DOI: 10.4081/aiua.2023.11076

ORIGINAL PAPER

Mobile health applications in kidney stone disease management: A reliable support for patients?

Luigi Cirillo [1], Celeste Manfredi [2], Biagio Barone [1], Vincenzo Morgera [1], Gianluigi Cacace [1], Francesco Mastrangelo [1], Francesco Di Bello [1], Marco Abate [1], Davide Arcaniolo [2], Lorenzo Spirito [2], Felice Crocetto [1], Roberto La Rocca [1], Massimiliano Creta [1], Francesco Paolo Calace [1], Giovanni Maria Fusco [1], Luigi Napolitano [1]

[1] Unit of Urology, Department of Neurosciences, Reproductive Sciences, and Odontostomatology University of Naples "Federico II", Naples, Italy;
[2] Unit of Urology, Department of Woman, Child and General and Specialized Surgery, University of Campania "Luigi Vanvitelli", Naples, Italy.

Summary *Introduction: Mobile health applications (MHAs) represent an interesting issue to assist and improve the quality of life of patients affected by Kidney Stone Disease (KSD). Despite this, their scientific quality and adherence to guidelines are not yet addressed.*
Material and methods: On 2 November 2022, we conducted an observational cross-sectional descriptive study of all MHAs on KSD. A search in the Apple App Store and Google Play Store was performed. We reviewed all mobile apps from Apple App Store and Google Play Store for KSD and evaluated their usage in screening, prevention, management, and adherence to EAU guidelines.
Results: In total 13 MHA were included in the final analysis. All MHAs, 4 (30.8%) from the Apple App Store and 9 (69.2%) from the Google Play Store are geared towards the patient. Engagement ranged from 1.73 to 4.06; Functionality ranged from 3.17 to 4.75; Aesthetics ranged from 1.9 to 4.12; Information ranged from 2.25 to 4.27, and Subjective quality ranged from 1.58 to 3.23. MHAs reported low and medium adherence to EAU guidelines.
Conclusions: MHAs provide a very useful assistance in several medical fields, including KSD. Despite MHAs development is constantly increasing, the scientific validation, content, and quality are not yet solved. Future research is necessary to improve the quality of the apps and promote new user designed, and high-quality apps.

KEY WORDS: *App; e-health; Mobile phone; Kidney stone; MARS.*

Submitted 11 December 2022; Accepted 28 December 2022

INTRODUCTION

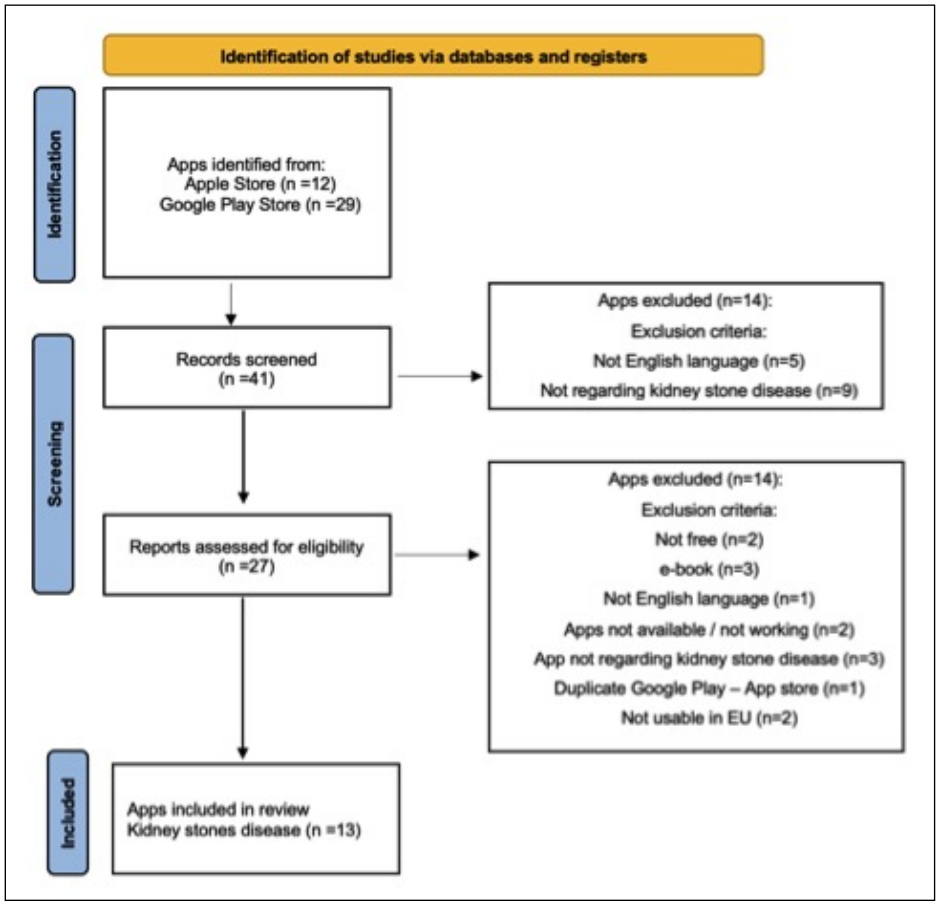
Kidney stones disease (KSD) is one of the most common urinary tract diseases, with a prevalence of 15-25% (1), and it seems to have increased in the last quarter of the 20th (2). Approximately 80% of kidney stones are composed of *calcium oxalate* (CaOx) mixed with *calcium phosphate* (CaP), followed by uric acid, struvite and cystine which account for 9%, 10% and 1% of stones, respectively (3). Several risk factors have been identified as well as geographical, ethnic, dietary, and genetic factors. Nowadays, many treatments are available: shockwave lithotripsy, ureteroscopic fragmentation, percutaneous nephrolithotomy etc. or medical treatment especially in case of uric acid stones (4). However, men and women with KSD often resort to using self-medication. Adherence to lifestyle and change behavior represent one of the important issues to prevent a recurrence. In this contest *mobile health applications* (MHA) offers a great opportunity to support lifestyle changes (5). Recently several apps have been developed worldwide and their use has increased in the last few years, particularly for medical and surgical conditions (6). Despite their number and widespread use, quality assessments are still a problem. To avoid this, in the last few years, several instruments have been developed. Among these, the most used tool is *Mobile Application Rating Scale* (MARS) (7, 8). Many MHAs have been developed for assessing and managing KSD, representing an important tool for patients. However, despite their potential utility, much effort must be made regarding the quality, the validation, and the adherence to guidelines. To the best of our knowledge, there are no studies reporting the quality of apps for KSD and their adherence to guidelines. The aim of this study is to give an overview of apps for KSD, currently freely available on the market to evaluate the quality and the adherence to guidelines.

MATERIAL AND METHODS

Search strategy

We performed an observational cross-sectional descriptive study of all smartphone apps for patients about KSD available on the iOS and Android platforms and evaluated their adherence to EAU guidelines. On 2 November 2022, three authors (M.A., L.C. and G.M.F.) separately conducted a search in Google Play Store for Android phones and Apple App Store for iPhones with the keywords '*kidney stone*', "*kidney stone disease*", "*kidney stone treatment*" and "*kidney stone diagnosis*" using the search tab. Authors used a wide array of keywords due to the search strategy of Google Play Store and Apple App Store which is based on finding keywords in titles, app descriptions and tags. Other searches of information provided in books or other formats were excluded. Authors screened separately in Apple App Store and Google Play Store apps during the search by reading the title and description in the app store. A fourth author

Figure 1.
PRISMA.



(L.N.) resolved any discrepancies. At the beginning all apps were reported in Excel form and, according to the exclusion criteria, were screened. All MHAs regarding KSD, providing a service to patients, in English, and free to download were included in this analysis. Apps not specifically focused on KSD, apps not allowing access to all users and those not available in English were excluded. Successively, all reviewers downloaded and installed the apps on their personal mobile device. They interacted for twenty minutes with each app to explore its features before completing the MARS and evaluated their adherence to EAU guidelines. To assess apps, they were downloaded to either an Android or an IOS device. If apps were available in both app stores, the iOS version was assessed.

A total of 41 apps were found by our search, 29 of them were from the *Google Play Store* (Android) and 12 of them were from the *Apple App Store* (iOS). Of the total, 27 apps were screened after removing apps not in English and not regarding KSD. Of the total screened apps, 14 apps met excluding criteria and were removed. In particular, one app resulted in both stores. Two apps reported the same name and had similar features in both *Apple App Store* and *Google Play Store* but had different producers: both apps were analyzed. Finally, 13 apps were eligible for the final evaluation.

The search strategy was conducted according to the PRISMA statement (Figure 1).

Table 1 shows the analyzed apps characteristics. The 13 suitable KSD apps were evaluated by three authors on a 5-point Likert scale based on MARS characteristics.

Data extraction

On 31 October 2022 reviewers discussed methods of recording data to ensure standardized modality and a predefined Excel form was created to collect data. The follow-

Table 1.
General characteristics.

Name of application	Android/Apple/Both	Download	Producer	Category	Focus
Stone MD - Kidney stones	Both	N.A.	Nariman Gadzhiev	Medicine	Diet, prevention, surgical management, EAU tutorial videos
OxiPur-Gout & Kidney Stones	Apple	N/A	Baliza GmbH	Food & Drink	Diet, prevention
Stone Pass: Kidney Stones	Apple	N/A	Know Stone LLC	Health & Fitness	Calculator of stone pass vs surgery
Kidney Stone Scoring	Apple	N/A	Putu Angga Risky Raharja	Health & Fitness	Calculator for stone free status after PCNL
Kidney Stone Symptoms & Treatment	Android	50000	Fall in Love Studio	Medicine	Epidemiology, definition, causes, prevention, symptoms, diagnosis, treatment
Kidney Stone Scoring	Android	1000	iMedical Apps	Health & Fitness	Calculator for stone free status after PCNL
Stone Diet Renal Gall Bladder Kidney Gallbladder	Android	5000	SendGroupSMS.com	Health & Fitness	Definition, diagnosis, risk factors, prevention, home remedies
Kidney Stones Removal Remedies	Android	10000	StatesApps	Health & Fitness	Home remedies, treatment
Kidney Stone Treatment - FAQ	Android	1000	Things To Do	Health & Fitness	Definition, symptoms, risk factors, causes, prevention, diagnosis, treatment
Home Remedies for Kidney Stones	Android	100	karanbir singh	Health & Fitness	Definition, risk factors, causes, diagnosis, prevention, home remedies
Oxalate Counts (Kidney Stones)	Android	5000	Denise Anderson	Health & Fitness	Diet/, Prevention - Calculator of oxalate in food
Home Remedies For Kidney Stones	Android	100	salim garba usman	Health & Fitness	Definition, home remedies
Reduce Stones	Android	1000	Shakeel	Health & Fitness	Epidemiology, causes, definition, risk factors, diet

ing data were extracted from MHA: title, language, customers, costs, source (*Google Play Store or Apple App Store*), field/disease, rating/feedback from the users and service provided.

Assessment of app quality

Mobile Application Rating Scale (MARS) was used to assess apps' quality as performed in our previous work (8).

Assessment of app adherence to EAU guidelines

An adherence checklist of five items (definition, physiopathology, diagnosis, risk factors and treatment) based on section 5 of the EAU guidelines of KSD has been created (10). Three independent reviewers (urologists with high experience in kidney stones disease) analyzed separate apps for their adherence to EAU guidelines. According to criteria used in similar studies, raters gave each app a score from 0 to 3 for each of the five items. A score of "0" indicated no adherence to guidelines. A score of "1" indicated a weak adherence. A score of "2" indicated a partial or moderate adherence. A score of "3" indicated strong adherence. A mean score for each category was calculated from the scores given by each reviewer. The possible score on the checklist ranged from 0 to 15 for each app. To facilitate evaluation, adherence to the checklist was arbitrarily considered low with a total score ranging from 0 to 5, medium (6-10), and high (11-15).

Statistical analysis

Adherence checklist was assessed via continuous variables with total mean value reported. Concordance among examiners was assessed utilizing the independent samples Kruskal-Wallis test, considering a p value > 0.05 as an indicator of concordance among examiners as the null hypothesis was "*same distribution of variables across the examiners*".

Results

In total 13 apps were included in the final analysis: 9 (69.2%) from the *Apple App Store* and 4 (30.8%) from the *Google Play Store*. Six (46.2%) provided information about treatment and five (38.5%) provided information about diagnosis and overall information. KSD risk factors were mentioned in some MHA. Data about downloads were available for 9 apps out of the 13 reviewed. Downloads were not available for MHAs presented in the Apple App Store. The most downloaded app was "*Kidney Stone Symptoms & Treatment*" in which more than 50000 downloads were reported. All the apps were planned to be used by patients. Rating was available only for the app "*OxiPur-Gout & Kidney Stones*" for which a five star review was reported. Cumulative MARS scale scores are represented in Table 2. Graphical depictions of variables assessed by the three independent examiners are reported in Figure 2, while mean total MARS score and mean subjective quality are reported in Figure 3. Figure 4 reports the mean total score for EAU adherence checklist according to different examiners. Both MARS score assessment, as single domains as well as total mean score, and EAU adherence checklist score were concordant among different examiners (p = 0.368).

Engagement

The score in this section was based on a 5-point Likert scale in 5 subscales (*Entertainment, Interest, Customization, Interactivity and Target-group*). The mean score was 2.35. Scores ranged from 1.73 to 4.06 out of 5. The "*Stone MD: Kidney Stones*" app (*Apple iOS*) produced by *Nariman Gadzhiev* received the highest score for the engagement. This app contains interactive features for dietary management, water intake, urine pH, prevention of kidney stones. It also contains information about surgical management, with EAU tutorial videos explaining several surgical techniques.

Functionality

The score of the functionality section was based on a 5-point Likert scale in 4 subscales (Performance, Ease of use, Navigation and Gestural design) and the mean score was 3.68. Scores ranged from 3.17 to 4.75. "*Stone MD: Kidney Stones*" app (Apple iOS) achieved the maximum score.

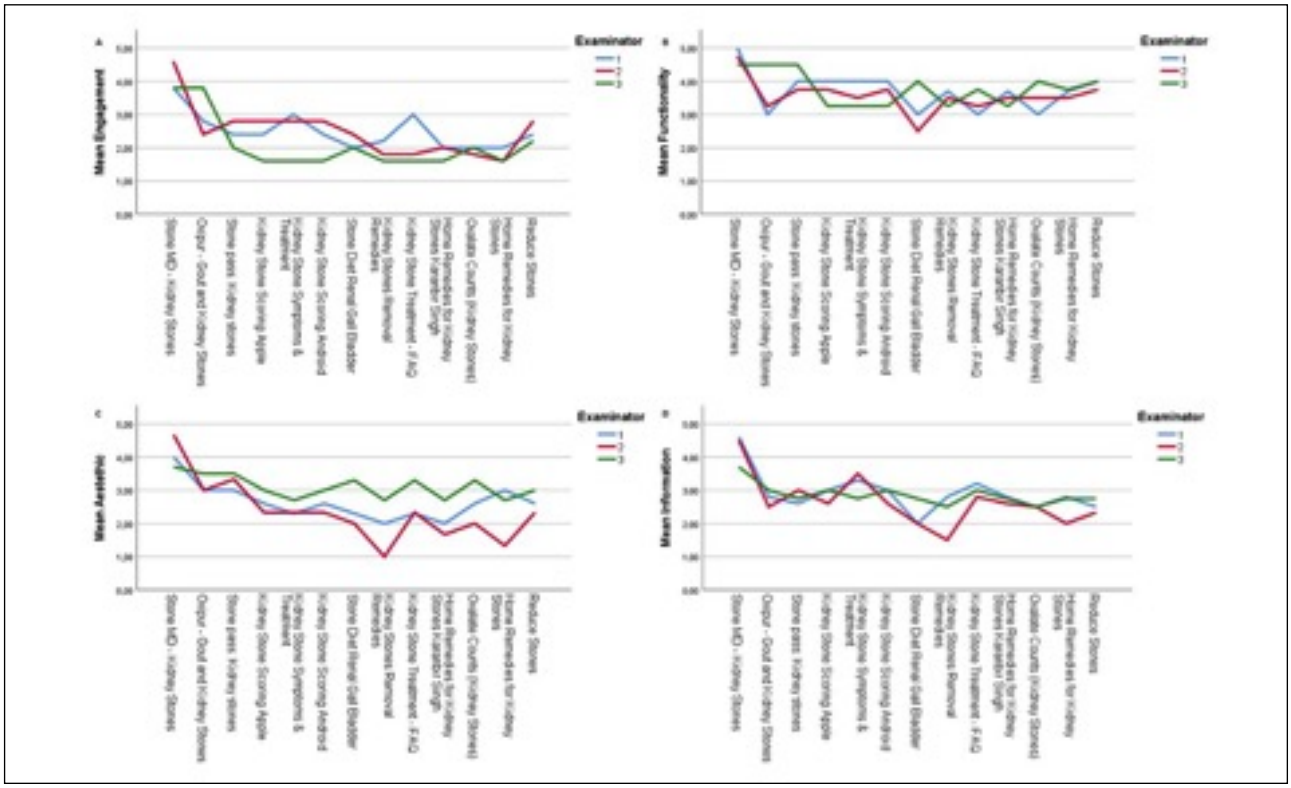
Aesthetics

The aesthetics section was formed by a 5-point Likert

Table 2.
MARS cumulative scores.

Name of application	Engagement (section A)	Functionality (section B)	Aesthetics (section C)	Information (section D)	Mean (A+B+C+D)	App subjective quality (section E)
Stone MD: Kidney stones	4.06	4.75	4.12	4.27	4.4	3.23
OxiPur-Gout & Kidney Stones	3	3.58	3.17	2.77	3.13	2.18
Stone Pass: Kidney Stones	2.4	4.08	3.28	2.78	3.14	2.02
Kidney Stone Scoring(apple)	2.27	3.67	2.64	2.87	2.86	2.08
Kidney Stone Symptoms & Treatment	2.47	3.58	2.44	3.19	2.92	2.18
Kidney Stone Scoring(android)	2.27	3.67	2.64	2.87	2.86	2.08
Stone Diet Renal Gall Bladder	2.13	3.17	2.53	2.25	2.52	1.93
Kidney Stones Removal Remedies	1.86	3.48	1.9	2.27	2.38	1.58
Kidney Stone Treatment - FAQ	2.13	3.33	2.65	3	2.78	2.25
Home Remedies for Kidney Stones(karanbir singh)	1.87	3.5	2.12	2.72	2.55	1.67
Oxalate Counts (Kidney Stones)	1.93	3.5	2.63	2.5	2.64	1.93
Home Remedies For Kidney Stones(salim garba usman)	1.73	3.65	2.34	2.52	2.56	1.75
Reduce Stones	2.47	3.91	2.64	2.53	2.89	1.92

Figure 2.
MARS scale score according to examiners. (A) Mean Engagement (B) Mean Functionality (C) Mean Aesthetic (D) Mean Information.



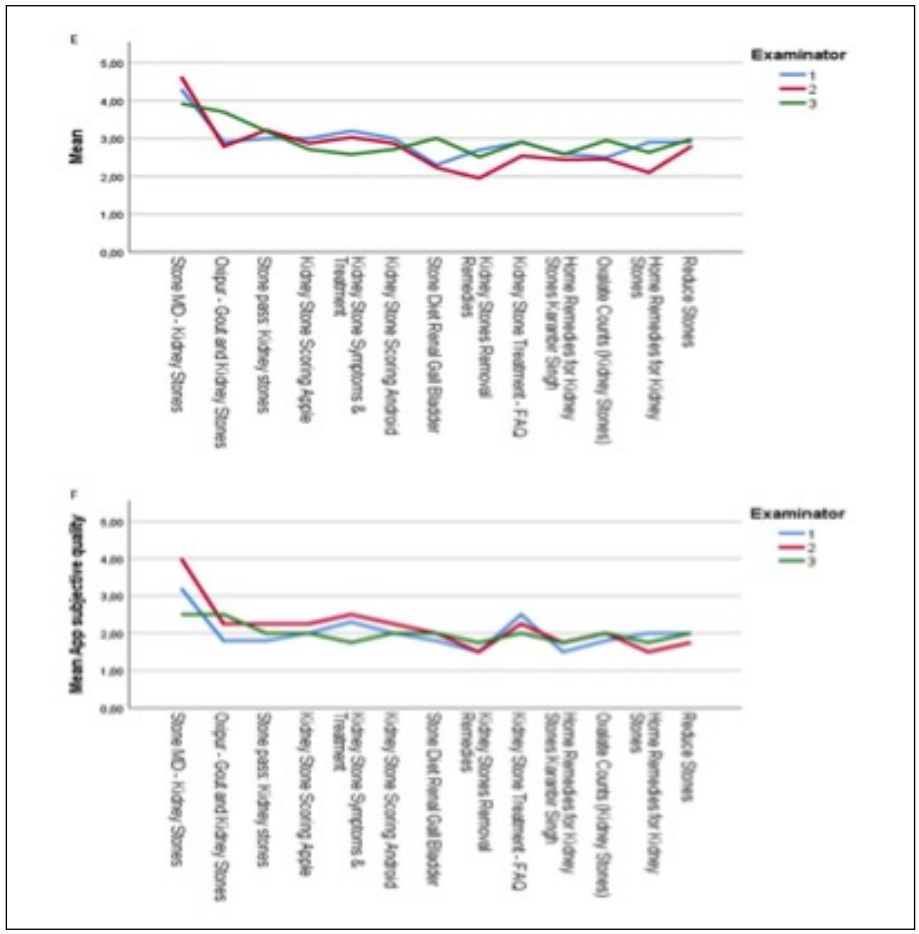


Figure 3.
(E) Mean MARS Score
(F) Mean App subjective quality according to examiners.

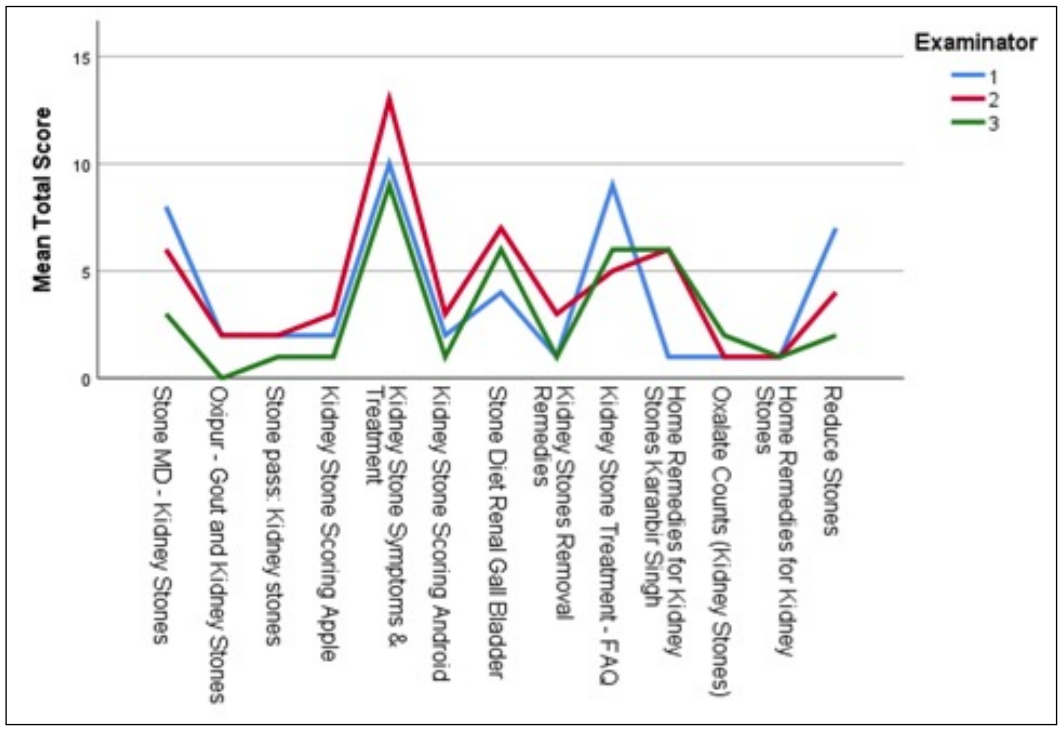


Figure 4.
Mean total score for EAU adherence checklist according to examiners.

scale in 3 subscales (*Layout, Graphics, Visual Appeal*) and the average score was 2.7. Scores ranged from 1.9 to 4.12 out of 5 and "*Stone MD: Kidney Stones*" app (*Apple iOS*) produced by *Nariman Gadzhiev* reached the maximum aesthetic score.

Information

The information section was formed by a 5-point Likert scale in 7 subscales and the mean score was 2.81. Score ranged from 2.25 to 4.27. The "*Stone MD: Kidney Stones" app* (*iOS Apple*) produced by *Nariman Gadzhiev* achieved the highest score in Information.

Subjective quality

The subjective quality section consisted of 4 items. The mean score was 2.06, with scores ranging from 1.58 to 3.23. "*Stone MD: Kidney stones*" app reached the maximum score.

EAU adherence checklist

We evaluated the EAU guidelines adherence in 13 apps. EAU adherence scores are represented in Table 3. The KS definition was reported in 9 (69.2%) apps; physiopathology was reported in 6 (46.2%) apps; risk factors were reported in 9 (69.2%) apps; diagnosis was reported in 9 (69.2%) apps; treatment was reported in 13 (100%) apps. The highest score was reported by *Kidney Stone Symptoms and Treatment* (Android) produced by *Fall in Love Studio* with an overall EAU Adherence Score of 10.67. This app contains information about definition, epidemiology, causes and prevention, symptoms, diagnosis and treatment of KSD. Only one of the 13 evaluated apps reached the maximum score of 3 in treatment, while none of the apps reached 3 in the other domanis.

Table 3.
EAU adherence checklist cumulative scores.

Name of application	Definition (0-3)	Physiopathology (0-3)	Risk factors (0-3)	Diagnosis (0-3)	Treatment (0-3)
Stone MD: Kidney stones	0.33	0.67	1	0.67	3
OxiPur-Gout & Kidney Stones	0	0	0.67	0	0.67
Stone Pass: Kidney Stones	0.33	0	0	0.33	1
Kidney Stone Scoring (Apple)	0	0	0	1	1
Kidney Stone Symptoms & Treatment	2.33	1.67	2	2.67	2
Kidney Stone Scoring (Android)	0	0	0	1	1
Stone Diet Renal Gall Bladder	1	2	1.33	0.67	0.67
Kidney Stones Removal Remedies	0.33	0	0.33	0	1
Kidney Stone Treatment - FAQ	1.67	0.67	1.33	1.33	1.67
Home Remedies for Kidney Stones (karanbir singh)	0.67	0.33	1.33	1	1
Oxalate Counts (Kidney Stones)	0	0	1	0	0.33
Home Remedies For Kidney Stones (salim garba usman)	0.33	0	0	0	0.67
Reduce Stones	1.67	0.67	1	0.67	0.33

Discussion

Mobile application represented a valid instrument both for patients and for physicians to manage chronic diseases, as previously assessed (9, 11-13). Furthermore, the clinical utility of MHAs is required to be assessed as the adherence to EAU guidelines for the condition considered. Thus, the aim of the study was to give an overview of currently available MHAs for KSD, to assess their quality and the adherence to EAU guidelines. Indeed, to the best of our knowledge, although several studies have been published, none

analyzed the adherence to EAU guidelines. We addressed this void and identified several noteworthy observations.

First of all, MHAs for KSD represent a very interesting topic and several papers have been published in the last few years. From our analysis, the quality of apps considered was between "2" defined as "*poor*" and 3, defined as "*acceptable*", according to MARS cumulative results. Particularly, the "*functionality*" section ranked the highest point (3.68). As previously shown in our study on MHAs for erectile dysfunction, apps were developed without healthcare support and the most important tool was their usability (9). Indeed, *Jupp et al.* showed that "*Functionality*" had the highest score in MHAs for oncology patients. These findings are in agreement with *Jupp et al.* and *O'Connor et al.* works. They previously observed that the apps were generally better designed in terms of their usability but may have several lacks in behavioral methodology related to long-term usage (14, 15). This suggests that MHAs are easy to navigate and efficient and, specifically, could represent a crucial tool for MHAs geared for KDS patients.

According to EAU adherence, the "*treatment*" was reported in 100% of MHAs while only 46.2% of apps treated the physiopathology of KSD. Consequently, this observation could affect the KSD prevention strategy. Indeed, KSD patients could not be aware of dietary regimens that cause their condition, continuing an unsafe lifestyle.

Recently *Lòperz et al.* evaluated, in a prospective multicenter study on 37 KSD patients, the usefulness and acceptability of the smart Lit-Control® pH Meter connected with a MHA (myLit-Control(R) App) used by KSD patients for home monitoring of urine pH (16). The study showed that the app was useful and acceptable, with a high compliance rate (87.6%) and good satisfaction (mean score of 6.0). According to EAU guidelines, the circadian fluctuation of pH could suggest a predisposing condition to urolithiasis such as the presence of an "*acidic arrest*" (when the value is constantly < 5.8) or a *renal tubular acidosis* (RTA) (when the value is constantly > 5.8). Both conditions could negatively affect the quality of life (QoL) and the prognosis of the patients (17). KSD patients could benefit from mobile applications to screen rapidly their condition, such as the urinary pH, and to prevent subsequent pathological diseases. Although, a larger prospective study with a longer follow-up period may be required to ensure the applicability and the usefulness of the MHAs in the prevention of the urolithiasis-related disease. Moreover *McKenzie et al.* reported that MHAs were a well-established tool for measuring fluid intake, without providing crucial information regarding the importance of hydration. Actually, the fluid intake (2.5-3.0L/day) combined to the diet represented the most important general preventive measure with a very beneficial cost-effectiveness (18). Recently, *Khambati et al.* reported only 50% adherence to fluid intake (19), while *Streeper et al.* showed an increasing interest of patients in making lifestyle changes and increasing fluid consumption. These shifts are promising, and MHAs must promote them. The lifestyle changes must be spread through the MHAs, highlighting the importance of hydration in the prevention of KSD and urolithiasis-related diseases. The apps should be more comprehensive and informative to support patients' adherence to prevention guidelines. Additionally, the major concern of the urolithiasis was the recurrence rate. Thus, MHAs should inform KSD patients also of a metaphylaxis protocol (20). As previously assessed, the implementation of metaphylaxis reduced the rate and risk of recurrent urolithiasis (21). Indeed, *Becker et al.* developed a mobile app (*StoneMD: Kidney Stones*) to increase compliance in stone metaphylaxis (22). The app calculated the individual risk of a new stone episode, and improved patient compliance and reduced the risk of stone formation. Our results corroborated previous data. Indeed "*Stone MD: Kidney stones*" reached the highest score in different MARS domains. This suggests that healthcare support is necessary in MHAs development. Despite this another MHA, *Kidney Stone Symptoms and Treatment*, reached the highest score of adherence to EAU guidelines. These data suggest that healthcare involvement in MHAs development is not related to better guidelines adherence.

Finally, *Shahmoradi et al.* aimed to develop and evaluate a self-care MHA for patients with urinary tract stones. This is a challenging issue that could transform the management of KSD where the patient became the main character. MHAs should consider patient needs assessment and participation of clinical and health information specialists to define the better management protocol of prophylaxis, metaphylaxis and treatment of KSD patients. According to *Shamoradi*, this addressed issue should be considered a model for designing and creating better MHAs (23).

Our study has several strengths: first of all, we examined for the first time the content, the quality, and the adherence to EAU guidelines about KSD; we performed a rigorous search, screening, and analysis on Apple and Google stores; reviewers had experience in MARS scale using. To avoid the inter-variability analysis among the three investigators, each app was independently evaluated, and a cumulative final point was measured and discussed by a fourth impartial author. The main limitation of our study is the number of apps subjected to the qualitative assessment. Furthermore, the reproducibility of the research turns out to be complex due to the working method of the *App Store* and *Google Play Store* (the visibility of apps depends on the device and on the country where the search is performed); the exclusion criteria, which led to the exclusion of paid apps; the guidelines developed for healthcare and not for patients and the constant production of new MHA. Taken together, our analysis definitely assessed the low quality of apps available on KSD. However, it could represent a starting point to produce high-quality and informative apps, easy to use. Indeed, MHAs represent a key instrument to spread EAU guidelines adherence among KSD patients, nowadays. Currently, the information provided by mobile apps is not satisfactory but improvable. Indeed, MHAs should elucidate exhaustively the prophylaxis and metaphylaxis protocols to reduce the risk and the recurrence of kidney stones, enlightening the role of lifestyle (fluid intake, diet and physical activities) as the most useful preventive measure.

Conclusions

Nowadays, MHAs represent a key instrument to spread EAU guidelines adherence among KSD patients.

Currently, the information provided by mobile apps must be improved. Indeed, MHAs should join exhaustively the prophylaxis and metaphylaxis protocols to reduce the risk and the recurrence of kidney stones, enlightening the role of lifestyle (fluid intake, diet and physical activities) as the most useful preventive measure. Thus, patients should use the MHAs without avoiding physician consultations.

References

1. Sohgaura A, Bigoniya P. A review on epidemiology and etiology of renal stone. Am. J. Drug Discov. Dev. 2017; 7: 54-62

2. Curhan GC. Epidemiology of stone disease. Urol Clin North Am. 2007; 34:287-93.

3. Khan SR, Pearle MS, Robertson WG, et al. Kidney stones. Nat Rev Dis Primers. 2016; 2:16008.

4. Frassetto L, Kohlstadt I. Treatment and prevention of kidney stones: an update. Am Fam Physician. 2011; 84:1234-42.

5. Spring B, Gotsis M, Paiva A, Spruijt-Metz D. Healthy apps: mobile devices for continuous monitoring and intervention. IEEE Pulse. 2013; 4:34-40.

6. Mirone V, Creta M, Capece M, et al. Telementoring for communication between residents and faculty physicians: Results from a survey on attitudes and perceptions in an Academic Tertiary Urology Referral Department in Italy. Arch Ital Urol Androl. 2021; 93:450-454.

7. Stoyanov SR, Hides L, Kavanagh DJ, et al. Mobile app rating scale: a new tool for assessing the quality of health mobile apps. JMIR Mhealth Uhealth. 2015; 3:e27.

8. Stec MA, Arbour MW, Hines HF. Client-Centered Mobile Health Care Applications: Using the Mobile Application Rating Scale Instrument for Evidence-Based Evaluation. J Midwifery Womens Health. 2019; 64:324-329.

9. Napolitano L, Fusco GM, Cirillo L, et al. Erectile dysfunction and mobile phone applications: Quality, content and adherence to European Association guidelines on male sexual dysfunction. Arch Ital Urol Androl. 2022; 94:211-216.

10. Davalbhakta S, Advani S, Kumar S, et al. A systematic review of the smartphone applications available for coronavirus disease 2019 (COVID19) and their assessment using the mobile app rating scale (MARS). medRxiv [Preprint]. 2020 Jul 4:2020.07.02.20144964. Update in: J Med Syst. 2020; 44:164.

11. Napolitano L, Cirillo L, Fusco GM, et al. Premature ejaculation in the era of mobile health application: A current analysis and evaluation of adherence to EAU guidelines. Arch Ital Urol Androl. 2022; 94:328-333.

12. Napolitano L, Cirillo L, Fusco GM, et al. Natural treatments for erectile dysfunction: A focus on mobile health applications. Arch Ital Urol Androl. 2022; 94:373-374.

13. Fusco GM, Cirillo L, Abate M, et al. Male infertility, what Mobile Health Applications "know": quality analysis and adherence to European Association of Urology Guidelines. Arch Ital Urol Androl. 2022; 94:470-475.

14. O'Connor SR, Kee F, Thompson DR, et al. A review of the quality and content of mobile apps to support lifestyle modifications following a transient ischaemic attack or 'minor' stroke. Digit Health. 2021; 7:20552076211065271.

15. Jupp JCY, Sultani H, Cooper CA, et al. Evaluation of mobile phone applications to support medication adherence and symptom management in oncology patients. Pediatr Blood Cancer. 2018; 65:e27278.

16. López JM, Mainez JA, Mora Christian J, et al. Usefulness and acceptability of a Smart pH meter and mobile medical App as a monitoring tool in patients with urolithiasis: short-term prospective study. Arch Esp Urol. 2022; 75:60-68.

17. Geraghty RM, Davis NF, Tzelves L, et al. Best Practice in Interventional Management of Urolithiasis: An Update from the European Association of Urology Guidelines Panel for Urolithiasis 2022. Eur Urol Focus. 2022:S2405-4569(22)00144-4.

18. Philip-McKenzie Y, Jamnadass E, Hameed BZ, et al. A content analysis of 'Water Apps' and prevention of urological diseases: Do apps really help? Cent European J Urol. 2020; 73:187-192.

19. Khambati A, Matulewicz RS, Perry KT, Nadler RB. Factors Associated with Compliance to Increased Fluid Intake and Urine Volume Following Dietary Counseling in First-Time Kidney Stone Patients. J Endourol. 2017; 31:605-610.

20. Streeper NM, Lehman K, Conroy DE. Acceptability of Mobile Health Technology for Promoting Fluid Consumption in Patients With Nephrolithiasis. Urology. 2018; 122:64-69.

21. Banov P, Ceban E. The efficacy of metaphylaxis in treatment of recurrent urolithiasis. J Med Life. 2017; 10:188-193.

22. Becker B, Gadzhiev N, Popiolek M, et al. Smartphone-App für Patienten mit Nierensteinen [A mobile app for patients suffering from kidney stones]. Urologe A. 2018; 57:577-582.

23. Shahmoradi L, Azizpour A, Bejani M, et al. Prevention and control of urinary tract stones using a smartphone-based self-care application: design and evaluation. BMC Med Inform Decis Mak. 2021; 21:299.

Correspondence

Luigi Cirillo, MD - cirilloluigi22@gmail.com
Biagio Barone, MD - biagio193@gmail.com
Vincenzo Morgera, MD - vincemorgera87@gmail.com
Gianluigi Cacace, MD - cacace.gianlu@gmail.com
Francesco Mastrangelo, MD - f.mastrangelo91@gmail.com
Francesco Di Bello, MD - fran.dibello12@gmail.com
Marco Abate, MD - marcoabate5@gmail.com
Davide Arcaniolo, MD - davide.arcaniolo@gmail.com
Felice Crocetto, MD - felice.crocetto@gmail.com
Roberto La Rocca, MD - robertolarocca87@gmail.com
Massimiliano Creta, MD - max.creta@gmail.com
Francesco Paolo Calace, MD - fra.calaca@gmail.com
Luigi Napolitano, MD - dr.luiginapolitano@gmail.com
Giovanni Maria Fusco, MD (Corresponding Author)
giom.fusco@gmail.com
Unit of Urology, Department of Neurosciences, Reproductive Sciences, and Odontostomatology University of Naples "Federico II"
Via Sergio Pansini 5, 80131 Naples, Italy

Celeste Manfredi, MD - manfredi.celeste@gmail.com
Lorenzo Spirito, MD - lorenzospirito@msn.com
Unit of Urology, Department of Woman, Child and General and Specialized Surgery, University of Campania "Luigi Vanvitelli", Naples (Italy)

Conflict of interest: The authors declare no potential conflict of interest.