

A Native Mobile-Based App for Nutritional Self-Care Behavior Assessment

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Abstract. *Background:* While obesity and weight mismatch are of the commonest health challenges worldwide, the advancement of mobile technology and its entry into the field of health have proven to have a significant role in weight control and self-care in nutritional behavior. *Purpose:* This study aimed to develop and evaluate an integrated communication app on the nutritional behavior of users and their opinion of the app usability. *Methods:* Fit-mail App for Nutritional Self-care (FANS) was developed according to the app development methodology including design, modeling, implementation, and evaluation phases. The FANS was provided to 50 students of Ahvaz University of Medical Sciences who voluntarily participated in the study. Nutritional behavior was examined using the FANS during two stages before and after a 60-day period. The usability and nutrition activity were assessed on the students who completed the intervention of a mobile app. *Results:* The results showed statistically significant differences between the two questionnaires before using FANS with mean = 61.7292 and after that mean = 92.1042 (p-value <0.001). The results showed that the frequency of having a goal to increase physical activity has changed before and after using the FANS. Moreover, using self-care app in nutritional behavior to check calorie intake with 40% was the most and getting information on nutrition with 18% the least important goal of the users. *Conclusions:* According to the results, a native mobile-based app can play valuable role in promoting healthy activities. Moreover, it enhanced people's attitude to adherence to diet and self-care consequently.

Key words: Diet therapy, mobile app, nutritional behavior, mobile health, self-care

Introduction

Healthy nutrition is a component of the healthy lifestyle. Many diseases will be preventable if one selects a healthy and active lifestyle. Lifestyle includes behaviors like eating habits, sleeping and resting, physical activity and weight control (1). There is a relationship

between health and lifestyle of the individuals (1). Wrong nutrition behaviors in Iran are so common and it is often seen that nutrition in Iran is restricted to consumption of certain foods and there is no variation in nutritional pattern. About 50% of Iran's population suffers from micronutrient deficient, with 18 to 20% of people suffering from excessive consumption

of carbohydrates (2). Per capita consumption of dairy products in Iran is 170 g / day that is very low compared to developed countries (450 g / day) (2).

Researchers focus on two important issues of nutrition health and diet therapy: diet therapy and individual counseling as a clinical topic based on scientific and clinical skills of nutritionists, and group training for the patients is particularly important in rehabilitation prevention centers (3). Diet therapy includes examining the habits and diet of patients and presenting a regular diet (4). Nutrition and diet therapy are of the key life issues in today's world, considered not only to reach health and treatment of various diseases but also for fitness. As consumption patterns of societies differ, with the lack of capital and food resources of that country as the main reasons, using indigenous nutrition patterns is of more interest in presenting therapeutic patterns by experts.

Modern, inexpensive and affordable technologies, like mobile phones, are used to reduce health care costs and to improve patient supervision by controlling compliance with self-care programs (5). Self-care involves actions a person does to stay healthy or to preserve his health (6). It is estimated that the individual himself without the intervention of specialists provides 65 to 85% of all health care (6). The effect of self-care on improving health outcomes and reducing costs has been proven in many studies (7). Self-care focuses on the aspects under the control of the individual. An important principle in self-care is the participation and assuming responsibility by the individual to prevent unpleasantness and illness by performing proper health behaviors (6).

Health-related technologies can be used to monitor the maintenance of a healthy lifestyle. The goal of some mobile-based apps is to improve healthy nutrition and increase energy consumption by monitoring food intake and dietary supplements (7). In the app download stores available on various platforms, diet programs are of the most popular programs in line with health programs (8). Mobile apps have a significant role in monitoring and managing people's weight (9). Using mobile apps can improve the quality of health care and change health behaviors by enhancing prevention and ultimately improving long-term health (5). Increased interest in utilizing mobile capabilities to

support health has led to the creation of an interdisciplinary branch of mobile health (6). The World Health Organization (WHO) defines mobile health as the provision of health care by mobile devices like mobile phones and other wireless devices (10). It seems that using smart mobile devices like mobile phones and the ability to install different apps on them can create new horizons in patient health (11). Recent developments in technology coupled with the development of mobile apps have created many opportunities recently (12). Mobile phones connected to information sources and are constantly updating their information can help physicians besides assisting physicians to access daily patient-information better (13).

Moreover, people's willingness to carry their mobile phones in place and their dependents on their mobile phones has created an increasing opportunity to apply this technology in health area (14). As in the last decade, smartphones have made it easier for users to access a great deal of health information via websites, media and social software, so users can meet their health information needs through health software. Easily receive at any time and place (15). Many studies have indicated the relationship between using nutrition software and its effects on self-care (7, 15).

Scholars have shown that using diet apps is related with changing dietary behavior (15). The results of a study by Wang et al. in 2016 showed that mobile-based apps had been very effective in promoting a healthy diet and exercise among the users. Moreover, Spring et al. in 2013 showed that mobile apps significantly improved eating habits among adults (16). Furthermore, Ahn et al. in 2019 developed a mobile dietary app to track and assess the dietary intake. They showed that the mobile app can assist the users to engage in standard dietary behavior (17).

These apps have greatly affected the actions of users in nutritional self-care (7). In spite of the emphasis of the above studies on the effect of dietary plans on self-care and nutritional behaviors, self-care nutrition apps have not been designed to fully connect Iranian users and nutritionists so far. Due to the differences in nutritional culture across various countries, the results of this study may prove useful. Thus, the purpose of the study was to design, develop, and evaluate an online communication app between users and

professionals to examine the nutrition and dietary app on users' nutritional behavior and self-care. Previous studies have examined using nutrition app to change behavior using qualitative methods, yet this study was descriptive-analytic.

Materials and Methods

This semi-experimental study was conducted in six phases in 2018–2019. The six phases were gathering significant features in nutrition self-care app, designing the initial version of the app, modifying and improving the app, enrolling specialists and volunteer users in the study, distributing questionnaires before and after using the app, and analyzing nutritional behavior of the users after using the app. Figure 1 shows the process of the study.

Design and development of nutrition self-care app

The process of designing and developing the FANS includes the following steps:

1. Collecting information needs and important parameters and features in nutrition self-care app based on library studies, nutrition guidelines and nutritionists' opinion
2. Designing a prototype based on the information collected and the app's initial evaluation and comparison with those available in the market

3. Modification and improvement of the features in the initial version of the app based on nutritionists' views to reach the goals

Designing and developing conceptual model of the FANS were done based on the following objectives:

1. The information content of the app increases the knowledge of the users on the types of foods and the energy they produce. This information includes calories of foods, fruits, vegetables, and local and non-native drinks consumed daily by users. The users will be able to receive calorie information based on each food item and compare with each other or based on the total calorie information received on a daily basis.
2. Users' awareness of physical health based on nutritional indices and their physical status should increase. By filling in their basic physical status information form based on nutritional indices, users view their current state of physical health and find ways to improve and refine it compared to normal conditions.
3. Users' self-care should increase by tracking and changing their nutritional behavior and improve it. Tracking and following up the physical state according to the type of physical activity of the users and tracking the change in their nutritional style is made possible by the information collected in the app. Information

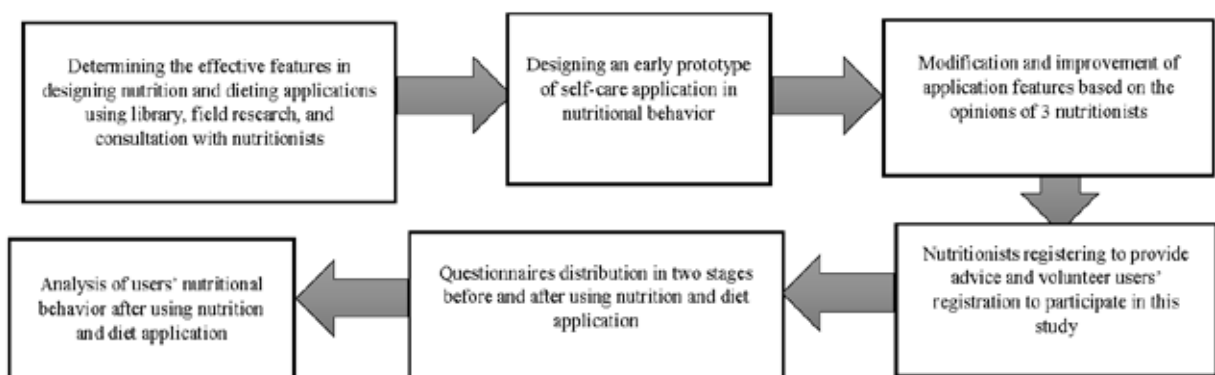


Figure 1. The process of designing, developing and evaluating self-care nutrition-behavior app

needed for proper weight, nutrition, and physical activity should be provided.

4. Effective communication should be established between users and nutritionists for online monitoring and consultation and nutrition planning. Creating a database of nutritionists and categorizing them according to the various consulting fields and creating the necessary context for virtual communication between users and professionals are among the most important goals in the Fitmail app. Thus, the experts can respond to users' requests for advice by having all the data recorded by users and the information generated by the app as well as interacting with users within the app. The advisory fields in this app did not include users and cases of clinical illness for clinical considerations.

FANS was developed in 2018 in 8 months to reach the above goals. The initial prototype of FANS was designed based on the information collected and

implemented using the web-based Php programming language. Then, an interface was designed for users to use on mobile platforms running Google Android and Apple IOS. The initial version was later reviewed by three experts and the necessary modifications were made to its features. In the next stage, the nutritionists' registration, consisting of 10 nutritionists, was done to provide participants with online counseling services.

Figure 2 is a screenshot of the final version of the FANS included the features needed in nutritional self-care. The app main parts are "User data registry", "Calorie measuring" as calorie counting of different foods by type, "Consultation request record" based on user information including personal, physical and Para-clinical information to access specialist online counseling services, a "health check" icon based on physical and nutritional indices, and a food-based calorimeter. Moreover, Figure 3 is a screenshot of the app for report on nutrition indices based on registered information, expert diet advisory information and weight tracking on weekly view.



Figure 2. A screenshot of the FANS (in Persian language): A) Basic features of the Nutrition app, B) Expert information registration form, C) Users' physical status record form for initial analysis of body mass index (BMI)



Figure 3. A screenshot of the FANS reporting and consulting features (in Persian language): A) Report on nutritional status based on registered information B) Expert diet advisory information based on user information C) Weight tracking on weekly view

Participants

In this study, after an initial evaluation, 50 students were selected as the sample and enrolled voluntarily (convenient sampling method). Inclusion criteria were as follows: 1) being students 2), voluntary participation, 3) having a smartphone with Google Android OS or Apple IOS, 4) not use of other nutrition apps during the study period, and 5) volunteers' not being treated by nutrition consultants during the study period. The volunteers being studied were BS and MS students of medical sciences, of whom two candidates did not continue until the end of the study and 48 remained in the study. The participants were examined by answering questions about their nutritional behavior before and after using the self-care app.

Data analysis

To evaluate the usability of the app on self-care, the users used the Wang nutrition and diet app questionnaire as the main source of questions (7). Two

nutrition and medical informatics specialists confirmed validity of the questionnaire. Moreover, reliability of the subscales was calculated using Cronbach Alpha with α -value=0.86 as threshold. The questionnaire was organized into four main sections with 20 questions and translated in Persian. The first part had 9 questions on nutritional behaviors, the second part 9 questions on dietary plans, the third part 1 multi-part question on the applicability of nutrition and diet programs, and the fourth part general questions consisting of one multi-part question. The questionnaire was distributed among the participants before using the FANS. Then it was installed on their smartphone. Later, the candidates were given a 60-day period to use the app. This period was used to evaluate the usability of the nutritional self-care app on users based on nutritionists' opinions. After that, the users completed the nutritional behavior questionnaire again. Given the importance of recording weight in the study, the participants used the same scales throughout the study to determine their weight to answer the question of weight. SPSS software was used for data analysis.

Paired t-test was used to evaluate the usability of the FANS self-care app. Descriptive results were presented to evaluate some of the questions in the results section.

Results

Descriptive statistics on app usability showed the following information of respondents: 36% of the users acknowledged that using FANS is strongly easy (0% were strongly disagreed. See Figure 4), 42% matched strongly that using FANS is valuable time for them (0% were strongly disagreed. See Figure 5) and 35% agreed strongly that getting the needed information through the FANS (0% strongly disagreed. See Figure 6).

Moreover, 30% of the participants considered it strongly usable to achieve those goals and 37% of them almost agreed that the FANS is usable to reach their goals (See Figure 7).

Each user has utilized the mobile app (FANS) for a specific purpose. Using the app to track calorie intake with 40% and getting food material-related general information with 18% were the most and the least important goals of the users, respectively. Other goals were as follow: facilitating weight loss: 38%, checking information on other health related food issues: 34%, helping healthier nutrition in general: 34%, facilitating access to nutritionists, sports coach, and so on; and to get general food consumption information: 20%.

FANS was somehow effective in replacing low-fat dairy products in 42% of users, and 10% of users

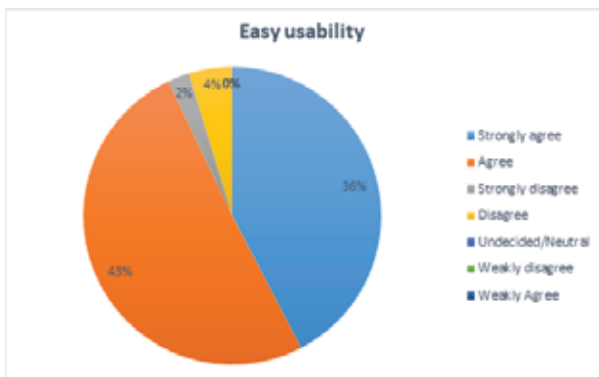


Figure 4. Users’ views for app usability question: It is easy for users to know about the usability

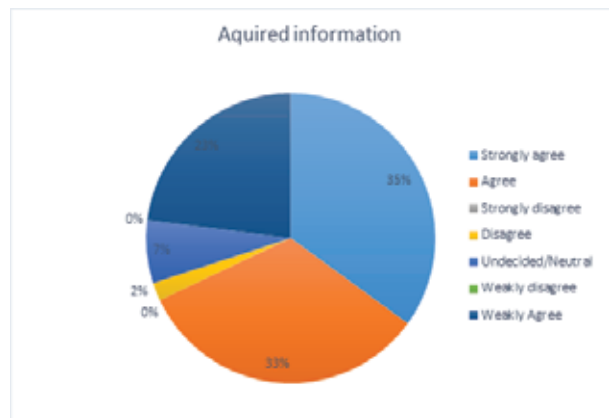


Figure 6. Users’ views for app usability question: Getting information through the app is easy

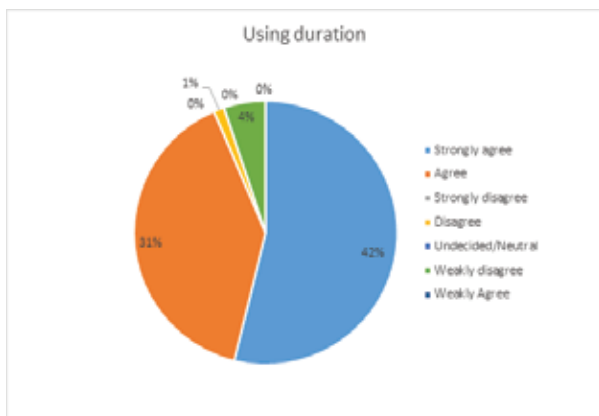


Figure 5. Users’ views for app usability question: The duration of use of the app is valuable

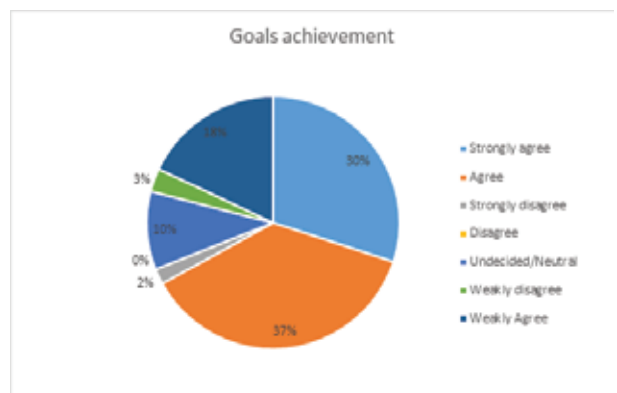


Figure 7. Users’ views for app usability question: Goals achievement through the app is easy

found it ineffective. It has been somehow effective in drinks with less artificial sugar 30%, eating less sausage 22%, eating more fruits and vegetables 42%, less fast food consumption 44%, and in choosing healthier foods 36%.

Figure 8 shows the frequency of users' opinions change regarding the new technology and health related apps. According to Figure 8, the frequency of supporters increased after using the app with respect to positive sentences in general, and conversely, the frequency of disapproval decreased after. For instance, the number of supporters of the FANS applicability in nutrition health in relation to questions about "making the app fun in nutrition health", "ease of using the app in nutrition health", and "liking the use of the app

in nutrition health" has increased. Moreover, one can state that the number of opponents of the app usability in nutrition health has often decreased regarding negative statements. Thus, the frequency of responses to questions like "lack of expectations for using the app for nutritional health" and "the time wasted in using the app for nutritional health" has decreased as negative sentences after using the app.

Additionally, the t-paired analytic test was done on other questions of the questionnaire. According to Table 1, the results of the test (p-value <0.001) showed a statistically significant difference between the two questionnaires before and after. Moreover, the paired t-test results showed that the frequency of having a goal to increase physical activity changed before and

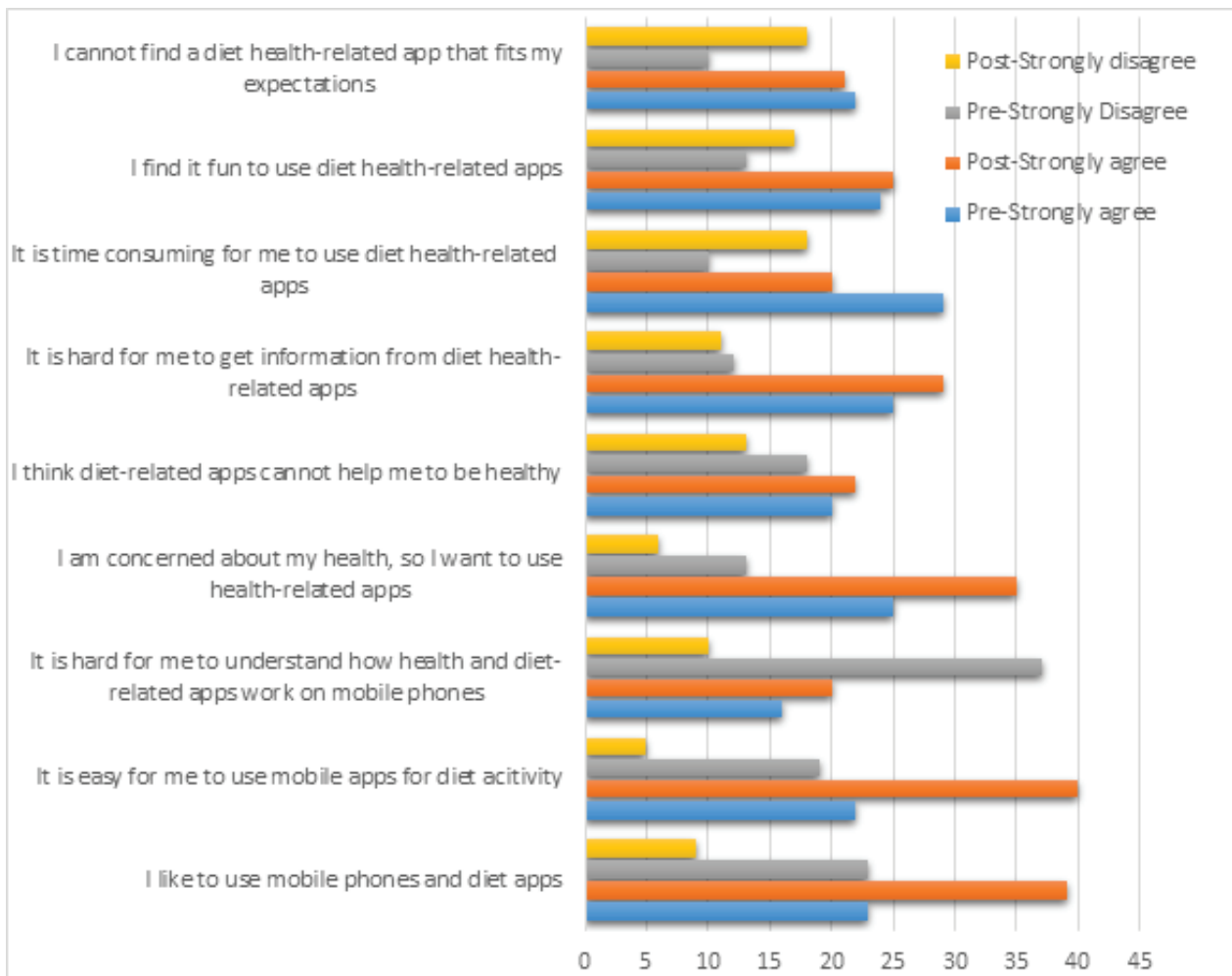


Figure 8. Frequency of users' opinions change regarding the health-related apps

Table 1. Paired t-test analysis of mean difference scores before and after using the self-care app

Variables	Paired Differences					t	df	P-value
	Mean	Std. Deviation	Std. Error Mean	95% Confidence Interval of the Difference				
				Lower	Upper			
Nutrition behavior Pre-post test	30.375	17.97472	2.59443	25.155	35.594	11.708	47	0.000
Post- test behavior	92.1042	13.4389	1.9397				47	
Pre- test behavior	61.7292	10.8407	1.5647				47	

after using the FANS. In other words, FANS raised the intention of physical activity among the users.

Discussion

Given the risk of weight mismatch as one of the leading causes of health challenges in the world, new methods including new technologies are required to improve monitoring and control of weight in communities. To best our knowledge, this study was one of the first Persian language app to identify the features design considerations as a supportive tool of nutritional practice. The app was developed to assess the various aspects of the applicability and usability. The results of this study are consistent with other studies on the impact of mobile intervention on the health care management, indicating that mobile apps have the potential to affect people behavior (18, 19, 20).

The usability of a native dietary app (FANS) on the users' nutritional self-care were examined. The results indicated that using mobile apps had a positive changes on the nutritional attitude of the users. The usability testing of the FANS showed the users' satisfaction of its structure including ease of use and the design of the app. The most users agreed the FANS met their expectations as the diet health related app. Similar studies showed that the app needs to be designed according to age range to fit the most users' expectations (7, 21). The FANS did not show to be time consuming, but was rarely fun for the applicants. Moreover, the results showed that the diet app can be used as an easy tool for monitoring the diet activity, goals achievement and food energy tracking information while physical activity was not measured in this study. However, the role

of the app in sharing the health records with the professionals was less important compared to the other functionalities of the app. Limitation in the role of app for health record sharing with the experts may due to perception of the users in little interest of dietitian to use the those apps (22). The results are consistent with other studies on the impact of mobile intervention on nutritional behavior change and users' motivation and desire for a healthy diet. The existing literature has shown that using nutrition and dietary apps has a significant effect on increasing self-care and changing nutritional behaviors (15), (18), (19), (20), (23). Nutrition apps increase users' nutritional understanding and awareness, and through self-care, have an effective role in the users' physical activity (24-26).

Moreover, these apps have a positive effect on the users' motivation and setting targets for changing their nutritional behavior (27). The results of similar studies on evaluated parameters like increasing motivation and interest, paying attention to patterns of nutrition consumption, and increasing physical activity are consistent with the results obtained in this study. However, some studies have reported inconsistent results about some apps available on Google play and Apple Itunes (9). Different outcomes by these studies may be due to different development purposes of those apps. In addition, nutritional conditions in various communities have a significant effect on designing apps (28-29).

In conclusion-the ever-increasing growth of smart phones has caused the development of a variety of health-related apps. Using the FANS set forth a solution to increase attention to promoting nutritional health and improving users' attitudes towards the role of mobile health technology in their nutritional behavior. The methodology used in designing

the fitness app according to the experts and considering the functional features needed by young users in the study geographical-area along the nutritional information of a variety of foods, including native foods, and the appropriate communication platform for communicating with experts for more supervision over the nutritional behavior of users could be among the different features of this study compared to the apps on the market. As using FANS may help the individuals' attitude to improve the self-care and adherence to a healthy diet approved by nutritionists, this study can play a significant role in the nutritional health of users as an easy, inexpensive and affordable approach. The role of this app on increasing user activity can reduce personal health problems created by inactivity and mismanagement. Development of a nutrition app to consider the effects of mobile app based diet therapy on obese people is recommended for future work.

Limitations of the study: As the sample of this study was the only medical students of Ahvaz Jundishapur University of Medical Sciences, Iran, it would not represent of the whole Iranian population, which may affect the generalizability of the results. There is bias possibility in the results given the use of self-report method in completing the questionnaire. As the study duration was only 60 days, more studies with a longer duration are needed with the effects controlled over time. Moreover, it is suggested that a study should be conducted to compare the effect of using the FANS on self-care with other similar apps.

Clinical Relevance Statement: The FANS aims to improve the nutritional self-care behavior by a more direct relation between the mobile users and nutritionist. Research in this area encourages the health care organizations to make more investment on the native health care apps to enhance the quality of health in the developing countries.

Conflict of Interest: The authors declare that there is no conflict of interest regarding the publication of this manuscript.

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