assessment in food environment research: a systematic review. Am J Prev Med 46:94-102 https://doi.org/10.1016/j.amepre.2013.08.015
28. Henríquez-Sánchez P, Sánchez-Villegas A, Doreste-Alonso J, et al (2009) Dietary assessment methods for micronutrient intake: a systematic review on vitamins. British journal of nutrition 102:S10-S37
29. Cade J, Thompson R, Burley V, et al (2002) Development, validation and utilisation of food-frequency questionnaires - a review. Public health nutrition 5:567-587 https://doi.org/10.1079/phn2001318
30. Teufel NI (1997) Development of culturally competent food-frequency questionnaires. The American journal of clinical nutrition 65:1173s-1178s https://doi.org/10.1093/ajcn/65.4.1173S
31. Willett WC, Sampson L, Stampfer MJ, et al (1985) Reproducibility and validity of a semiquantitative food frequency questionnaire. American journal of epidemiology 122:51-65

32. McClung HL, Ptomey LT, Shook RP, et al (2018) Dietary intake and physical activity assessment: current tools, techniques, and technologies for use in adult populations. American journal of preventive medicine 55:e93-e104
33. Rhyner D, Loher H, Dehais J, et al (2016) Carbohydrate Estimation by a Mobile Phone-Based System Versus Self-Estimations of Individuals With Type 1 Diabetes Mellitus: A Comparative Study. Journal of medical Internet research 18:e101 https://doi.org/10.2196/jmir.5567
34. Subar AF, Midthune D, Tasevska N, et al (2013) Checking for completeness of 24-h urine collection using para-amino benzoic acid not necessary in the Observing Protein and Energy Nutrition study. European journal of clinical nutrition 67:863-867 https://doi.org/10.1038/ejcn.2013.62
35. Forni Ogna V, Ogna A, Vuistiner P, et al (2015) New anthropometry-based age- and sex-specific reference values for urinary 24-hour creatinine excretion based on the adult Swiss population. BMC Med 13:40 https://doi.org/10.1186/s12916-015-0275-x
36. Knuiman JT, Hautvast JG, van der Heyden L, et al (1986) A multi-centre study on completeness of urine collection in 11 European centres. I. Some problems with the use of creatinine and 4-aminobenzoic acid as markers of the completeness of collection. Human nutrition Clinical nutrition 40:229-237
37. Murakami K, Sasaki S, Takahashi Y, et al (2008) Sensitivity and specificity of published strategies using urinary creatinine to identify incomplete 24-h urine collection. Nutrition (Burbank, Los Angeles County, Calif) 24:16-22 https://doi.org/10.1016/j.nut.2007.09.001
38. Bingham SA, Cummings JH (1985) Urine nitrogen as an independent validatory measure of dietary intake: a study of nitrogen balance in individuals consuming their normal diet. The American journal of clinical nutrition 42:1276-1289 https://doi.org/10.1093/ajcn/42.6.1276
39. McLean R, Cameron C, Butcher E, et al (2019) Comparison of 24-hour urine and 24-hour diet recall for estimating dietary sodium intake in populations: A systematic review and meta-analysis. Journal of clinical hypertension (Greenwich, Conn) 21:1753-1762 https://doi.org/10.1111/jch.13729
40. Tasevska N, Runswick SA, Bingham SA (2006) Urinary potassium is as reliable as urinary nitrogen for use as a recovery biomarker in dietary studies of free living individuals. The Journal of nutrition 136:1334-1340 https://doi.org/10.1093/jn/136.5.1334
41. Ginos BNR, Engberink R (2020) Estimation of Sodium and Potassium Intake: Current Limitations and Future Perspectives. Nutrients 12https://doi.org/10.3390/nu12113275
42. Zimmermann DJ, Hesse A, von Unruh GE (2005) Influence of a high-oxalate diet on intestinal oxalate absorption. World journal of urology 23:324-329 https://doi.org/10.1007/s00345-005-0028-0
43. Holmes RP, Goodman HO, Assimos DG (2001) Contribution of dietary oxalate to urinary oxalate excretion. Kidney international 59:270-276 https://doi.org/10.1046/j.1523-1755.2001.00488.x
44. Guerra A, Ticinesi A, Allegri F, et al (2019) Insights about urinary hippuric and citric acid as biomarkers of fruit and vegetable intake in patients with kidney stones: The role of age and sex. Nutrition (Burbank, Los Angeles County, Calif) 59:83-89 https://doi.org/10.1016/j.nut.2018.07.112
45. Zuckerman JM, Assimos DG (2009) Hypocitraturia: pathophysiology and medical management. Reviews in urology 11:134-144
46. Zhang N, Du S, Tang Z, et al (2017) Hydration, Fluid Intake, and Related Urine Biomarkers among Male College Students in Cangzhou, China: A Cross-Sectional

Study-Applications for Assessing Fluid Intake and Adequate Water Intake. International journal of environmental research and public health 14https://doi.org/10.3390/ijerph14050513
47. Williams JC, Jr., Gambaro G, Rodgers A, et al (2021) Urine and stone analysis for the investigation of the renal stone former: a consensus conference. Urolithiasis 49:1-16 https://doi.org/10.1007/s00240-020-01217-3
48. Subar AF, Freedman LS, Tooze JA, et al (2015) Addressing Current Criticism Regarding the Value of Self-Report Dietary Data. The Journal of nutrition 145:2639-2645 https://doi.org/10.3945/jn.115.219634
49. Kipnis V, Midthune D, Freedman L, et al (2002) Bias in dietary-report instruments and its implications for nutritional epidemiology. Public health nutrition 5:915-923 https://doi.org/10.1079/phn2002383
50. Dodd KW, Guenther PM, Freedman LS, et al (2006) Statistical methods for estimating usual intake of nutrients and foods: a review of the theory. Journal of the American Dietetic Association 106:1640-1650 https://doi.org/10.1016/j.jada.2006.07.011
51. Song L, Maalouf NM, Nephrolithiasis (2000) In: Feingold KR, Anawalt B, Boyce A, et al (eds) Endotext, MDText.com, Inc. Copyright © 2000-2021, MDText.com, Inc., South Dartmouth (MA)
52. Robertson WG (2016) Dietary recommendations and treatment of patients with recurrent idiopathic calcium stone disease. Urolithiasis 44:9-26 https://doi.org/10.1007/s00240-015-0849-2
53. Skolarikos A, Straub M, Knoll T, et al (2015) Metabolic evaluation and recurrence prevention for urinary stone patients: EAU guidelines. European urology 67:750-763 https://doi.org/10.1016/j.eururo.2014.10.029
54. Ferraro PM, Taylor EN, Gambaro G, et al (2017) Dietary and Lifestyle Risk Factors Associated with Incident Kidney Stones in Men and Women. The Journal of urology 198:858-863 https://doi.org/10.1016/j.juro.2017.03.124
55. Lieske JC, Turner ST, Edeh SN, et al (2016) Heritability of dietary traits that contribute to nephrolithiasis in a cohort of adult sibships. Journal of nephrology 29:45-51 https://doi.org/10.1007/s40620-015-0204-2
56. Sorensen MD, Kahn AJ, Reiner AP, et al (2012) Impact of nutritional factors on incident kidney stone formation: a report from the WHI OS. The Journal of urology 187:1645-1649 https://doi.org/10.1016/j.juro.2011.12.077
57. Reedy J, Subar AF, George SM, et al (2018) Extending methods in dietary patterns research. Nutrients 10:571
58. Chatelan A, Beer-Borst S, Randriamiharisoa A, et al (2017) Major Differences in Diet across Three Linguistic Regions of Switzerland: Results from the First National Nutrition Survey menuCH. Nutrients 9https://doi.org/10.3390/nu9111163

Figures


Methods for the Dietary Assessment of Adult Kidney Stone Formers: A Scoping Review
Systematic search: Medline, Embase, Cinahl, Cochrane, Web of Sciences
No time limit, search conducted on June 10th 2020
Limited to adult kidney stone formers
871 publications screened based on title and abstract
569 publications excluded (wrong population, reviews...)
302 full-texts reviewed
149 publications excluded
162 publications included
Results:
- Mostly observational and cross-sectional studies
- Most studies from the USA (40%) and Europe (33%)
- Short and self-addressed methods mostly used
- New technologies rarely used
→ Call for guidelines to develop and use dietary assessment methods
→ Future research: combination of self-report and objective biomarkers
Legay et al, 2021

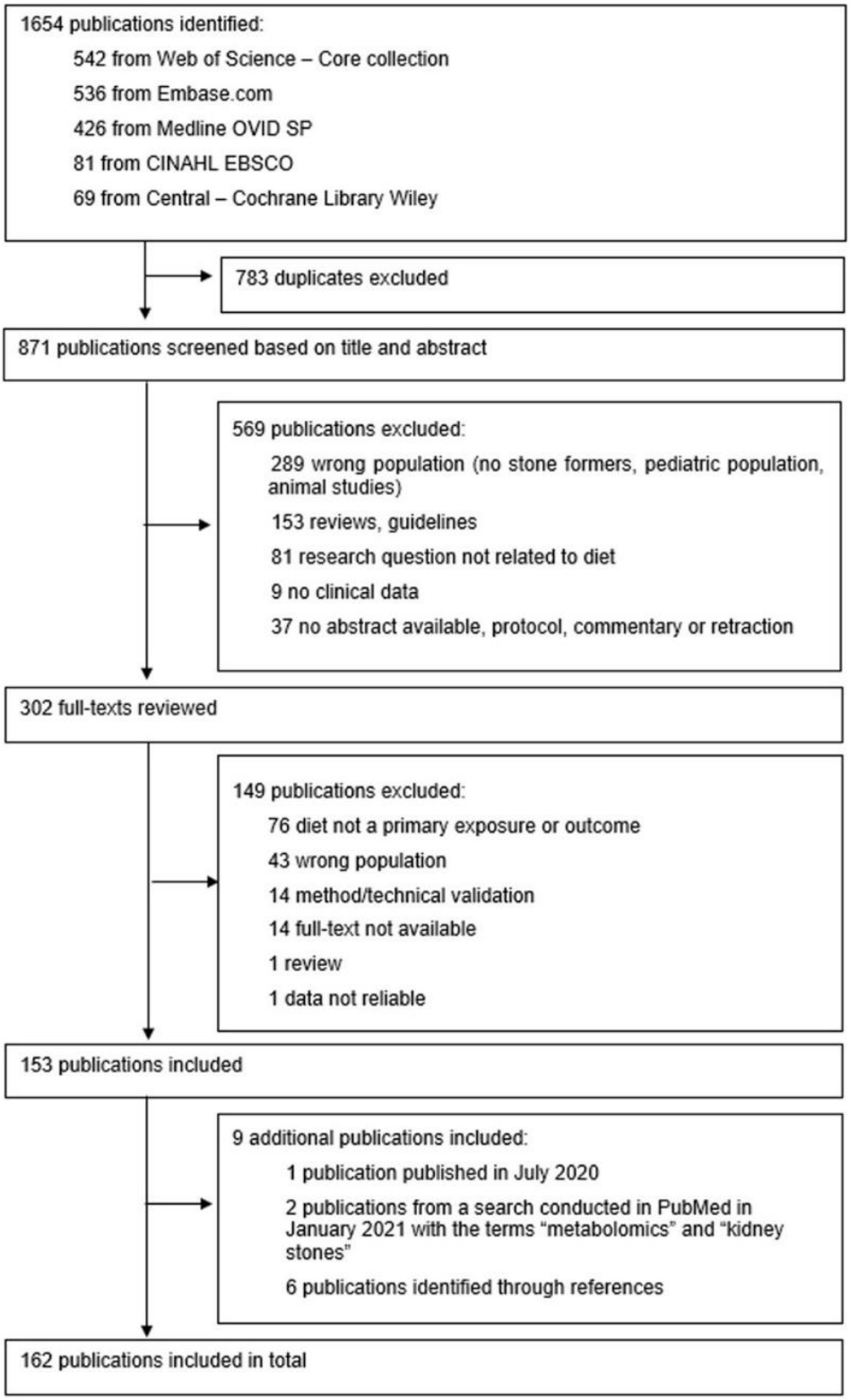


Fig. 1 Flow-chart representing the selection process of the publications included in the review

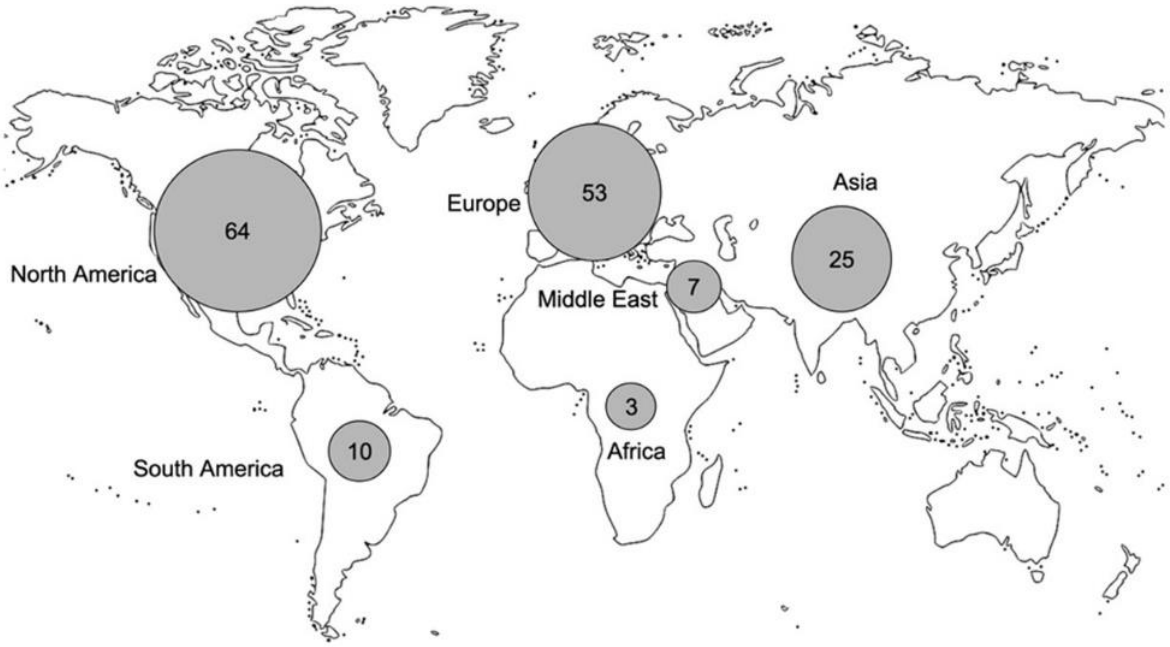


Fig. 2 Origin of the participants in the publications
North America region includes Canada, Puerto Rico and the USA
South America region includes Brazil
Europe region includes Austria, Bulgaria, Croatia, Czech Republic, Finland, France, Greece, Germany, Ireland, Italy, Macedonia, Poland, Romania, Serbia, Slovenia, Spain, Sweden and the UK
Middle East region includes Iran, Saudi Arabia and Turkey
Africa region includes Morocco and South Africa
Asia region includes China, India, Japan, Korea, Pakistan, Taiwan and Thailand

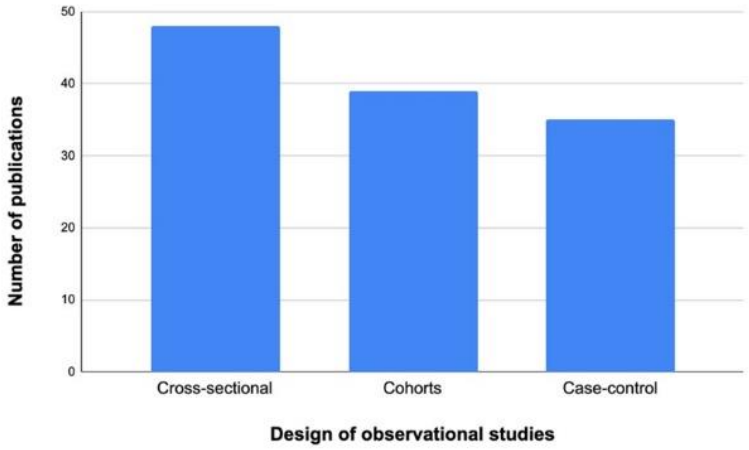


Fig. 3a Number of publications for each type of observational studies (n=122)

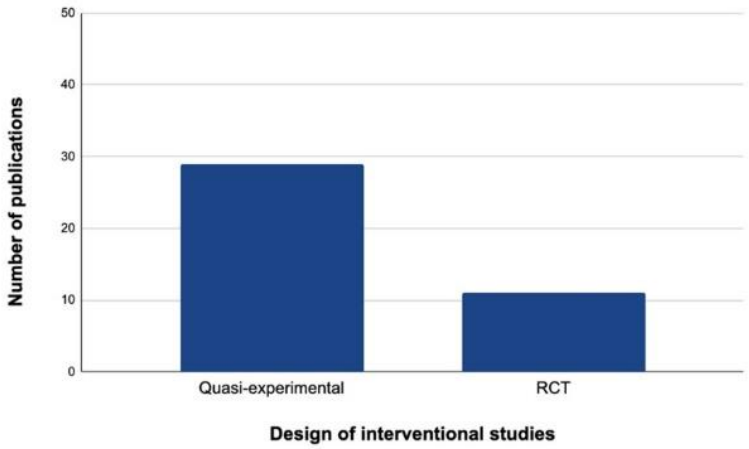


Fig. 3b Number of publications for each type of interventional studies (n=40)

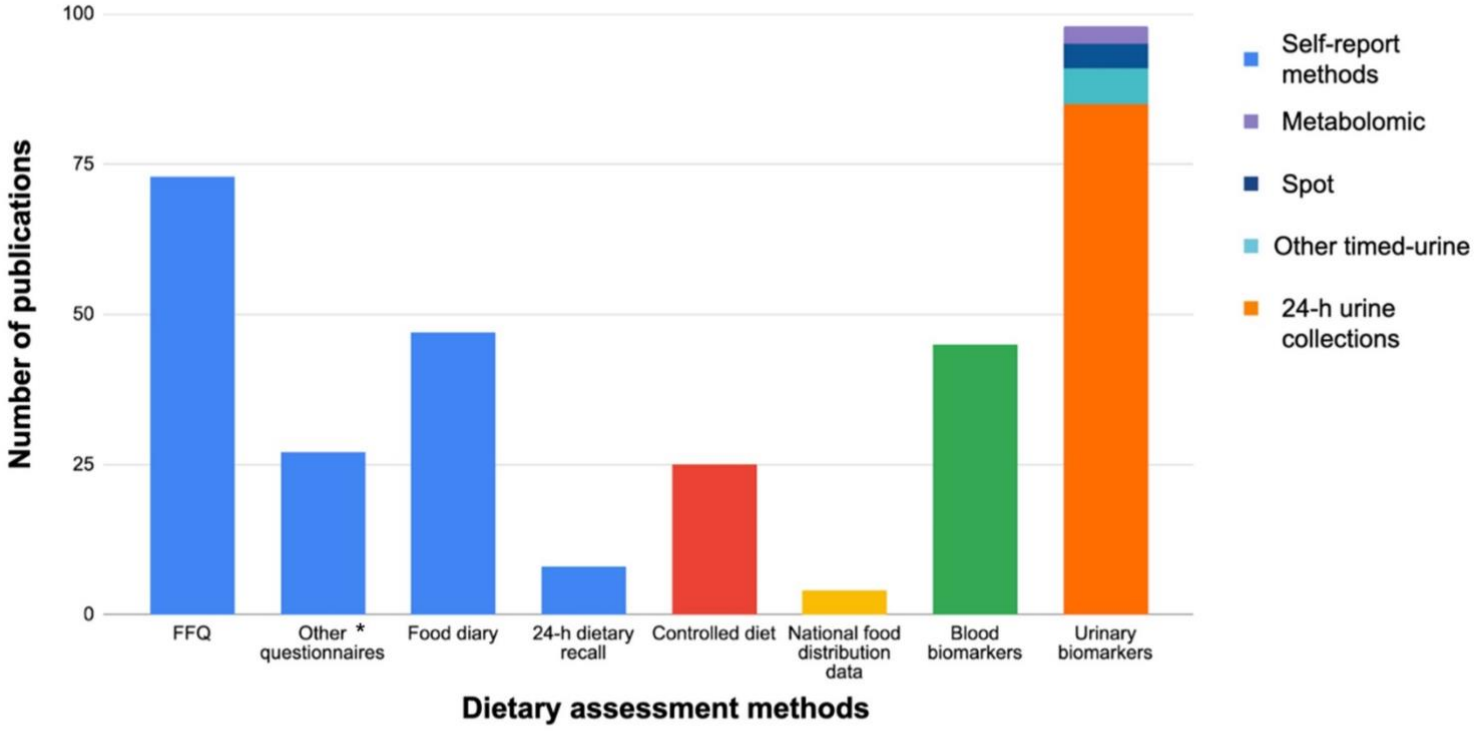


Fig. 4 Number of publications per dietary assessment method (n=162)
* other questionnaires include diet history and non-FFQ questionnaires

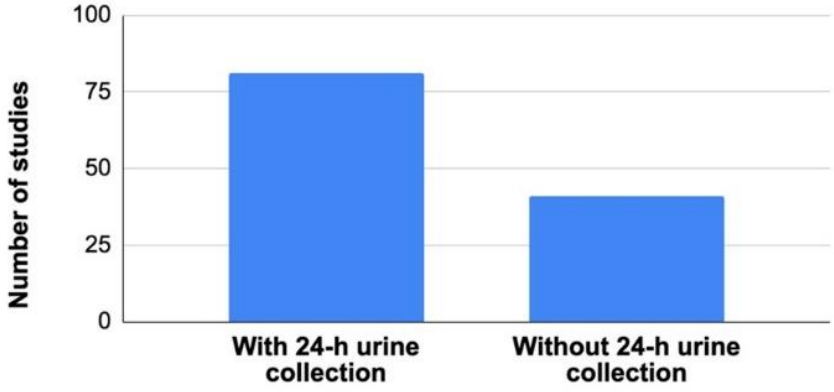


Fig. 5a Number of studies with or without 24-h urine collections available (n=122)

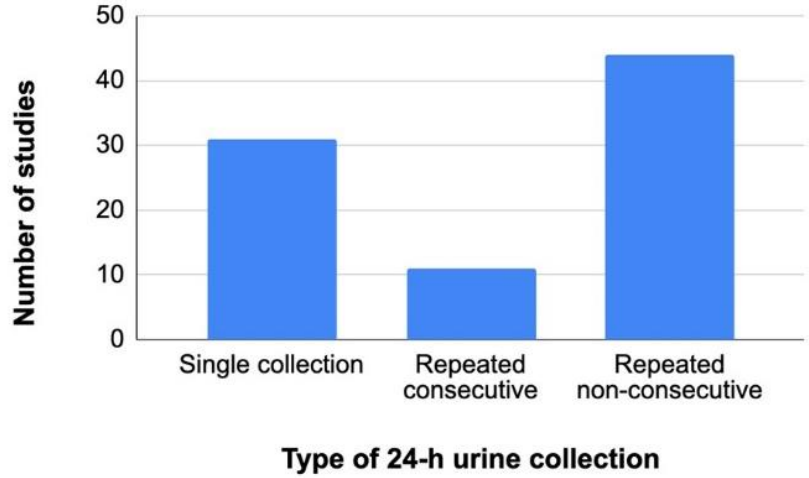


Fig. 5b Number of studies per type of 24-h urine collection (n=81)

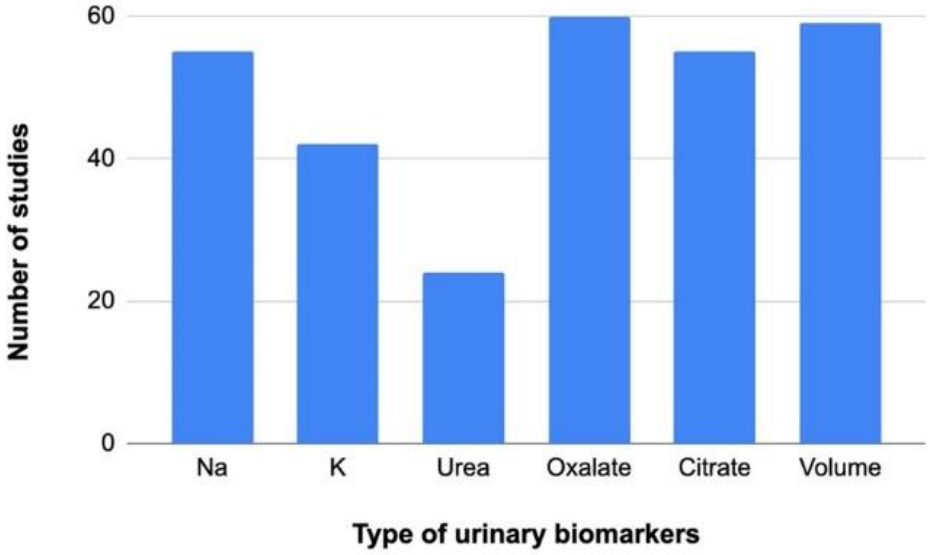


Fig. 6 Number of studies per type of urinary biomarkers measured in the 24-h urine collections (n=81)

The number of studies represents the studies in which the values of the biomarkers were reported in at least one publication based on this study

Supplementary material

Full search equations

Medline Ovid SP

(Urolithiasis/ OR exp Nephrolithiasis/ OR kidney lithiasis.ti,ab,kf. OR nephrolithiasis.ti,ab,kf. OR renal lithiasis.ti,ab,kf. OR renolithiasis.ti,ab,kf. OR ((kidney OR renal) adj2 (calcul* OR stone*)).ti,ab,kf. OR (urinary calcul* OR urinary lithiasis OR urinary stone* OR urinary tract calcul* OR urinary tract lithiasis OR urinary tract stone* OR urine calcul* OR urine lithiasis OR urine stone* OR uro-lithiasis OR urocalcul* OR urolith OR urolithiasis OR urolithogenesis OR urologic calcul* OR urological calcul*).ti,ab,kf.) AND (Nutrition Assessment/ OR Diet Records/ OR Mobile Applications/ OR ((diet* OR eating OR fluid consumption OR fluid intake OR food OR nutrient* OR nutrition*) adj3 (assess* OR behavio$r* OR biochemical analysis OR biochemistry OR diaries OR diary OR evaluat* OR habit$ OR measur* OR record*)).ti,ab,kf. OR ((biological marker* OR biomarker*).ti,ab,kf,sh. AND (diet* OR food OR nutrit*).ti,ab,kf,hw.) OR (24h recall OR 24hour recall OR 24-hour recall OR 24h urine collection OR 24hour urine collection OR 24-hour urine collection OR FFQ OR food frequency questionnaire OR online questionnaire* OR photo app* OR photo phone app* OR smart bottle*).ti,ab,kf.) AND English.lg. NOT (exp animals/ not humans/) NOT ((exp Infant/ OR exp Child/ OR Adolescent/) not exp Adult/) NOT (comment/ or editorial/ or letter/)

As of June 10th 2020, 426 references found.

Embase.com

('urolithiasis'/de OR 'nephrolithiasis'/de OR 'kidney lithiasis':ti,ab,kw OR 'nephrolithiasis':ti,ab,kw OR 'renal lithiasis':ti,ab,kw OR 'renolithiasis':ti,ab,kw OR ((kidney OR renal) NEAR/2 (calcul* OR stone*)):ti,ab,kw OR ('urinary calcul*' OR 'urinary lithiasis' OR 'urinary stone*' OR 'urinary tract calcul*' OR 'urinary tract lithiasis' OR 'urinary tract stone*' OR 'urine calcul*' OR 'urine lithiasis' OR 'urine stone*' OR 'uro-lithiasis' OR urocalcul* OR urolith OR urolithiasis OR urolithogenesis OR 'urologic calcul*' OR 'urological calcul*'):ti,ab,kw) AND ('nutritional assessment'/de OR 'food frequency questionnaire'/de OR 'mobile application'/exp OR ((diet* OR eating OR 'fluid consumption' OR 'fluid intake' OR food OR nutrient* OR nutrition*) NEAR/3 (assess* OR behavio$r* OR 'biochemical analysis' OR biochemistry OR diaries OR diary OR evaluat* OR habit$ OR measur* OR record*)):ti,ab,kw OR (('biological marker*' OR biomarker*):ti,ab,kw,de AND (diet* OR food OR nutrit*):ti,ab,kw,de) OR ('24h recall' OR '24hour recall' OR '24-hour recall' OR '24h urine collection' OR '24hour urine collection' OR '24-hour urine collection' OR FFQ OR 'food frequency questionnaire' OR 'online questionnaire*' OR 'photo app*' OR 'photo phone app*' OR 'smart bottle*'):ti,ab,kw) AND [english]/lim NOT ([animals]/lim NOT [humans]/lim) NOT ('juvenile'/exp NOT 'adult'/exp) NOT ('conference abstract'/it OR 'conference review'/it OR 'editorial'/it OR 'letter'/it)

As of June 10th 2020, 536 references found.

CINAHL EBSCO

(MH "Urolithiasis" OR TI "kidney lithiasis" OR AB "kidney lithiasis" OR TI nephrolithiasis OR AB nephrolithiasis OR TI "renal lithiasis" OR AB "renal lithiasis" OR TI renolithiasis OR AB renolithiasis OR ((TI kidney OR AB kidney OR TI renal OR AB renal) N2 (TI calcul* OR AB calcul* OR TI stone* OR AB stone*)) OR TI "urinary calcul*" OR AB "urinary calcul*" OR TI "urinary lithiasis" OR AB "urinary lithiasis" OR TI "urinary stone*" OR AB "urinary stone*" OR TI "urinary tract calcul*" OR AB "urinary tract calcul*" OR TI "urinary tract lithiasis" OR AB "urinary tract lithiasis" OR TI "urinary tract stone*" OR AB "urinary tract stone*" OR TI "urine calcul*" OR AB "urine calcul*" OR TI "urine lithiasis" OR AB "urine lithiasis" OR TI "urine stone*" OR AB "urine stone*" OR TI uro-lithiasis OR AB uro-lithiasis OR TI urocalcul* OR AB urocalcul* OR TI urolith OR AB urolith OR TI urolithiasis OR AB urolithiasis OR TI urolithogenesis OR AB urolithogenesis OR TI "urologic calcul*" OR AB "urologic calcul*" OR TI "urological calcul*" OR AB "urological calcul*")

AND

(MH "Nutritional Assessment" OR MH "Diet Records" OR MH "Mobile Applications" OR ((TI diet* OR AB diet* OR TI eating OR AB eating OR TI "fluid consumption" OR AB "fluid consumption" OR TI "fluid intake" OR AB "fluid intake" OR TI food OR AB food OR TI nutrient* OR AB nutrient* OR TI nutrition* OR AB nutrition*) N3 (TI assess* OR AB assess* OR TI behavio#r# OR AB behavior#r# OR TI "biochemical analysis" OR AB "biochemical analysis" OR TI biochemistry OR AB biochemistry OR TI diaries OR AB diaries OR TI diary OR AB diary OR TI evaluat* OR AB evaluat* OR TI habit* OR AB habit* OR TI measur* OR AB measur* OR TI record* OR AB record*)) OR ((TI "biological marker*" OR AB "biological marker*" OR TI biomarker* OR AB biomarker*) AND (TI diet* OR AB diet* OR TI food OR AB food OR TI nutrit* OR AB nutrit*)) OR (TI "24h recall" OR AB "24h recall" OR TI "24hour recall" OR AB "24hour recall" OR TI "24-hour recall" OR AB "24-hour recall" OR TI "24h urine collection" OR AB "24h urine collection" OR TI "24hour urine collection" OR AB "24hour urine collection" OR TI "24-hour urine collection" OR AB "24-hour urine collection" OR TI FFQ OR AB FFQ OR TI "food frequency questionnaire" OR AB "food frequency questionnaire" OR TI "online questionnaire*" OR AB "online questionnaire*" OR TI "photo app*" OR AB "photo app*" OR TI "photo phone app*" OR AB "photo phone app*" OR TI "smart bottle*" OR AB "smart bottle*"))

NOT (((MH "Child+") OR (MH "Adolescence+")) NOT (MH "Adult+"))

As of June 10th 2020, 81 references found.

Central - Cochrane Library Wiley

(urolithiasis OR "kidney lithiasis" OR nephrolithiasis OR "renal lithiasis" OR renolithiasis OR ((kidney OR renal) NEAR/2 (calcul* OR stone*)) OR "urinary calcul*" OR "urinary lithiasis" OR "urinary stone*" OR "urinary tract calcul*" OR "urinary tract lithiasis" OR "urinary tract stone*" OR "urine calcul*" OR "urine lithiasis" OR "urine stone*" OR uro-lithiasis OR urocalcul* OR urolith OR urolithiasis OR urolithogenesis OR "urologic calcul*" OR "urological calcul*") AND (((diet* OR eating OR "fluid consumption" OR "fluid intake" OR food OR nutrient* OR nutrition*) NEAR/3 (assess* OR behavior* OR behaviour* OR "biochemical analysis" OR biochemistry OR diaries OR diary OR evaluat* OR habit OR habits OR measur* OR record*)) OR (("biological marker*" OR biomarker*) AND (diet* OR food

OR nutrit*)) OR ("24h recall" OR "24hour recall" OR "24-hour recall" OR "24h urine collection" OR "24hour urine collection" OR "24-hour urine collection" OR FFQ OR "food frequency questionnaire" OR "mobile application*" OR "online questionnaire*" OR "photo app*" OR "photo phone app*" OR "smart bottle*"))

As of June 10th 2020, 69 references found.

Web of Science – Core collection*

(urolithiasis OR "kidney lithiasis" OR nephrolithiasis OR "renal lithiasis" OR renolithiasis OR ((kidney OR renal) NEAR/2 (calcul* OR stone*)) OR "urinary calcul*" OR "urinary lithiasis" OR "urinary stone*" OR "urinary tract calcul*" OR "urinary tract lithiasis" OR "urinary tract stone*" OR "urine calcul*" OR "urine lithiasis" OR "urine stone*" OR uro-lithiasis OR urocalcul* OR urolith OR urolithiasis OR urolithogenesis OR "urologic calcul*" OR "urological calcul*") AND (((diet* OR eating OR "fluid consumption" OR "fluid intake" OR food OR nutrient* OR nutrition*) NEAR/3 (assess* OR behavior* OR behaviour* OR "biochemical analysis" OR biochemistry OR diaries OR diary OR evaluat* OR habit OR habits OR measur* OR record*)) OR (("biological marker*" OR biomarker*) AND (diet* OR food OR nutrit*)) OR ("24h recall" OR "24hour recall" OR "24-hour recall" OR "24h urine collection" OR "24hour urine collection" OR "24-hour urine collection" OR FFQ OR "food frequency questionnaire" OR "mobile application*" OR "online questionnaire*" OR "photo app*" OR "photo phone app*" OR "smart bottle*")) NOT ((Child* OR Adolescen*) NOT adult))

As of June 10th 2020, 542 references found.

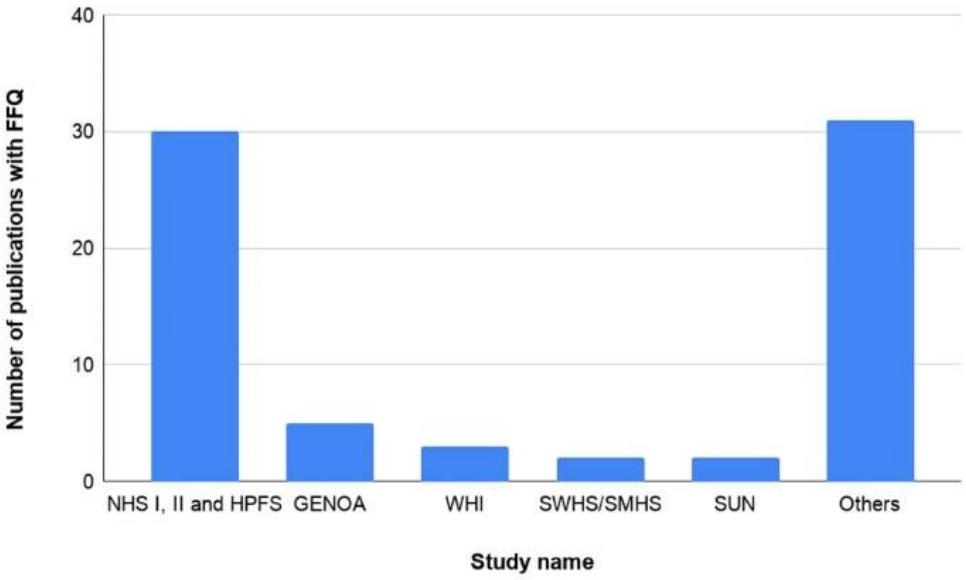


Fig.7 Number of publications per study with a FFQ (n=73)

NHS I and II: Nurses' Health Study I and II
HPFS: Health Professionals Follow-Up Study
GENOA: The Genetic Epidemiology Network of Arteriopathy cohort
WHI: The Women's Health Initiative Observational Study
SWHS/SMHS: Shanghai Women's Health Study and Shanghai Men's Health Study
SUN: The Seguimiento Universidad de Navarra

Table 1 Description of included studies

Study Name	Number of publications	Observational design	Interventional design	References
Studies with multiple publications	48	47	1	
NHS I and II, HPFS *	30	30	0	[1-30]
GENOA †	5	5	0	[31-35]
WHI ‡	3	3	0	[36-38]
SUN §	2	2	0	[39, 40]
SWHS and SMHS ¶	2	2	0	[41, 42]
Bonn Urolithiasis Follow-up Study	2	1	1	[43, 44]
Naya et al.	2	2	0	[45, 46]
Damasio et al.	2	2	0	[47, 48]
Studies with a single publication	114	75	39	[49-162]
Total	162	122	40	

* Nurses' Health Study I and II, Health Professionals Follow-Up Study
† The Genetic Epidemiology Network of Arteriopathy cohort
‡ The Women's Health Initiative Observational Study
§ The Seguimiento Universidad de Navarra
¶ Shanghai Women's Health Study and Shanghai Men's Health Study

References

1. Curhan GC, Rimm EB, Willett WC, et al (1994) Regional variation in nephrolithiasis incidence and prevalence among United States men. The Journal of urology 151:838-841 https://doi.org/10.1016/s0022-5347(17)35101-7
2. Curhan GC, Willett WC, Knight EL, et al (2004) Dietary factors and the risk of incident kidney stones in younger women: Nurses' Health Study II. Archives of internal medicine 164:885-891 https://doi.org/10.1001/archinte.164.8.885
3. Curhan GC, Willett WC, Rimm EB, et al (1998) Body size and risk of kidney stones. Journal of the American Society of Nephrology : JASN 9:1645-1652
4. Curhan GC, Willett WC, Rimm EB, et al (1996) Prospective study of beverage use and the risk of kidney stones. American journal of epidemiology 143:240-247 https://doi.org/10.1093/oxfordjournals.aje.a008734
5. Curhan GC, Willett WC, Rimm EB, et al (1996) A prospective study of the intake of vitamins C and B6, and the risk of kidney stones in men. The Journal of urology 155:1847-1851

6. Curhan GC, Willett WC, Rimm EB, et al (1993) A prospective study of dietary calcium and other nutrients and the risk of symptomatic kidney stones. The New England journal of medicine 328:833-838 https://doi.org/10.1056/nejm199303253281203
7. Curhan GC, Willett WC, Rimm EB, et al (1997) Family history and risk of kidney stones. Journal of the American Society of Nephrology : JASN 8:1568-1573
8. Curhan GC, Willett WC, Speizer FE, et al (1997) Comparison of dietary calcium with supplemental calcium and other nutrients as factors affecting the risk for kidney stones in women. Annals of internal medicine 126:497-504 https://doi.org/10.7326/0003-4819-126-7-199704010-00001
9. Curhan GC, Willett WC, Speizer FE, et al (1998) Beverage use and risk for kidney stones in women. Annals of internal medicine 128:534-540 https://doi.org/10.7326/0003-4819-128-7-199804010-00003
10. Ferraro PM, Curhan GC, Gambaro G, et al (2016) Total, Dietary, and Supplemental Vitamin C Intake and Risk of Incident Kidney Stones. American journal of kidney diseases : the official journal of the National Kidney Foundation 67:400-407 https://doi.org/10.1053/j.ajkd.2015.09.005
11. Ferraro PM, Curhan GC, Sorensen MD, et al (2015) Physical activity, energy intake and the risk of incident kidney stones. The Journal of urology 193:864-868 https://doi.org/10.1016/j.juro.2014.09.010
12. Ferraro PM, Gambaro G, Curhan GC, et al (2018) Intake of Trace Metals and the Risk of Incident Kidney Stones. The Journal of urology 199:1534-1539 https://doi.org/10.1016/j.juro.2018.01.077
13. Ferraro PM, Mandel EI, Curhan GC, et al (2016) Dietary Protein and Potassium, Diet-Dependent Net Acid Load, and Risk of Incident Kidney Stones. Clinical journal of the American Society of Nephrology : CJASN 11:1834-1844 https://doi.org/10.2215/cjn.01520216
14. Ferraro PM, Taylor EN, Gambaro G, et al (2018) Vitamin B6 intake and the risk of incident kidney stones. Urolithiasis 46:265-270 https://doi.org/10.1007/s00240-017-0999-5
15. Ferraro PM, Taylor EN, Gambaro G, et al (2013) Soda and other beverages and the risk of kidney stones. Clinical journal of the American Society of Nephrology : CJASN 8:1389-1395 https://doi.org/10.2215/cjn.11661112
16. Ferraro PM, Taylor EN, Gambaro G, et al (2014) Caffeine intake and the risk of kidney stones. The American journal of clinical nutrition 100:1596-1603 https://doi.org/10.3945/ajcn.114.089987
17. Ferraro PM, Taylor EN, Gambaro G, et al (2017) Dietary and Lifestyle Risk Factors Associated with Incident Kidney Stones in Men and Women. The Journal of urology 198:858-863 https://doi.org/10.1016/j.juro.2017.03.124
18. Ferraro PM, Taylor EN, Gambaro G, et al (2017) Vitamin D Intake and the Risk of Incident Kidney Stones. The Journal of urology 197:405-410 https://doi.org/10.1016/j.juro.2016.08.084
19. Mandel EI, Taylor EN, Curhan GC (2013) Dietary and lifestyle factors and medical conditions associated with urinary citrate excretion. Clinical journal of the American Society of Nephrology : CJASN 8:901-908 https://doi.org/10.2215/cjn.07190712
20. Rodriguez A, Curhan GC, Gambaro G, et al (2020) Mediterranean diet adherence and risk of incident kidney stones. The American journal of clinical nutrition https://doi.org/10.1093/ajcn/nqaa066

21. Taylor EN, Curhan GC (2013) Dietary calcium from dairy and nondairy sources, and risk of symptomatic kidney stones. The Journal of urology 190:1255-1259 https://doi.org/10.1016/j.juro.2013.03.074
22. Taylor EN, Curhan GC (2008) Determinants of 24-hour urinary oxalate excretion. Clinical journal of the American Society of Nephrology : CJASN 3:1453-1460 https://doi.org/10.2215/cjn.01410308
23. Taylor EN, Curhan GC (2007) Oxalate intake and the risk for nephrolithiasis. Journal of the American Society of Nephrology : JASN 18:2198-2204 https://doi.org/10.1681/asn.2007020219
24. Taylor EN, Curhan GC (2008) Fructose consumption and the risk of kidney stones. Kidney international 73:207-212 https://doi.org/10.1038/sj.ki.5002588
25. Taylor EN, Fung TT, Curhan GC (2009) DASH-style diet associates with reduced risk for kidney stones. Journal of the American Society of Nephrology 20:2253-2259
26. Taylor EN, Stampfer MJ, Curhan GC (2004) Dietary factors and the risk of incident kidney stones in men: new insights after 14 years of follow-up. Journal of the American Society of Nephrology : JASN 15:3225-3232 https://doi.org/10.1097/01.Asn.0000146012.44570.20
27. Taylor EN, Stampfer MJ, Curhan GC (2005) Fatty acid intake and incident nephrolithiasis. American journal of kidney diseases : the official journal of the National Kidney Foundation 45:267-274 https://doi.org/10.1053/j.ajkd.2004.09.026
28. Taylor EN, Stampfer MJ, Curhan GC (2005) Obesity, weight gain, and the risk of kidney stones. Jama 293:455-462 https://doi.org/10.1001/jama.293.4.455
29. Taylor EN, Stampfer MJ, Curhan GC (2005) Diabetes mellitus and the risk of nephrolithiasis. Kidney international 68:1230-1235 https://doi.org/10.1111/j.1523-1755.2005.00516.x
30. Taylor EN, Stampfer MJ, Mount DB, et al (2010) DASH-style diet and 24-hour urine composition. Clinical journal of the American Society of Nephrology : CJASN 5:2315-2322 https://doi.org/10.2215/cjn.04420510
31. Lieske JC, Turner ST, Edeh SN, et al (2014) Heritability of urinary traits that contribute to nephrolithiasis. Clinical journal of the American Society of Nephrology : CJASN 9:943-950 https://doi.org/10.2215/cjn.08210813
32. Lieske JC, Turner ST, Edeh SN, et al (2016) Heritability of dietary traits that contribute to nephrolithiasis in a cohort of adult sibships. Journal of nephrology 29:45-51 https://doi.org/10.1007/s40620-015-0204-2
33. Perinpam M, Ware EB, Smith JA, et al (2016) Key influence of sex on urine volume and osmolality. Biology of sex differences 7:12 https://doi.org/10.1186/s13293-016-0063-0
34. Perinpam M, Ware EB, Smith JA, et al (2015) Effect of Demographics on Excretion of Key Urinary Factors Related to Kidney Stone Risk. Urology 86:690-696 https://doi.org/10.1016/j.urology.2015.07.012
35. Perinpam M, Ware EB, Smith JA, et al (2017) Association of urinary citrate excretion, pH, and net gastrointestinal alkali absorption with diet, diuretic use, and blood glucose concentration. Physiological reports 5https://doi.org/10.14814/phy2.13411
36. Sorensen MD, Chi T, Shara NM, et al (2014) Activity, energy intake, obesity, and the risk of incident kidney stones in postmenopausal women: a report from the Women's Health Initiative. Journal of the American Society of Nephrology : JASN 25:362-369 https://doi.org/10.1681/asn.2013050548
37. Sorensen MD, Hsi RS, Chi T, et al (2014) Dietary intake of fiber, fruit and vegetables decreases the risk of incident kidney stones in women: a Women's Health Initiative

report. The Journal of urology 192:1694-1699 https://doi.org/10.1016/j.juro.2014.05.086
38. Sorensen MD, Kahn AJ, Reiner AP, et al (2012) Impact of nutritional factors on incident kidney stone formation: a report from the WHI OS. The Journal of urology 187:1645-1649 https://doi.org/10.1016/j.juro.2011.12.077
39. Carlos S, De La Fuente-Arrillaga C, Bes-Rastrollo M, et al (2018) Mediterranean Diet and Health Outcomes in the SUN Cohort. Nutrients 10https://doi.org/10.3390/nu10040439
40. Leone A, Fernández-Montero A, de la Fuente-Arrillaga C, et al (2017) Adherence to the Mediterranean Dietary Pattern and Incidence of Nephrolithiasis in the Seguimiento Universidad de Navarra Follow-up (SUN) Cohort. American journal of kidney diseases : the official journal of the National Kidney Foundation 70:778-786 https://doi.org/10.1053/j.ajkd.2017.06.027
41. Shu X, Cai H, Xiang YB, et al (2019) Green tea intake and risk of incident kidney stones: Prospective cohort studies in middle-aged and elderly Chinese individuals. International journal of urology : official journal of the Japanese Urological Association 26:241-246 https://doi.org/10.1111/iju.13849
42. Shu X, Calvert JK, Cai H, et al (2019) Plant and Animal Protein Intake and Risk of Incident Kidney Stones: Results from the Shanghai Men's and Women's Health Studies. The Journal of urology 202:1217-1223 https://doi.org/10.1097/ju.0000000000000493
43. Siener R, Ebert D, Nicolay C, et al (2003) Dietary risk factors for hyperoxaluria in calcium oxalate stone formers. Kidney international 63:1037-1043 https://doi.org/10.1046/j.1523-1755.2003.00807.x
44. Siener R, Glatz S, Nicolay C, et al (2003) Prospective study on the efficacy of a selective treatment and risk factors for relapse in recurrent calcium oxalate stone patients. European urology 44:467-474 https://doi.org/10.1016/s0302-2838(03)00317-8
45. Naya Y, Ito H, Masai M, et al (2000) Effect of dietary intake on urinary oxalate excretion in calcium oxalate stone formers in their forties. European urology 37:140-144 https://doi.org/10.1159/000020130
46. Naya Y, Ito H, Masai M, et al (2002) Association of dietary fatty acids with urinary oxalate excretion in calcium oxalate stone-formers in their fourth decade. BJU international 89:842-846 https://doi.org/10.1046/j.1464-410x.2002.02740.x
47. Damasio PC, Amaro CR, Berto SJ, et al (2010) Urinary lithiasis and idiopathic hypercalciuria: the importance of dietary intake evaluation. International braz j urol : official journal of the Brazilian Society of Urology 36:557-562 https://doi.org/10.1590/s1677-55382010000500005
48. Damasio PC, Amaro CR, Cunha NB, et al (2011) The role of salt abuse on risk for hypercalciuria. Nutrition journal 10:3 https://doi.org/10.1186/1475-2891-10-3
49. Al Zahrani H, Norman RW, Thompson C, et al (2000) The dietary habits of idiopathic calcium stone-formers and normal control subjects. BJU international 85:616-620 https://doi.org/10.1046/j.1464-410x.2000.00511.x
50. Allen SE, Singh S, Robertson WG (2006) The increased risk of urinary stone disease in betel quid chewers. Urological research 34:239-243 https://doi.org/10.1007/s00240-006-0050-8
51. Baatiah NY, Alhazmi RB, Albathi FA, et al (2020) Urolithiasis: Prevalence, risk factors, and public awareness regarding dietary and lifestyle habits in Jeddah, Saudi Arabia in 2017. Urology annals 12:57-62 https://doi.org/10.4103/ua.Ua_13_19

52. Bailly GG, Norman RW, Thompson C (2000) Effects of dietary fat on the urinary risk factors of calcium stone disease. Urology 56:40-44 https://doi.org/10.1016/s0090-4295(00)00590-2
53. Barker DJP, Morris JA, Margetts BM (1988) Diet and renal stones in 72 areas in England and Wales. British journal of urology 62:315-318
54. Basiri A, Shakhssalim N, Khoshdel AR, et al (2009) Influential nutrient in urolithiasis incidence: protein or meat? Journal of renal nutrition : the official journal of the Council on Renal Nutrition of the National Kidney Foundation 19:396-400 https://doi.org/10.1053/j.jrn.2009.01.017
55. Bazyar H, Ahmadi A, Zare Javid A, et al (2019) The association between dietary intakes and stone formation in patients with urinary stones in Shiraz. Medical journal of the Islamic Republic of Iran 33:8 https://doi.org/10.34171/mjiri.33.8
56. Bellizzi V, De Nicola L, Minutolo R, et al (1999) Effects of water hardness on urinary risk factors for kidney stones in patients with idiopathic nephrolithiasis. Nephron 81 Suppl 1:66-70 https://doi.org/10.1159/000046301
57. Berkemeyer S, Bhargava A, Bhargava U (2007) Urinary phosphorus rather than urinary calcium possibly increases renal stone formation in a sample of Asian Indian, male stone-formers. The British journal of nutrition 98:1224-1228 https://doi.org/10.1017/s0007114507778686
58. Bobulescu IA, Maalouf NM, Capolongo G, et al (2013) Renal ammonium excretion after an acute acid load: blunted response in uric acid stone formers but not in patients with type 2 diabetes. American journal of physiology Renal physiology 305:F1498-1503 https://doi.org/10.1152/ajprenal.00374.2013
59. Bobulescu IA, Park SK, Xu LHR, et al (2019) Net Acid Excretion and Urinary Organic Anions in Idiopathic Uric Acid Nephrolithiasis. Clinical journal of the American Society of Nephrology : CJASN 14:411-420 https://doi.org/10.2215/cjn.10420818
60. Burtis WJ, Gay L, Insogna KL, et al (1994) Dietary hypercalciuria in patients with calcium oxalate kidney stones. The American journal of clinical nutrition 60:424-429
61. Caudarella R, Rizzoli E, Buffa A, et al (1998) Comparative study of the influence of 3 types of mineral water in patients with idiopathic calcium lithiasis. The Journal of urology 159:658-663
62. Dai M, Zhao A, Liu A, et al (2013) Dietary factors and risk of kidney stone: a case-control study in southern China. Journal of renal nutrition : the official journal of the Council on Renal Nutrition of the National Kidney Foundation 23:e21-28 https://doi.org/10.1053/j.jrn.2012.04.003
63. de OGMC, Martini LA, Baxmann AC, et al (2003) Effects of an oxalate load on urinary oxalate excretion in calcium stone formers. Journal of renal nutrition : the official journal of the Council on Renal Nutrition of the National Kidney Foundation 13:39-46 https://doi.org/10.1053/jren.2003.50002
64. De SK, Liu X, Monga M (2014) Changing trends in the American diet and the rising prevalence of kidney stones. Urology 84:1030-1033 https://doi.org/10.1016/j.urology.2014.06.037
65. Domrongkitchaiporn S, Stitchantrakul W, Kochakarn W (2006) Causes of hypocitraturia in recurrent calcium stone formers: focusing on urinary potassium excretion. American journal of kidney diseases : the official journal of the National Kidney Foundation 48:546-554 https://doi.org/10.1053/j.ajkd.2006.06.008
66. Dongre AR, Rajalakshmi M, Deshmukh PR, et al (2017) Risk Factors for Kidney Stones in Rural Puducherry: Case-Control Study. Journal of clinical and diagnostic research : JCDR 11:Lc01-lc05 https://doi.org/10.7860/jcdr/2017/29465.10561

67. Dussol B, Iovanna C, Rotily M, et al (2008) A randomized trial of low-animal-protein or high-fiber diets for secondary prevention of calcium nephrolithiasis. Nephron Clinical practice 110:c185-194 https://doi.org/10.1159/000167271
68. Fatiha L, Fouzia RF, Ali A, et al (2009) Correlations between the composition of Moroccan urinary stones and the risk factors (food habit). Pakistan Journal of Nutrition 8:977-982
69. Fellström B, Danielson BG, KarlstrÖM B, et al (1989) Dietary habits in renal stone patients compared with healthy subjects. British journal of urology 63:575-580
70. Gambaro G, Bertaglia G, Inelmen EM, et al (1993) Diet and nephrolithiasis: Study in an obese population. Nutrition Research 13:535-540
71. Gasińska A, Gajewska D (2007) Tea and coffee as the main sources of oxalate in diets of patients with kidney oxalate stones. Roczniki Panstwowego Zakladu Higieny 58:61-67
72. Goldfarb DS, Fischer ME, Keich Y, et al (2005) A twin study of genetic and dietary influences on nephrolithiasis: a report from the Vietnam Era Twin (VET) Registry. Kidney international 67:1053-1061 https://doi.org/10.1111/j.1523-1755.2005.00170.x
73. Gordiano EA, Tondin LM, Miranda RC, et al (2014) Evaluation of food intake and excretion of metabolites in nephrolithiasis. Jornal brasileiro de nefrologia : 'orgao oficial de Sociedades Brasileira e Latino-Americana de Nefrologia 36:437-445 https://doi.org/10.5935/0101-2800.20140063
74. Griffith HM, O'Shea B, Maguire M, et al (1986) A case-control study of dietary intake of renal stone patients. II. Urine biochemistry and stone analysis. Urological research 14:75-82 https://doi.org/10.1007/bf00257892
75. Guerra A, Folesani G, Mena P, et al (2014) Hippuric acid in 24 h urine collections as a biomarker of fruits and vegetables intake in kidney stone formers. International journal of food sciences and nutrition 65:1033-1038 https://doi.org/10.3109/09637486.2014.950210
76. Guerra A, Ticinesi A, Allegri F, et al (2019) Insights about urinary hippuric and citric acid as biomarkers of fruit and vegetable intake in patients with kidney stones: The role of age and sex. Nutrition (Burbank, Los Angeles County, Calif) 59:83-89 https://doi.org/10.1016/j.nut.2018.07.112
77. Hamid R, Robertson WG, Woodhouse CR (2008) Comparison of biochemistry and diet in patients with enterocystoplasty who do and do not form stones. BJU international 101:1427-1432 https://doi.org/10.1111/j.1464-410X.2008.07492.x
78. Hassapidou MN, Paraskevopoulos ST, Karakoltsidis PA, et al (1999) Dietary habits of patients with renal stone disease in Greece. Journal of Human Nutrition and Dietetics 12:47-51
79. Heningburg AM, Mohapatra A, Potretzke AM, et al (2016) Electronic nutritional intake assessment in patients with urolithiasis: A decision impact analysis. Investigative and clinical urology 57:196-201 https://doi.org/10.4111/icu.2016.57.3.196
80. Hirvonen T, Pietinen P, Virtanen M, et al (1999) Nutrient intake and use of beverages and the risk of kidney stones among male smokers. American journal of epidemiology 150:187-194 https://doi.org/10.1093/oxfordjournals.aje.a009979
81. Hsu TC, Chen J, Huang HS, et al (2002) Association of changes in the pattern of urinary calculi in Taiwanese with diet habit change between 1956 and 1999. Journal of the Formosan Medical Association = Taiwan yi zhi 101:5-10
82. Icer MA, Gezmen-Karadag M (2019) The potential effects of dietary food and beverage intakes on the risk of kidney stone formation. Revista de Nutrição 32

83. Iguchi M, Kataoka K, Kohri K, et al (1984) Nutritional risk factors in calcium stone disease in Japan. Urologia internationalis 39:32-35 https://doi.org/10.1159/000280940
84. Iguchi M, Umekawa T, Ishikawa Y, et al (1990) Dietary intake and habits of Japanese renal stone patients. The Journal of urology 143:1093-1095
85. Jabbar F, Asif M, Dutani H, et al (2015) Assessment of the role of general, biochemical and family history characteristics in kidney stone formation. Saudi journal of biological sciences 22:65-68 https://doi.org/10.1016/j.sjbs.2014.06.002
86. Karagiannis A, Skolarikos A, Alexandrescu E, et al (2017) Epidemiologic study of urolithiasis in seven countries of South-Eastern Europe: S.E.G.U.R. 1 study. Archivio italiano di urologia, andrologia : organo ufficiale [di] Societa italiana di ecografia urologica e nefrologica 89:173-177 https://doi.org/10.4081/aiua.2017.3.173
87. Karagülle O, Smorag U, Candir F, et al (2007) Clinical study on the effect of mineral waters containing bicarbonate on the risk of urinary stone formation in patients with multiple episodes of CaOx-urolithiasis. World journal of urology 25:315-323 https://doi.org/10.1007/s00345-007-0144-0
88. Kaufman DW, Kelly JP, Curhan GC, et al (2008) Oxalobacter formigenes may reduce the risk of calcium oxalate kidney stones. Journal of the American Society of Nephrology : JASN 19:1197-1203 https://doi.org/10.1681/asn.2007101058
89. Khambati A, Matulewicz RS, Perry KT, et al (2017) Factors Associated with Compliance to Increased Fluid Intake and Urine Volume Following Dietary Counseling in First-Time Kidney Stone Patients. Journal of endourology 31:605-610 https://doi.org/10.1089/end.2016.0836
90. Kıraç M, Küpeli B, Irkilata L, et al (2013) Effects of dietary interventions on 24-hour urine parameters in patients with idiopathic recurrent calcium oxalate stones. The Kaohsiung journal of medical sciences 29:88-92 https://doi.org/10.1016/j.kjms.2012.08.015
91. Kocvara R, Plasgura P, Petrík A, et al (1999) A prospective study of nonmedical prophylaxis after a first kidney stone. BJU international 84:393-398 https://doi.org/10.1046/j.1464-410x.1999.00216.x
92. Krieger JN, Kronmal RA, Coxon V, et al (1996) Dietary and behavioral risk factors for urolithiasis: potential implications for prevention. American journal of kidney diseases : the official journal of the National Kidney Foundation 28:195-201 https://doi.org/10.1016/s0272-6386(96)90301-7
93. Kumar MKR (2015) Weight Gain and the Risk of Kidney Stones. Journal of Pharmaceutical Sciences and Research 7:776
94. Lange JN, Easter L, Amoroso R, et al (2013) Internet program for facilitating dietary modifications limiting kidney stone risk. The Canadian journal of urology 20:6922-6926
95. Leonetti F, Dussol B, Berthezene P, et al (1998) Dietary and urinary risk factors for stones in idiopathic calcium stone formers compared with healthy subjects. Nephrology, dialysis, transplantation : official publication of the European Dialysis and Transplant Association - European Renal Association 13:617-622 https://doi.org/10.1093/ndt/13.3.617
96. Lieske JC, Tremaine WJ, De Simone C, et al (2010) Diet, but not oral probiotics, effectively reduces urinary oxalate excretion and calcium oxalate supersaturation. Kidney international 78:1178-1185 https://doi.org/10.1038/ki.2010.310
97. Lingeman JE, Pareek G, Easter L, et al (2019) ALLN-177, oral enzyme therapy for hyperoxaluria. International urology and nephrology 51:601-608 https://doi.org/10.1007/s11255-019-02098-1

98. Littlejohns TJ, Neal NL, Bradbury KE, et al (2020) Fluid Intake and Dietary Factors and the Risk of Incident Kidney Stones in UK Biobank: A Population-based Prospective Cohort Study. European urology focus 6:752-761 https://doi.org/10.1016/j.euf.2019.05.002
99. Maalouf NM, Poindexter JR, Adams-Huet B, et al (2019) Increased production and reduced urinary buffering of acid in uric acid stone formers is ameliorated by pioglitazone. Kidney international 95:1262-1268 https://doi.org/10.1016/j.kint.2018.11.024
100. Marić I, Kizivat T, Smolić M, et al (2019) LIFESTYLE RISK FACTORS AND BONE MASS IN RECURRENT STONE-FORMING PATIENTS: A CROSS-SECTIONAL STUDY IN 144 SUBJECTS. Acta clinica Croatica 58:439-445 https://doi.org/10.20471/acc.2019.58.03.06
101. Martini LA, Cuppari L, Cunha MA, et al (1998) Potassium and sodium intake and excretion in calcium stone forming patients. Journal of renal nutrition : the official journal of the Council on Renal Nutrition of the National Kidney Foundation 8:127-131 https://doi.org/10.1016/s1051-2276(98)90003-6
102. Masai M, Ito H, Kotake T (1995) Effect of dietary intake on urinary oxalate excretion in calcium renal stone formers. British journal of urology 76:692-696
103. Massey LK, Kynast-Gales SA (1998) Substituting milk for apple juice does not increase kidney stone risk in most normocalciuric adults who form calcium oxalate stones. Journal of the American Dietetic Association 98:303-308 https://doi.org/10.1016/s0002-8223(98)00071-6
104. Melo TL, Esper PLG, Zambrano LI, et al (2020) Expression of vitamin D receptor, CYP27B1 and CYP24A1 hydroxylases and 1,25-dihydroxyvitamin D(3) levels in stone formers. Urolithiasis 48:19-26 https://doi.org/10.1007/s00240-019-01163-9
105. Mente A, Irvine EJ, Honey RJ, et al (2009) Urinary potassium is a clinically useful test to detect a poor quality diet. The Journal of nutrition 139:743-749 https://doi.org/10.3945/jn.108.098319
106. Meschi T, Nouvenne A, Ticinesi A, et al (2012) Dietary habits in women with recurrent idiopathic calcium nephrolithiasis. Journal of translational medicine 10:63 https://doi.org/10.1186/1479-5876-10-63
107. Messa P, Marangella M, Paganin L, et al (1997) Different dietary calcium intake and relative supersaturation of calcium oxalate in the urine of patients forming renal stones. Clinical Science 93:257-263
108. Miladipour AH, Shakhssalim N, Parvin M, et al (2012) Effect of Ramadan fasting on urinary risk factors for calculus formation. Iranian journal of kidney diseases 6:33-38
109. Nagy EN, Tilinca MC, Iacob A, et al (2017) Study on Chemical Composition of Urinary and Salivary Gland Stones in Relationship with Laboratory Parameters and Lifestyle Habits of Patients with Lithiasis. REVISTA DE CHIMIE 68:680-682
110. Nascimento L, Oliveros FH, Cunningham E (1984) Renal handling of sodium and calcium in hypercalciuria. Clinical pharmacology and therapeutics 35:342-347 https://doi.org/10.1038/clpt.1984.41
111. Nishiura JL, Martini LA, Mendonça CO, et al (2002) Effect of calcium intake on urinary oxalate excretion in calcium stone-forming patients. Brazilian journal of medical and biological research = Revista brasileira de pesquisas medicas e biologicas 35:669-675 https://doi.org/10.1590/s0100-879x2002000600006
112. Nomura K, Ito H, Masai M, et al (1995) Reduction of urinary stone recurrence by dietary counseling after SWL. Journal of endourology 9:305-312 https://doi.org/10.1089/end.1995.9.305

113. Oliveira LM, Hauschild DB, Leite Cde M, et al (2014) Adequate dietary intake and nutritional status in patients with nephrolithiasis: new targets and objectives. Journal of renal nutrition : the official journal of the Council on Renal Nutrition of the National Kidney Foundation 24:417-422 https://doi.org/10.1053/j.jrn.2014.06.003
114. Pak CY, Odvina CV, Pearle MS, et al (2005) Effect of dietary modification on urinary stone risk factors. Kidney international 68:2264-2273 https://doi.org/10.1111/j.1523-1755.2005.00685.x
115. Pendse AK, Singh PP (1986) The etiology of urolithiasis in Udaipur (western part of India). Urological research 14:59-62 https://doi.org/10.1007/bf00257889
116. Pieras E, Costa-Bauzá A, Ramis M, et al (2006) Papillary and nonpapillary calcium oxalate monohydrate renal calculi: comparative study of etiologic factors. TheScientificWorldJournal 6:2411-2419 https://doi.org/10.1100/tsw.2006.374
117. Primiano A, Persichilli S, Ferraro PM, et al (2020) A Specific Urinary Amino Acid Profile Characterizes People with Kidney Stones. Disease markers 2020:8848225 https://doi.org/10.1155/2020/8848225
118. Rao PN, Gordon C, Davies D, et al (1984) Metabolic response to refined carbohydrates in idiopathic urolithiasis. Urologia internationalis 39:165-169 https://doi.org/10.1159/000280967
119. Rao PN, Prendiville V, Buxton A, et al (1982) Dietary management of urinary risk factors in renal stone formers. British journal of urology 54:578-583
120. Rodgers A, Mokoena M, Durbach I, et al (2016) Do teas rich in antioxidants reduce the physicochemical and peroxidative risk factors for calcium oxalate nephrolithiasis in humans? Pilot studies with Rooibos herbal tea and Japanese green tea. Urolithiasis 44:299-310 https://doi.org/10.1007/s00240-015-0855-4
121. Rodgers AL (1997) Effect of mineral water containing calcium and magnesium on calcium oxalate urolithiasis risk factors. Urologia internationalis 58:93-99 https://doi.org/10.1159/000282958
122. Rodrigues FG, Lima TM, Zambrano L, et al (2020) Dietary pattern analysis among stone formers: resemblance to a DASH-style diet. Jornal brasileiro de nefrologia : 'orgao oficial de Sociedades Brasileira e Latino-Americana de Nefrologia 42:338-348 https://doi.org/10.1590/2175-8239-jbn-2019-0183
123. Rotily M, Léonetti F, Iovanna C, et al (2000) Effects of low animal protein or high-fiber diets on urine composition in calcium nephrolithiasis. Kidney international 57:1115-1123 https://doi.org/10.1046/j.1523-1755.2000.00939.x
124. Ryu HY, Lee YK, Park J, et al (2018) Dietary risk factors for urolithiasis in Korea: A case-control pilot study. Investigative and clinical urology 59:106-111 https://doi.org/10.4111/icu.2018.59.2.106
125. Schwen ZR, Riley JM, Shilo Y, et al (2013) Dietary management of idiopathic hyperoxaluria and the influence of patient characteristics and compliance. Urology 82:1220-1225 https://doi.org/10.1016/j.urology.2013.08.002
126. Shafi H, Dorosty Motlagh AR, Bagherniya M, et al (2017) The Association of Household Food Insecurity and the Risk of Calcium Oxalate Stones. Urology journal 14:4094-5000
127. Shavit L, Ferraro PM, Johri N, et al (2015) Effect of being overweight on urinary metabolic risk factors for kidney stone formation. Nephrology, dialysis, transplantation : official publication of the European Dialysis and Transplant Association - European Renal Association 30:607-613 https://doi.org/10.1093/ndt/gfu350

128. Siener R, Hoppe B, Löhr P, et al (2018) Metabolic profile and impact of diet in patients with primary hyperoxaluria. International urology and nephrology 50:1583-1589 https://doi.org/10.1007/s11255-018-1939-1
129. Siener R, Netzer L, Hesse A (2013) Determinants of brushite stone formation: a case-control study. PloS one 8:e78996 https://doi.org/10.1371/journal.pone.0078996
130. Siener R, Petzold J, Bitterlich N, et al (2013) Determinants of urolithiasis in patients with intestinal fat malabsorption. Urology 81:17-24 https://doi.org/10.1016/j.urology.2012.07.107
131. Siener R, Schade N, Nicolay C, et al (2005) The efficacy of dietary intervention on urinary risk factors for stone formation in recurrent calcium oxalate stone patients. The Journal of urology 173:1601-1605 https://doi.org/10.1097/01.ju.0000154626.16349.d3
132. Soldati L, Bertoli S, Terranegra A, et al (2014) Relevance of Mediterranean diet and glucose metabolism for nephrolithiasis in obese subjects. Journal of translational medicine 12:34 https://doi.org/10.1186/1479-5876-12-34
133. Somashekara HM, Urooj A (2015) Nutritional status and dietary habits of subjects with urolithiasis. Current Research in Nutrition and Food Science Journal 3:46-53
134. Stitchantrakul W, Kochakarn W, Ruangraksa C, et al (2007) Urinary risk factors for recurrent calcium stone formation in Thai stone formers. Journal of the Medical Association of Thailand = Chotmaihet thangphaet 90:688-698
135. Stout* T, Lingeman J, Krambeck A, et al (2019) MP12-05 UTILIZATION OF A SMART WATER BOTTLE TO INCREASE FLUID INTAKE IN STONE FORMERS. The Journal of urology 201:e169-e170
136. Sweeney DD, Tomaszewski JJ, Ricchiuti DD, et al (2009) Effect of carbohydrate-electrolyte sports beverages on urinary stone risk factors. The Journal of urology 182:992-997 https://doi.org/10.1016/j.juro.2009.05.020
137. Tessaro CZW, Ramos CI, Heilberg IP (2018) Influence of nutritional status, laboratory parameters and dietary patterns upon urinary acid excretion in calcium stone formers. Jornal brasileiro de nefrologia : 'orgao oficial de Sociedades Brasileira e Latino-Americana de Nefrologia 40:35-43 https://doi.org/10.1590/2175-8239-jbn-3814
138. Thomas LD, Elinder CG, Tiselius HG, et al (2013) Dietary cadmium exposure and kidney stone incidence: a population-based prospective cohort study of men & women. Environment international 59:148-151 https://doi.org/10.1016/j.envint.2013.06.008
139. Ticinesi A, Milani C, Guerra A, et al (2018) Understanding the gut-kidney axis in nephrolithiasis: an analysis of the gut microbiota composition and functionality of stone formers. Gut 67:2097-2106 https://doi.org/10.1136/gutjnl-2017-315734
140. Toren PJ, Norman RW (2005) Is 24-hour urinary calcium a surrogate marker for dietary calcium intake? Urology 65:459-462 https://doi.org/10.1016/j.urology.2004.10.025
141. Tosukhowong P, Boonla C, Ratchanon S, et al (2007) Crystalline composition and etiologic factors of kidney stone in Thailand: update 2007.
142. Trinchieri A, Lizzano R, Marchesotti F, et al (2006) Effect of potential renal acid load of foods on urinary citrate excretion in calcium renal stone formers. Urological research 34:1-7 https://doi.org/10.1007/s00240-005-0001-9
143. Trinchieri A, Maletta A, Lizzano R, et al (2013) Potential renal acid load and the risk of renal stone formation in a case-control study. European journal of clinical nutrition 67:1077-1080 https://doi.org/10.1038/ejcn.2013.155

144. Trinchieri A, Mandressi A, Luongo P, et al (1991) The influence of diet on urinary risk factors for stones in healthy subjects and idiopathic renal calcium stone formers. British journal of urology 67:230-236
145. Trinchieri A, Nespoli R, Ostini F, et al (1998) A study of dietary calcium and other nutrients in idiopathic renal calcium stone formers with low bone mineral content. The Journal of urology 159:654-657
146. Trinchieri A, Zanetti G, Currò A, et al (2001) Effect of potential renal acid load of foods on calcium metabolism of renal calcium stone formers. European urology 39 Suppl 2:33-36; discussion 36-37 https://doi.org/10.1159/000052556
147. Turney BW, Appleby PN, Reynard JM, et al (2014) Diet and risk of kidney stones in the Oxford cohort of the European Prospective Investigation into Cancer and Nutrition (EPIC). European journal of epidemiology 29:363-369 https://doi.org/10.1007/s10654-014-9904-5
148. Vezzoli G, Dogliotti E, Terranegra A, et al (2015) Dietary style and acid load in an Italian population of calcium kidney stone formers. Nutrition, metabolism, and cardiovascular diseases : NMCD 25:588-593 https://doi.org/10.1016/j.numecd.2015.03.005
149. Wollin DA, Davis LG, Winship BB, et al (2020) Assessment of conservative dietary management as a method for normalization of 24-h urine pH in stone formers. Urolithiasis 48:131-136 https://doi.org/10.1007/s00240-019-01139-9
150. Worcester EM, Bergsland KJ, Gillen DL, et al (2020) Evidence for disordered acid-base handling in calcium stone-forming patients. American Journal of Physiology-Renal Physiology 318:F363-F374
151. Yasui T, Okada A, Hamamoto S, et al (2013) The association between the incidence of urolithiasis and nutrition based on Japanese National Health and Nutrition Surveys. Urolithiasis 41:217-224 https://doi.org/10.1007/s00240-013-0567-6
152. Zechner O, Latal D, Pflüger H, et al (1981) Nutritional risk factors in urinary stone disease. The Journal of urology 125:51-54
153. Zeng G, Mai Z, Xia S, et al (2017) Prevalence of kidney stones in China: an ultrasonography based cross-sectional study. BJU international 120:109-116 https://doi.org/10.1111/bju.13828
154. Zhao A, Dai M, Chen YJ, et al (2015) Risk factors associated with nephrolithiasis: a case-control study in China. Asia-Pacific journal of public health 27:Np414-424 https://doi.org/10.1177/1010539512445189
155. Zhuo D, Li M, Cheng L, et al (2019) A Study of Diet and Lifestyle and the Risk of Urolithiasis in 1,519 Patients in Southern China. Medical science monitor : international medical journal of experimental and clinical research 25:4217-4224 https://doi.org/10.12659/msm.916703
156. Duan X, Zhang T, Ou L, et al (2020) (1)H NMR-based metabolomic study of metabolic profiling for the urine of kidney stone patients. Urolithiasis 48:27-35 https://doi.org/10.1007/s00240-019-01132-2
157. Borghi L, Schianchi T, Meschi T, et al (2002) Comparison of two diets for the prevention of recurrent stones in idiopathic hypercalciuria. The New England journal of medicine 346:77-84 https://doi.org/10.1056/NEJMoa010369
158. Meschi T, Maggiore U, Fiaccadori E, et al (2004) The effect of fruits and vegetables on urinary stone risk factors. Kidney international 66:2402-2410 https://doi.org/10.1111/j.1523-1755.2004.66029.x
159. Nouvenne A, Meschi T, Guerra A, et al (2009) Diet to reduce mild hyperoxaluria in patients with idiopathic calcium oxalate stone formation: a pilot study. Urology 73:725-730, 730.e721 https://doi.org/10.1016/j.urology.2008.11.006

160. Nouvenne A, Meschi T, Prati B, et al (2010) Effects of a low-salt diet on idiopathic hypercalciuria in calcium-oxalate stone formers: a 3-mo randomized controlled trial. The American journal of clinical nutrition 91:565-570 https://doi.org/10.3945/ajcn.2009.28614
161. Nouvenne A, Ticinesi A, Allegri F, et al (2014) Twenty-five years of idiopathic calcium nephrolithiasis: has anything changed? Clinical chemistry and laboratory medicine 52:337-344 https://doi.org/10.1515/cclm-2013-0618
162. Hiatt RA, Ettinger B, Caan B, et al (1996) Randomized controlled trial of a low animal protein, high fiber diet in the prevention of recurrent calcium oxalate kidney stones. American journal of epidemiology 144:25-33 https://doi.org/10.1093/oxfordjournals.aje.a008851