The Function Analysis and Quality Assessment of Persian-Language Nutrition-Related Mobile Apps on Google Play and Iranian App Stores

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ABSTRACT

Background: A growing variety of smartphone applications (apps) have been developed to provide nutritional information for promoting illness prevention and a healthy lifestyle. However, the effectiveness of these apps have not been extensively investigated. Thus, the current study aimed to assess the functionality and quality of Persian-language nutrition-related apps in Iran. **Methods:** Twenty-two eligible apps were included in the study according to the systematic search on Android Google Play and Iranian app stores. Then, each app underwent an overall quality assessment by six specialists in the fields of nutrition sciences and health information technology using the Mobile App Rating Scale (MARS). **Results:** The MARS mean scores for the investigated apps was 3.04. The functional effectiveness scope obtained the highest mean score of 3.43, followed by aesthetics scope (mean score of 2.95), engagement scope (mean score of 2.83), and content quality scope (mean score of 2.36), respectively. In addition, the subjective quality outcomes revealed that just less than 5% of apps were desirable for users to use enthusiastically more than 50 times over the next 12 months or recommend them to other individuals. However, 27.3% of apps were appraised appropriate depending on the user's intention to pay for the app. **Conclusion:** The present study indicated an acceptable overall MARS quality score among the Persian-language nutrition-related mobile apps in android Google Play and Iranian popular app stores.

Introduction

Non-communicable diseases (NCDs) are known as primary culprits of mortality, which are responsible for nearly 80% of deaths in countries with low or middle incomes (Azadnajafabad *et al.*, 2024). These global chronic health problems are recognized as cluster of endocrine or metabolic impairments mainly including overweight and obesity, diabetes, cancer, cardiovascular diseases, kidney disease, and chronic respiratory disease (Hunter and Reddy, 2013). In this regard, the important role of modifiable preventative strategies such as changing lifestyle behaviors and adherence to a nutritious eating pattern by having healthier food choices have been an important focus of interest for healthcare researchers for the management of NCDs (Budreviciute *et al.*, 2020, Sherafatmanesh *et al.*, 2017).

Considering the universalization of mobile technologies in the last decade, using mobile health (mHealth) applications (apps) have delivered a privileged opportunity to encourage patients for effective lifestyle modifications and reduce NCDs risk factors (Laure *et al.*, 2015, Sherafatmanesh *et al.*, 2021). The novel mHealth approach is particularly suitable for nutritional interventions due to easy access of users to comprehensive nutritional information requirements regarding appropriate food choices, maintaining a healthy weight, counting calories, and preparing nutritious meals (DiFilippo *et al.*, 2015). Currently, various software programs have been designed to allow users to control their daily calorie and water intake, as well as improving nutritional knowledge and disease symptomatology (Hingle and Patrick, 2016). Other main features of a useful mHealth app comprise a user-friendly interface, a free trial, support for social networks, and the ability to sync with other health and wellness apps such as smartwatches or computers for facilitating the review and sharing of personal health statistics (Franco *et al.*, 2016). However, as the development of mHealth apps follows an upward trend all over the world, their effectiveness examination is considered among the most important issues (Schnall *et al.*, 2016). Although health benefits of technologies have been established, it has been documented that the effectiveness of over 50% of mHealth apps is confined by functional errors, lack of evidence-based information, unfavorable features, and little usability (Fernandez-Lazaro *et al.*, 2024, Martinon *et al.*, 2022). In different countries, several studies have been conducted regarding the evaluation of nutrition-related mobile apps (Fernandez-Lazaro *et al.*, 2024, Li *et al.*, 2019, Martinon *et al.*, 2022). Although there are a number of Iranian mobile apps that provide nutritional guidance, their features and quality have not been yet extensively investigated. Therefore, the present study aimed to evaluate the quality and functional effectiveness of Persian-language nutrition-related mobile apps available in android Google Play and Iranian app stores.

Materials and Methods

Search strategy

From February 17 to April 14, 2023, a systematic search was conducted by academic investigators of department of nutrition, Shahid Sadoughi University of Medical Sciences, Yazd, Iran, for Persian-language nutrition-related apps on the popular Iranian online app stores (Bazar, MyKet, Sibche) and also Google Play store. The keywords entered in the search window of the app stores were as follows: "تغذيه" (diet), "رژيم غذايی" (nutrition), " رژيم " (dietary program), "برنامه غذايی" (healthy diet), " غذا" (food), "مصرف غذا" (food consumption), "غذايی سالم" (calorie), "کالری" (weight), "وزن" (slimming), and "لاغری" "تناسب اندام" (fitness). Given that search results in app stores are displayed at the top of the list based on the greater relevance to each search term (Chen *et al.*, 2015), the first 50 apps listed in Bazar, MyKet, Sibche, and Google Play were identified for the screening phase.

Data screening

The Preferred Reporting Items for Systematic reviews and Meta-Analyses (PRISMA) description was used to reflect the screening procedure
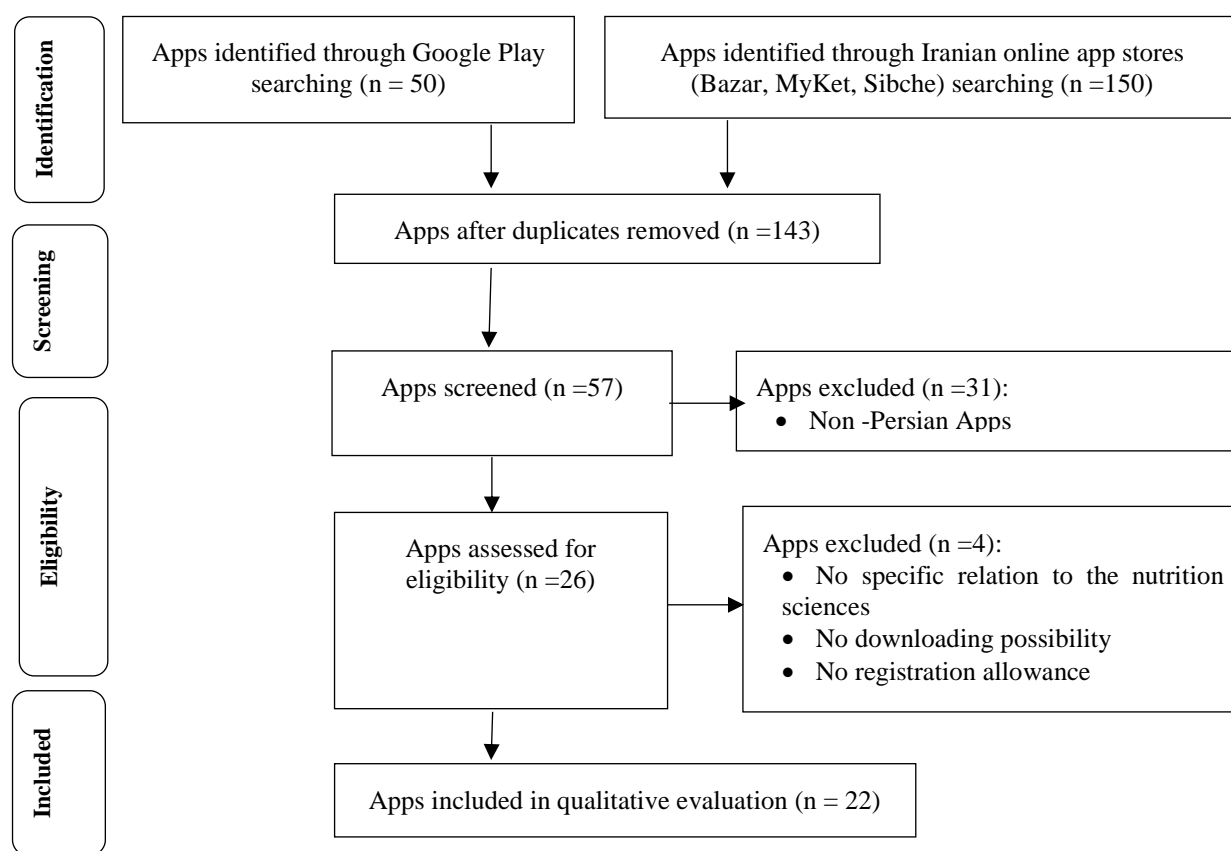
(**Figure 1**) (Page *et al.*, 2021).

Figure 1. PRISMA flow diagram of the study.

After eliminating duplicates within and between the searched app stores (considering the name and developer of the app), an independent cross-check screening method was performed by the study researchers to explore eligible nutrition-related apps which were able to provide diet. Primary analysis was limited to Persian-language apps, and according to a consensus reached between the study investigators, all apps that had no downloading possibility, no registration allowance, and no specific relation to the nutrition sciences (e.g., restaurant booking, take-away orders, meal delivery, food sales, recipes, traditional medicine, sports, food alert notifications, or general nutritional knowledge without any scientific evidence) were excluded from the investigation.

Data extraction
Based on the study inclusion and exclusion criteria, a total of 22 apps were finally considered eligible and then downloaded for further analysis. Each app underwent an in-depth review regarding general features such as name, number of installations, user ratings, number of raters, last update, developer, software platform, version, and in-app payment status.

Quality assessment of mobile apps
Six specialists in fields of nutrition sciences and health information technology, who had the experience of using mobile nutrition-related apps, were randomly divided into two equal groups. At first, all the evaluators were given time to be acquainted with each app menus and functionality.

Then, a detailed guidance document was provided to assist them on how to accurately report each app quality measurement criteria.

In the present cross-sectional study, the validated Mobile Application Rating Scale (MARS) tool was applied to assess the quality of the selected nutrition-related apps (Stoyanov *et al.*, 2015). The MARS scale encompasses 19 sections (with a 5-point Likert scale) which classified into four separate scopes of information including a) engagement: five queries regarding entertainment, interest, customization, and interactivity (e.g., sending alerts, messages, reminders, feedback, or allows sharing allowance, b) functional effectiveness: four queries regarding performance, the app ease of use, navigation features, and gestural design, c) aesthetics: three queries regarding graphic design, layout, overall visual appeal, color scheme, and style consistency, and d) content quality: seven queries regarding authenticity of app outline, objectives, quality, and quantity of data, validity, and evidence-based information. Finally, the total MARS score (ranged from 0-5) for each reviewed app was measured by summing the mean scores for each specific scope of information, and dividing by four, which a greater overall score reflects higher app quality.

In addition, a subjective quality assessment was conducted regarding information such as, a) user's interest to recommend the app to other people, b) estimated number of times the app will be used over the next 12 months, c) user's interest to pay for the app, and d) app rating (ranging from one to five stars).

Ethical considerations

The procedure of the present investigation was approved by the Ethics Committee of Shahid Sadoughi University of Medical Sciences, Yazd, Iran (IR.SSU.SPH.REC.1401.193).

Data analysis

Descriptive statistics were performed to assess the mean and minimum/maximum of MARS scores. Radar graph chart was also employed to compare differences between MARS mean scores for each section. Moreover, the number and

percentage of apps were calculated for the subjective quality evaluation. All data analysis was done using the Statistical Package for Social Sciences (SPSS, version 24.0).

Results

App characteristics

General characteristics of the study-eligible mobile apps are presented in **Table 1**. As the table depicts, 6 apps were last updated in 2023, 8 apps were in 2022, 2 apps were in 2021, and the rest of them were before 2021. Of the 22 apps, the highest number of active installations was for "کرفس" application with one million, and then for the "زیره" and "مانکن" with more than 500 thousand. Also, the number of raters for "کرفس" application were significantly higher than other apps.

Overall quality of apps

All comparisons between MARS mean scores for each specific-section are shown in **Figure 2**. The MARS mean score for the evaluated apps was 3.04. In total, 6 apps received scores lower than 2.5, which indicated that these apps were not of acceptable quality. Among the four information scopes of the MARS tool, the functional effectiveness scope reached the highest mean score of 3.43, followed by aesthetics scope (mean score of 2.95), engagement scope (mean score of 2.83), and content quality scope (mean score of 2.36), respectively. Generally, apps received higher scores on gestural design, while the evidence-based, validity, and customization aspects were accompanied by lower scores.

Subjective quality of apps

Findings regarding the subjective quality assessment of the study apps are reported in **Table 2**. The evaluators concluded that less than 5% of apps were reasonably appropriate for users to use them willingly more than 50 times over the next 12 months or recommend them to other people. Nevertheless, 27.3% of apps were evaluated as suitable, based on the user's intention to pay for the app. It is also worth noting that 40.9% of apps received an average of three stars in app rating scale.

Table 1. General characteristics of the study-eligible mobile apps.

| No.	Name	Number of installations	User ratings	Number of raters	Last update	Developer	Software platform	Version	In-app payment status
1	اکسیژن فیت	+100 K	4.1	722	6 Apr. 2023	گروه اکسیژن	Android	4.3.7	Yes
2	استپ فیت	+10 K	4.5	744	9 Apr. 2023	تاپ گل	Android	5.2.5	Yes
3	باریکا	+20 K	4.5	533	5 July 2022	باریکا	Android	3.0.3	Yes
4	بدن ساز من	+50 K	4.2	157	31 July 2020	امید رها	Android	_	No
5	بشقاب	+200 K	4.6	26704	27 July 2021	شرکت پیشرو سامانه آزاد	Android	2.8.16	Yes
6	بنتو	+100 K	4.3	2677	15 Mar. 2022	گروه کرفس	Android	2.5.3	Yes
7	پا به پا	+50 K	4.2	297	4 Nov. 2019	پا به پا	Android	1.2.1	Yes
8	پایه	+10 K	4	96	7 Oct. 2019	هایلی	Android	2.0.10	No
9	جزیره	+10 K	4.6	444	23 Oct. 2022	سروش نا	Android	1.4.3	Yes
10	جیم شو	+50 K	4.1	563	21 Jan. 2023	اریتکو	Android	3.1.0	Yes
11	رجیمی	+20 K	4	8	29 Oct. 2022	الف	Android	2.5.1	Yes
12	به اندام	+100 K	4.2	140	17 Dec. 2022	به افزار	Android	4.0.6	Yes
13	رژیم پلاس	+50 K	5	978	28 Apr. 2022	آذر مهر	Android	3.8.6	No
14	رژیم چاقی سریع	+10 K	4.2	43	30 May 2022	Ananya Reddy	Android	1	No
15	رژیم دکتر غیاثوند	+10 K	5	515	14 Oct. 2021	برنامه رژیم غذایی دکتر رضا غیاثوند	Android	1.0.1	Yes
16	رژیم سبز	+20 K	4.7	2038	3 May 2016	پرفا	Android	V4.7	No
17	زیره	+500 K	4.3	7874	15 Jan. 2023	کارسو	Android	7.3.0-GP	Yes
18	سیگما	+20 K	4.2	142	26 Jan. 2023	Sigma Lifestyle Team	Android	2.5.9	Yes
19	کرفس	+1 M	4.3	62465	21 Sept. 2022	گروه کرفس	Android	5.6.5	Yes
20	لاغری پلاس	+10 K	4.2	25	6 Sept. 2016	حمیدرضا السون	Android	0.1.9	Yes
21	مانکن	+500 K	4.5	442	22 Jan. 2023	مانکن	Android	5.9.7	Yes
22	یکا	+10 K	3.5	81	31 Oct. 2020	یکا	Android	3.0.8	No
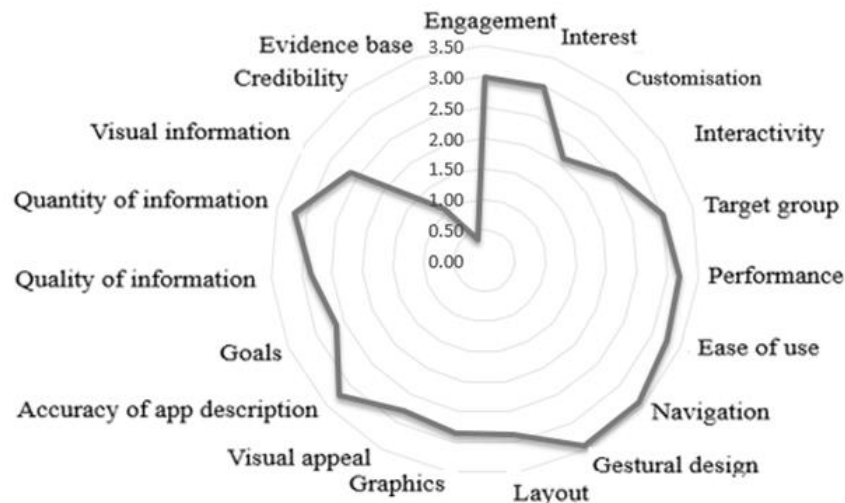
Figure 2. Comparisons between MARS mean scores for each specific section.

Discussion

To the best of our knowledge, the current investigation provides the first analytical evidence regarding the function analysis and quality assessment of Persian-language nutrition-related mobile apps.

mHealth apps for improving nutritional knowledge and dietary intakes have become increasingly popular (Martinon *et al.*, 2022). In recent years, millions of people have downloaded various nutrition-related programs which implies people's desire to monitor and manage their diet (Franco *et al.*, 2016, Vasiloglou *et al.*, 2021). Since mHealth apps have shown to impose an impact on human general health, and also healthcare specialists may make important decisions based on the user's information provided in these apps, proper investigations regarding their functionality, quality, accuracy, and reliability seem to be a high priority (Choi *et al.*, 2021, Park *et al.*, 2014).

In the present study, the overall quality of the study-eligible apps revealed an acceptable level (mean overall MARS score 3.04). Moreover, in agreement with the results of earlier studies utilizing the MARS, the functional effectiveness and aesthetics categories in this study received the highest and subsequent highest scores, respectively (Bardus *et al.*, 2016, Schoeppe *et al.*, 2017, Simões *et al.*, 2018). A proper functional effectiveness consists of higher app performance, navigation, and gestural design (Stoyanov *et al.*, 2015), which all have been reported to be associated with better usability and enhanced individuals' motivation with mHealth technologies (Boulos *et al.*, 2011). It has also been demonstrated that app suitable visual aesthetic features including images, tables, and graphs may become important indicators for attainment of higher overall MARS scores (Choi *et al.*, 2021, Li *et al.*, 2019).

The acceptable overall MARS quality score in this study was approximately in accordance with the estimated quality scores reported for nutrition-related apps in previous investigations (Li *et al.*, 2019, McAleese *et al.*, 2022). However, the study specialists estimated low results regarding the subjective quality of apps (less than 5% of apps seemed to be appropriate for users to often use them over next 12 months or to recommend them to other subjects), which confirming prior health care specialists' estimations on nutrition and diet apps (Vasiloglou *et al.*, 2020). It is noteworthy that the current study inclusion criteria were not accompanied by just high rated apps, which can describe the slightly lower overall quality score of the present study compared to earlier studies (Choi *et al.*, 2021, Schumer *et al.*, 2018). In addition, nutritionists and health information technology experts evaluated the quality of apps in the current study, whereas numerous conventional users can

do assessments in app stores. Although star ratings or number of raters are fundamental indicators for the popularity of apps, it may not constantly reveal the proper quality or facing reliable scientific content in mHealth apps (Choi *et al.*, 2021, Martinon *et al.*, 2022).

Table 2. Subjective quality assessment of the study eligible mobile apps.

Queries of the subjective quality assessment	App (%)
User's interest to recommend the app to people who might benefit from it	
Not at all	4 (18.2)
Few people	4 (18.2)
Maybe	7 (31.8)
Many people	6 (27.3)
Definitely	1 (4.5)
Estimated number of times the app will be used over the next 12 months	
None	4 (18.2)
1-2	5 (22.7)
3-10	6 (27.3)
10-50	6 (27.3)
>50	1 (4.5)
User's interest to pay for the app	
Yes	6 (27.3)
Maybe	7 (31.8)
No	9 (40.9)
App rating (ranging from one to five stars)	
★	1 (4.5)
★★	3 (13.7)
★★★	9 (40.9)
★★★★	8 (36.4)
★★★★★	1 (4.5)

Meanwhile, the lowest quality scores in this investigation were detected in relation to the evidence-based, validity, and customization aspects of the MARS measurement. Similarly, in 2022, a study by Martinon *et al*., demonstrated major concerns regarding the lack of accurate scientific-based data in large number of mHealth apps (Martinon *et al.*, 2022). This issue has also been found in most of well-known weight management apps, worldwide (Bardus *et al.*, 2016). Besides, total energy consumption has been overestimated or underestimated in earlier literatures on nutrition tracking apps (Bzikowska-Jura *et al.*, 2021, Griffiths *et al.*, 2018). The implementation of various nutritional reference guidelines, and the absence of alternative serving sizes provided by apps may account for the discrepancy in calorie intake and nutrient assessments across nutrition-related apps (Chen *et al.*, 2015, Fallaize *et al.*, 2019, Ferrara *et al.*, 2019). Since spreading invalidated information in mHealth apps might have a detrimental impact on users' well-being and overall health, the content presented by apps should be supported by reliable scientific-based data and rigorously tested for correctness (Fernandez-Lazaro *et al.*, 2024). Therefore, it is crucial that app developers engage in providing appropriate evidence-based scientific content to improve the app overall quality (McAleese *et al.*, 2022).

The present study findings should be interpreted while considering the main limitations. Although we identified the first 50 apps listed in studied app stores as the most relevant apps to each search term, it still may not be representative of the entire Persian-language nutrition-related apps. Other less popular Iranian app stores, such as sibapp, iapps, sibou, sibirani, and sibaneh could have been

searched for app identification. Moreover, other quality assessment scales, such as ENLIGHT could have been employed to compare the final results between different scales. Hence, future well-designed studies are required to confirm the results.

Conclusion

Findings of the current study indicated an acceptable overall MARS quality score among the Persian-language nutrition-related mobile apps in android Google Play and Iranian popular app stores. However, the quality of apps regarding the evidence-based, validity, and customization aspects still need to be improved.

Authors' contribution

Dehghani Mahmoodabadi A: Original draft, data curation, formal analysis, investigation, software, visualization, review and editing; Nadjarzadeh A: Methodology, formal analysis, validation, visualization, review and editing; Yousefianzadeh O: Supervision, data curation, formal analysis, visualization, review and editing; Pourrokni Salehan S, Sajjadi SS, Khosravi-Boroujeni H and Maayeshi N: Methodology, data curation, validation, visualization, review and editing; Sherafatmanesh S: Conceptualization, supervision, data curation, formal analysis, methodology, project administration, validation, visualization, original draft, review and editing.

Conflict of interest

The authors report no conflict of interest.

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