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Chronic kidney disease and mobile health: quality of renal nutritional APPs in Italy

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Abstract. *Background and aim:* Patients with chronic kidney disease (CKD) must adhere to a nutritional therapy characterized by a restrictive dietary scheme. Nutritional self-care can be enhanced through the use of nutritional apps. The purpose of this study is to evaluate the characteristics of specific nutritional apps for chronic renal failure available in Italy. *Methods:* A systematic search of mobile apps was conducted by two academic researchers in three Italian App stores: Google Play Store, Apple Store and Huawei AppGallery. Of the 1602 apps identified, 2 apps (Miku; MyFIR) were evaluated with the Italian version of a Mobile Application Rating Scale (MARS-ITA) by a multidisciplinary team of 20 professionals. *Results:* The study found that the two selected apps, available in the Google Play Store and Apple Store, aim to increase well-being through the acquisition of knowledge and behavioral change; but none identify health goals that should be achieved. The strategies used by the two applications are: information, education, monitoring and cognitive-behavioral challenge. The technical analysis showed adequate protection of personal data but only the most downloaded app (Miku) provides the possibility to share content, to send reminders and to browse when offline. *Conclusions:* To date, there are only two applications available to monitor nutrition in patients with kidney disease. Although both apps have shown adequate quality, a greater offer with a greater number of apps available in all mobile stores would be desirable in the future.

Key words: chronic kidney disease, nutrition, mobile APPs, mobile-health technology

Introduction

According to the National Kidney Foundation, chronic kidney disease (CKD) is a pathological condition that progressively reduces the ability of the kidneys to remove waste products and excess fluids from the body (1). Its prevalence to date is estimated to be between 10% and 14% in the general population (2), a percentage that could increase dramatically in the coming decades due to an aging population and a growing incidence of diabetes and hypertension (3). Patients with end-stage Chronic Renal Disease (ESRD) on hemodialysis treatment must adhere to a complex, demanding and long-lasting therapy, characterized by a restrictive dietary pattern and a large intake of drugs. Patients often have to change their

lifestyle (4), which is why non-adherence to dietary and pharmacological therapy is very common, thus favoring the risk of disease progression and raising the mortality rate (5). With the increase in the incidence of CKD, it is therefore essential to find innovative and efficient methods to interact with this population, providing patient-centered care and optimizing self-management (6). E-Health (Electronic Health) is a term used to indicate the application of information and communication technologies to the entire health sector, in particular it has been defined as an emerging field of interaction between information and communication technologies on the one hand and health on the other hand, in support of public health sectors (7). In the past years there has been a steady increase in the use of technology for education of patients with CKD. Examples are websites, low literacy brochures, videos, voice response systems, as well as self-management focused mobile health applications (8). Apps in particular can in fact offer a support tool both for healthcare staff in patient management and for the user himself as an aid to improve self-management of his disease (6). Some existing apps have special features like text search or a barcode scanner for data entry, as well as a camera function to take pictures of meals. This could be useful to recognize food and estimate portion sizes to have a more accurate data collection and tracking (9). Dietary and liquid restrictions require continuous self-management and are therefore one of the most difficult aspects of dialysis treatment. Mobile health applications, therefore, could be useful tools to easily support self-management in the dietary-nutritional therapy of these patients (5).

The purpose of this study is to examine which nutrition-related mobile apps are currently available in the three main Italian app stores (Google Play Store, Apple Store, Huawei Store) and to evaluate their functionality and quality.

Methods

Research strategy for mobile app selection

As a preliminary step, relevant documents and clinical practice guidelines published by National Kidney Foundation-Kidney Disease Outcomes Quality Initiative (NKF- KDOQI) were evaluated (10). Subsequently, a systematic and comprehensive search on mobile apps was conducted by two academic researchers on three major mobile app databases available in Italy: Google Play Store, Apple Store and Huawei AppGallery; because the use of abbreviations and logic operators (such as AND, OR, and NOT) were not possible in the app store databases, each search term was provided separately. Additionally, a manual search was conducted in Google search engine for a supplementary analysis. The search was carried out using the following keywords: nutrition (nutrizione), alimentation (alimentazione), diet (dieta), dialysis (dialisi), chronic kidney disease (insufficienza renale cronica), CKD (IRC), kidneys (reni), kidney (rene) in search strings adapted to the specificities of the different app store databases in Italian language, from February 20th 2023 to February 27th 2023.

Full search algorithms are available for consultation in the supplementary file (Search Strategy).

Criteria and process

The two researchers eliminated apps that both of them found by cross-checking the name of the app and the developer before comparing their respective lists. The remaining apps were screened, and then downloaded for in-depth screening using the inclusion criteria: (1) Italian language, (2) adult population, (3) chronic kidney disease, (4) personalized programs, and (5) free app (or free for at least 14 days).

Exclusion criteria were: mobile apps or health apps that focus on conditions other than chronic kidney disease, apps created for nutritionists, meal delivery, food pollutant detectors, food allergy and intolerance detectors and barcode scanners.

Selection of a standardized rating scale for mobile apps

We used the Italian version of the Mobile App Rating Scale (MARS-I) (11). The MARS-I includes 19 objective items rated with a 5-point Likert scale that is divided into four sections [17-21]: the engagement section (five items) evaluates if the app is fun, interesting, customizable, and interactive (for example: sends alerts,

messages, reminders, feedback, or allows sharing); the functionality section (four items) focuses on app operation, easy to learn, navigation, flow logic, and gestural design of the app; the aesthetics section (three items) evaluates the graphic design, the overall visual appeal, the color scheme, and the stylistic consistency; and the information quality section (seven items) determines if the app contains high-quality information (for example: text, feedback, measurements, and references) from a credible source. The mean scores and distributions for each section were calculated. The overall MARS-I mean score was the mean score of the engagement, functionality, aesthetics, and information quality sections. Additionally, there is a subjective quality section (four items), which evaluates the user's interest for the app, and a specificity section, which assesses perceived effect on the user's knowledge, attitudes, and intentions to change as well as the likelihood of changing the identified targeted behaviors (we used daily habits).

Evaluation process of mobile apps

Training to evaluate apps was conducted after the enrollment of 20 healthcare professionals (five dieticians, five nephrologist physicians, and five hemodialysis nurse specialists and five peritoneal dialysis nurse specialists (Table 1). All evaluators participated in an e-learning training course on the use of the MARS-I scale through a training video lesson in English. For the training, all evaluators evaluated the two apps that were previously selected. For this they downloaded and tested each app for at least 15 minutes and filled out the MARS-I questionnaire. When an assessment score differed by at least 2 points, they confronted their understanding of the item to ensure a similar understanding of it (Supplementary File, Table S2).

Table 1. Characteristics of the health professionals involved.

Gender	**n.**	**%**
Female	17	85.0
Male	3	15.0
Health professionals		
Dieticians	5	25.0
Nephrologist physicians	5	25.0
Hemodialysis nurse specialists	5	25.0
Peritoneal dialysis nurse specialist	5	25.0
Length of service		
< 5 years	3	15.0
5-10 years	10	50.0
11-20 years	1	5.0
> 20 years	6	30.0

The evaluation process took place from March 01st 2023 to March 15th, 2023. The evaluators used each app independently for 30 minutes, then immediately evaluated the app using a web-based MARS-I questionnaire.

Data synthesis

The included mobile apps have been grouped according to the specific objectives of the review. The results obtained from the present study and the general conclusions were summarized for each of the outcomes. And then reported as a narrative synthesis and as statistical results (Table 2-4 and table S1-S2 available in Supplementary File).

Statistical analysis

Data was entered anonymously into a dedicated database and was analyzed by using the statistical package IBM-SPSS Statistics (Ver. 28 for Windows, IBM Co., Armonk, NY, USA). The median, interquartile range (IQR) and frequencies were used as descriptive statistics. The apps were evaluated using the MARS-I questionnaire. The Mann-Whitney U-test was applied to ordinal variables. The Mann-Whitney U-test is a nonparametric test, meaning that it is not based on any assumptions about the distribution of the data. It is commonly used in cases where the data is not normally distributed, or the sample sizes are small. Two-tailed p-values less than 0.05 were considered statistically significant.

Study authorization

All the preliminary authorizations were requested from the hospitals that participated in the study; all enrolled health professionals have given their consent to the processing of personal data for scientific purposes.

Further requests for authorization have not been submitted, as they are unnecessary given the purely observational nature of this study.

Results

A total of 1,601 apps were identified through mobile app stores searches (Google Play Store, Apple Store and Huawei AppGallery) and one app was identified through additional sources (documents published by Italian Society of Nephrological Nurses and National Association of Hemodialysis Patients (12). After five apps were removed as duplicates, all app names were screened, and 13 apps were pre-evaluated (installed and displayed). Of these, 11 apps were judged as not relevant (not Italian language n=7; not-diet apps n=2; access with restriction n=2) and two apps assessed for eligibility (installed and tested). The screening process ultimately included two apps for MARS-I evaluation (Figure 1).

General characteristics of the identified mobile apps

The analyzed apps were created by different developers, and both are free to download. Both apps allow password protection and require login. While only Miku allows social sharing (Facebook, Twitter, WhatsApp, etc.), sends reminders and does not require an internet connection. No app has an online community.

The apps focus on increasing well-being and knowledge, both target behavior change and physical health. No app requires the user to set goals (Table 2).

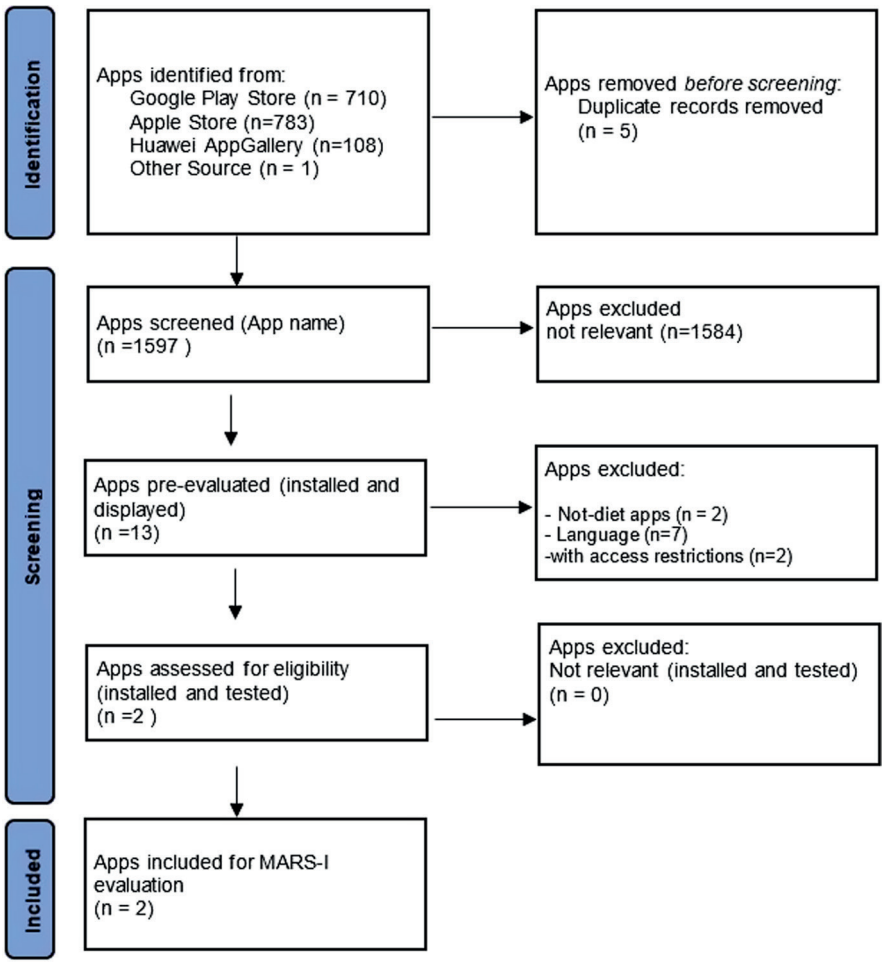

Figure 1. Flow diagram used for the identification of nutritional APPs for nephropathy in the main Italian APPs Stores.

Miku is the most downloaded app with over 5000 downloads, followed by MyFIR with over 1000 downloads (Table 3).

Table 2. Characteristics of nutrition mobile apps. CBT=Cognitive behavioral therapy; ACT=Acceptance commitment therapy.

	Miku	**MyFIR**
Focus: what the app targets		
Increase Well-being	x	x
Behavior change	x	x
Goal setting	-	-
Physical Health	x	x
Knowledge increase	x	x
	le	
Theoretical background/strategies		
Assessment	x	x
Feedback	x	x
Information/Education	x	x
Monitoring	x	x
Goal setting	-	-
Advice and tips	x	x
CBT - Behavioral	x	x
CBT –Cognitive (thought challenging)	x	x
ACT	x	x
Technical aspects of app		
Allows sharing (Facebook, Twitter, WhatsApp, etc.)	x	-
Has an app community	-	-
Allows password- protection	x	x
Requires login	x	x
Sends reminders	x	-
Need web access to function	-	x

Mobile APPs evaluation

The results of the study show an equal level of quality of the app content, in fact the overall median score (section A-D) obtained is the same (score=4) (Supplementary File, Table S1). Furthermore, there are no differences between the medians of the individual sections A-D. However, while the IQR value is zero for the engagement and functionality scores, the interquartile range is one for the information quality score. All the items of sections A-D show a median score of four except for the Layout item of the Aesthetics section and the Visual information item of the Information section which have a median value of three.

The subjective quality median scores (section E) is three for both Miku and MyFIR but the interquartile range score is different, with an IQR of 0.5 for MyFIR and 0 for Miku.

The median scores for specificity of the app content (section F) are also the same for both apps (median 4, IQR 0).

The quality median score (section A-D) is equal to the app-specific median score (section F). Both scores are always higher than the subjective quality score (section E) but lower than the rating score from the app stores. The results of the items related to the purchase and app usage frequency have negatively affected the overall lower subjective quality score (section E).

The comparison of the quality overall score (section A-D) with subjective item "What is your overall star rating of the app?" shows that the quality score (median= 4) is lower than that of subjective item (median=5).

The relationship between the medians of the apps items shows a p-value always higher than 0.05.

Table 3. Rating of the two nutrition mobile apps in iOS and Android stores. FIR= Italian Kidney Foundation.

App name	**Developer**	**Rating in the IOS App Store (Nb of raters)**	**Rating in the Android App store (Nb of downloads-Nb of raters)**	**Paid Content**
Miku	Carealytix	5 (1)	5 (over 5000-1)	Free
MyFIR	Visionage FIR	5 (1)	4.3 (over 1000-10)	Free

Thus there is no evidence of a statistically significant difference between the two distributions, i.e. the difference between the medians does not differ significantly from zero (Table 4; Supplementary File, Table S1).

The store ratings are higher than overall MARS-I median scores. Indeed, store rating is 5 in Apple store for both apps while the ratings are 4.3 for MyFIR and 5 for Miku in Google play store.

However, the comparison of the overall MARS-I median score for the two apps with the ratings of the stores, is limited by the discrepancies among the number of raters. In fact, the study involved only 20 evaluators, while Miku has only one rating both in the Google and Apple store and MyFIR has ten ratings in the Google play store and only one rating in the Apple store.

Discussion

In recent years we have seen a steady increase in the use of technology for nutrition education of CKD patients through websites, videos, voice response systems, and through healthcare applications. Mobile apps can offer a support tool both for healthcare personnel in the management of nephropathy patients, and as a tool to promote nutritional self-care (9, 13, 14). In particular, one study (13) brecommends the involvement of health professionals (renal dietitians and nephrologists) in the development of health apps to ensure the credibility and security of the content of the health information provided.

In this study, the apps considered have demonstrated adequate content, characterized by a valid, safe and reliable scientific background. Showing to be suitable for use both by patients and by different healthcare professionals. Both apps (Miku; MyFIR) guarantee safety in terms of privacy with the use of passwords and logging in.

The analysis of the websites of the manufacturers of these apps, shows that there is the possibility of requesting and/or downloading a specific nutritional brochure, which appears to be a tool in combination with the mobile app for the nutritional education of the patient with CKD.

Another feature identified was the Miku app's ability to share data through social networks such as Facebook, Twitter and WhatsApp. Both apps allow to send reminders to the user without requiring an Internet connection. Both developers have not yet set up a forum or space to create an online community. The main characteristics on which the mobile apps focused are the increase in physical well-being, greater participation and knowledge of the patient towards diet therapy. Both mobile apps made it possible to monitor nutritional status over time, with the limitation of not defining short, medium and long-term goals but giving advice and suggestions on food and on the type of diet.

Both apps obtained a higher score in the app stores investigated than the quality score of the MARS-I scale. Star ratings and user comments are valuable indicators for users because they provide information on the effectiveness and popularity of apps; however, they do not provide an objective assessment of quality. The overall median score (section A-D) obtained is equivalent to the same score present in the mobile app stores (n=4). Furthermore, there are no differences between the medians of the individual sections A-D. However, the IQR value was found to be 0 for the scores. All items in sections A-D, except the one relating to the layout and the one investigating the visualization of information, had a score of four. Layout and information display, items that evaluate the graphical presentation of content, obtained a median score of three, therefore graphics could be a weakness of both apps. The subjective quality assessment (section E) scored lower than the quality assessment (section A-D); this result can be attributed to the low median value of the items relating to the purchase and usability of the app. The article results related to purchase and frequency (section E) of app use negatively impacted the subjective Quality Score with a lower overall score of three for both Miku and MyFIR, but the interquartile range score it is different, with an IQR of 0.5 for MyFIR and 0 for Miku (Supplementary File-Table S1).

The main limitation of this study was the identification of nutritional apps for nephropathy patients available in the Apple, Google and Huawei stores, excluding other uninvestigated apps stores, such as Samsung and BlackBerry.

Table 4. Apps'evaluation using the MARS-I questionnaire.

	MyFIR		Miku		
	median	**IQR**	**median**	**IQR**	**p-value**
SECTION A-ENGAGEMENT					
Entertainment	4	0	4	0	0.62
Interest	4	0	4	0	0.44
Customization	4	0	4	0	0.22
Interactivity	4	0	4	0	0.62
Target group	4	0	4	0	0.62
Engagement score	**4**	**0**	**4**	**0**	
SECTION B-FUNCTIONALITY					
Performance	4	0	4	0	0.64
Ease to use	4	0	4	0	0.21
Navigation	4	0	4	0	0.79
Gestural design	4	0	4	0	1.00
Functionality score	**4**	**0**	**4**	**0**	
SECTION C-AESTHETICS					
Layout	3	1	3	1	0.84
Graphics	4	0	4	0	0.60
Visual appeal	4	0	4	0	0.42
Aesthetics score	**4**	-	**4**	-	
SECTION D-INFORMATION					
Accuracy of app description (in app store)	4	0	4	0	0.82
Goals	4	1	4	1	0.64
Quality of information	4	0	4	0	0.60
Quantity of information	4	0	4	0.75	0.12
Visual information	3	1	3	1	0.86
Credibility	4	0	4	0	1.00
Information score	4	1	4	1	
Quality score (A,B,C,D)	**4**	**1**	**4**	**1**	
SECTION E-SUBJECTIVE QUALITY					
App recommendation	4	0	4	0	0.79
App use frequency	3	0	3	0	0.56
App purchase	1	0	1	0	0.88
Star rating	5	1	5	0	0.18
Subjective quality score	**3**	**0.5**	**3**	**0**	
SECTION F-MOBILE APP SPECIFICITIES					
Awareness	4	0	4	0	0.82
Knowledge	4	0	4	0	0.65
Attitudes	4	0	4	0	0.60
Intention to change	4	0	4	0	1.00
Help seeking	4	0	4	0	0.79
Behavior change	4	0	4	0	1.00
Mobile app specificities score	**4**	**0**	**4**	**0**	
Overall MARS-I score	**4**	-	**4**	-	

Implications for clinical practice

The use of apps focused on the implementation of nutritional self-care could be an effective methodology to increase adherence to a correct dietary style in patients with CKD. An educational approach that uses these "digital" methodologies should be considered by various health professionals (15), promoting the use of nutritional apps in combination with traditional therapeutic education tools (leaflets, information brochures). In fact, the role of eHealth seems to be promising both in the medical field and on an educational level; however, further research is needed to evaluate the effectiveness of eHealth in terms of behavior modification, self-care and patient health literacy.

Conclusions

As e-health progresses and rapidly expands, nutritional applications could be a promising option in promoting behavior change, managing CKD, and improving disease outcomes by ensuring high-quality healthcare. In particular, apps that focus on improving motivation, self-efficacy, attitudes, knowledge, and goal setting can be especially helpful for the patient. The study showed good results in terms of efficacy and safety (privacy) of the nutritional apps. The apps can also support health professionals in the therapeutic education of the patient, improving it.

Although the use of nutrition-related mobile apps could be a key element in changing patient behavior, this tool should be combined with other therapeutic education methods, such as nutritional brochures.

It would also be interesting to conduct randomized studies involving the use of nutritional apps by the patient or caregiver.

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Ethic Committee: Not required, as this was a purely observational study that did not investigate a sample of patients and was not directly related to clinical practice

Conflict of Interest: Each author declares that he or she has no commercial associations (e.g. consultancies, stock ownership, equity interest, patent/licensing arrangement etc.) that might pose a conflict of interest in connection with the submitted article.

Supplementary File: Data relating to the complete search algorithm and supplementary tables are made available

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Appendix–Supplementary files

Table S1. Apps' evaluation using the MARS-I questionnaire

	MyFir		Miku		*p-value*
	median	**IQR**	**median**	**IQR**	
Entertainment: Is the app fun/entertaining to use? Does it use any strategies to increase engagement through entertainment (eg, through gamification)?	4	0	4	0	.620
Interest: Is the app interesting to use? Does it use any strategies to increase engagement by presenting its content in an interesting way?	4	0	4	0	.445
Customization: Does it provide/retain all necessary settings/preferences for apps features (eg, sound, content, notifications, etc.)?	4	0	4	0	.221
Interactivity: Does it allow user input, provide feedback, contain prompts (reminders, sharing options, notifications, etc.)?	4	0	4	0	.620
Target group: Is the app content (visual information, language, design) appropriate for your target audience?	4	0	4	0	.620
Performance: How accurately/fast do the app features (functions) and components (buttons/menus) work?	4	0	4	0	.640
Ease of use: How easy is it to learn how to use the app; how clear are the menu labels/icons and instructions?	4	0	4	0	.211
Navigation: Is moving between screens logical/accurate/appropriate/ uninterrupted; are all necessary screen links present?	4	0	4	0	.799
Gestural design: Are interactions (taps/swipes/pinches/scrolls) consistent and intuitive across all components/screens?	4	0	4	0	1.000
Layout: Is arrangement and size of buttons/icons/menus/content on the screen appropriate or zoomable if needed?	3	1	3	1	.841
Graphics: How high is the quality/resolution of graphics used for buttons/icons/ menus/content?	4	0	4	0	.602
Visual appeal: How good does the app look?	4	0	4	0	.429
Accuracy of app description (in app store): Does app contain what is described?	4	0	4	0	.820
Goals: Does app have specific, measurable and achievable goals (specified in app store description or within the app itself)?	4	1	4	1	.640
Quality of information: Is app content correct, well written, and relevant to the goal/topic of the app?	4	0	4	0	.602
Quantity of information: Is the extent coverage within the scope of the app; and comprehensive but concise?	4	0	4	0.75	.121
Visual information: Is visual explanation of concepts – through charts/graphs/ images/videos, etc. – clear, logical, correct?	3	1	3	1	.862
Credibility: Does the app come from a legitimate source (specified in app store description or within the app itself)?	4	0	4	0	1.000
Would you recommend this app to people who might benefit from it?	4	0	4	0	.799
How many times do you think you would use this app in the next 12 months if it was relevant to you?	3	0	3	0	.565
Would you pay for this app?	1	0	1	0	.883
What is your overall rating of the app from 1 to 5?	5	1	5	0	.183
Awareness: This app is likely to increase awareness of the importance of deal with kidney disease by also integrating dietary prescriptions	4	0	4	0	.820
Knowledge: This app is likely to increase knowledge/understanding of the role that proper nutrition has in slowing the progression of kidney disease and its complications	4	0	4	0	.659
Attitudes: This app is likely to improve attitudes around the need to make changes to your eating habits	4	0	4	0	.602

	MyFir		Miku		*p-value*
	median	**IQR**	**median**	**IQR**	
Intentions to Change: This app is likely to increase intentions/motivations to make the necessary changes in one's eating habits	4	0	4	0	1.000
Help seeking: Use of this app is likely to further encourage seeking help to achieve and/or maintain adequate nutritional status	4	0	4	0	.799
Behavior change: Use of this app is likely to decrease the risk of engaging in unhealthy eating habits	4	0	4	0	1.000

Table S2. Detailed frequencies of the MARS-I questionnaire

	MyFir					Miku				
	1	**2**	**3**	**4**	**5**	**1**	**2**	**3**	**4**	**5**
	n(%)	**n(%)**	**n(%)**	**n(%)**	**n(%)**	**n(%)**	**n(%)**	**n(%)**	**n(%)**	**n(%)**
Entertainment: Is the app fun/ entertaining to use? Does it use any strategies to increase engagement through entertainment (eg, through gamification)?	0	0	1 (5.0)	17 (85.0)	2 (10.0)	0	0	0	17 (85.0)	3 (15.0)
Interest: Is the app interesting to use? Does it use any strategies to increase engagement by presenting its content in an interesting way?	0	0	1 (5.0)	18 (90.0)	1 (5.0)	0	0	0	17 (85.0)	3 (15.0)
Customisation: Does it provide/retain all necessary settings/preferences for apps features (eg, sound, content, notifications, etc.)?	0	0	3 (15.0)	17 (85.0)	0	0	0	1 (5.0)	16 (80.0)	3 (15.0)
Interactivity: Does it allow user input, provide feedback, contain prompts (reminders, sharing options, notifications, etc.)?	0	0	3 (15.0)	17 (85.0)	0	0	0	2 (10.0)	17 (85.0)	1 (5.0)
Target group: Is the app content (visual information, language, design) appropriate for your target audience?	0	0	1 (5.0)	17 (85.0)	2 (10.0)	0	0	0	17 (85.0)	3 (15.0)
Performance: How accurately/ fast do the app features (functions) and components (buttons/menus) work?	0	0	2 (10.0)	16 (80.0)	2 (10.0)	0	0	0	18 (90.0)	2 (10.0)
Ease of use: How easy is it to learn how to use the app; how clear are the menu labels/icons and instructions?	0	0	2 (10.0)	18 (90.0)	0	0	0	0	17 (85.0)	3 (15.0)
Navigation: Is moving between screens logical/accurate/ appropriate/ uninterrupted; are all necessary screen links present?	0	0	0	18 (90.0)	2 (10.0)	0	0	0	17 (85.0)	3 (15.0)

Table S2 (*Continued*)

Table S2. Detailed frequencies of the MARS-I questionnaire

	MyFir					Miku				
	1	**2**	**3**	**4**	**5**	**1**	**2**	**3**	**4**	**5**
	n(%)	**n(%)**	**n(%)**	**n(%)**	**n(%)**	**n(%)**	**n(%)**	**n(%)**	**n(%)**	**n(%)**
Gestural design: Are interactions (taps/swipes/pinches/scrolls) consistent and intuitive across all components/screens?	0	0	0	18 (90.0)	2 (10.0)	0	0	1 (5.0)	16 (80.0)	3 (15.0)
Layout: Is arrangement and size of buttons/icons/menus/content on the screen appropriate or zoomable if needed?	0	0	12 (60.0)	7 (35.0)	1 (5.0)	0	1 (5.0)	10 (50.0)	7 (35.0)	2 (10.0)
Graphics: How high is the quality/ resolution of graphics used for buttons/icons/menus/content?	0	0	0	19 (95.0)	1 (5.0)	0	0	0	17 (85.0)	3 (15.0)
Visual appeal: How good does the app look?	0	0	0	19 (95.0)	1 (5.0)	0	0	0	16 (80.0)	4 (20.0)
Accuracy of app description (in app store): Does app contain what is described?	0	0	0	18 (90.0)	2 (10.0)	0	0	1 (5.0)	17 (85.0)	2 (10.0)
Goals: Does app have specific, measurable and achievable goals (specified in app store description or within the app itself)?	2 (10.0)	0	7 (35.0)	11 (55.0)	0	2 (10.0)	0	5 (25.0)	13 (65.0)	0
Quality of information: Is app content correct, well written, and relevant to the goal/topic of the app?	0	0	0	19 (95.0)	1 (5.0)	0	0	0	17 (85.0)	3 (15.0)
Quantity of information: Is the extent coverage within the scope of the app; and comprehensive but concise?	0	0	1 (5.0)	19 (95.0)	0	0	0	0	15 (75.0)	5 (25.0)
Visual information: Is visual explanation of concepts – through charts/graphs/images/videos, etc. – clear, logical, correct?	0	0	13 (65.0)	7 (35.0)	0	0	0	13 (65.0)	5 (25.0)	2 (10.0)
Credibility: Does the app come from a legitimate source (specified in app store description or within the app itself)?	0	0	2 (10.0)	17 (85.0)	1 (5.0)	0	0	2 (10.0)	17 (85.0)	1 (5.0)
Would you recommend this app to people who might benefit from it?	0	0	0	20 (100.0)	0	0	0	1 (5.0)	17 (85.0)	2 (10.0)
How many times do you think you would use this app in the next 12 months if it was relevant to you?	0	3 (15.0)	13 (65.0)	3 (13.0)	1 (5.0)	0	4 (20.0)	14 (70.0)	0	2 (10.0)
Would you pay for this app?	16 (80.0)	0	4 (20.0)	0	0	17 (85.0)	0	1 (5.0)	0	2 (10.0)
What is your overall rating of the app from 1 to 5?	0	0	0	9 (45.0)	11 (55.0)	0	0	0	4 (20.0)	16 (80.0)
Awareness: This app is likely to increase awareness of the importance of deal with kidney disease by also integrating dietary prescriptions	0	0	0	17 (85.0)	3 (15.0)	0	0	1 (5.0)	16 (80.0)	3 (15.0)

	MyFir					Miku				
	1	2	3	4	5	1	2	3	4	5
	n(%)	n(%)	n(%)	n(%)	n(%)	n(%)	n(%)	n(%)	n(%)	n(%)
Knowledge: This app is likely to increase knowledge/understanding of the role that proper nutrition has in slowing the progression of kidney disease and its complications	0	0	0	17 (85.0)	3 (15.0)	0	0	2 (10.0)	15 (75.0)	3 (15.0)
Attitudes: This app is likely to improve attitudes around the need to make changes to your eating habits	0	0	0	16 (80.0)	4 (20.0)	0	0	0	18 (90.0)	2 (10.0)
Intentions to Change: This app is likely to increase intentions/ motivations to make the necessary changes in one's eating habits	0	0	0	19 (95.0)	1 (5.0)	0	0	1 (5.0)	17 (85.0)	2 (10.0)
Help seeking: Use of this app is likely to further encourage seeking help to achieve and/or maintain adequate nutritional status	0	0	0	17 (85.0)	3 (15.0)	0	0	0	18 (90.0)	2 (10.0)
Behavior change: Use of this app is likely to decrease the risk of engaging in unhealthy eating habits	0	0	0	18 (90.0)	2 (10.0)	0	0	0	18 (90.0)	2 (10.0)

Search strategy

ID	Google Play Store	Results
#1	nutrition (nutrizione)	30
#2	alimentation (alimentazione)	30
#3	diet (dieta)	30
#4	dialysis (dialisi)	30
#5	chronic kidney disease (insufficienza renale cronica)	200
#6	CKD (IRC)	14
#7	kidneys (reni)	30
#5	kidney (rene)	146
	Total	**710**
	Apple Store	**Results**
#1	nutrition nutrizione	181
#2	alimentation (alimentazione),	194
#3	diet (dieta)	225
#4	dialysis (dialisi)	8
#5	chronic kidney disease (insufficienza renale cronica)	1
#6	CKD (IRC)	10

ID	Google Play Store	Results
#7	kidneys (reni)	17
#5	kidney (rene)	147
	Total	**783**
ID	**Huawey Appgallery**	**Results**
#1	nutrition nutrizione	1
#2	alimentation (alimentazione),	24
#3	diet (dieta)	25
#4	dialysis (dialisi)	0
#5	chronic kidney disease (insufficienza renale cronica)	0
#6	CKD (IRC)	25
#7	kidneys (reni)	20
#5	kidney (rene)	14
	Total	**108**
Grey Literature		**1**
	TOTAL ARTICLES FOUND	**1602**