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<https://doi.org/10.55463/issn.1674-2974.51.1.6>

Designing Sustainable Mobile Weight Management Applications: Perspectives from Focus Groups

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Received: October 6, 2023 / Revised: November 3, 2023 / Accepted: December 8, 2023 / Published: January 31, 2024

Abstract: Obesity is a widespread chronic disease. Numerous weight management interventions are in place, yet the prevalence of obesity continues to rise. There is a need for long-term solutions that empower individuals to take charge of their health by regulating their weight. This study has two main objectives: (1) to understand the issues/problems faced by the participants in their current weight management initiatives and (2) to determine the expected user experience that mobile weight management applications should offer. In this study, we examine the perspectives and experiences of overweight and weight-conscious people on factors contributing to excess weight gain, challenges that prevent them from using mobile apps to manage weight, and how mobile apps can be best designed to aid in sustainable weight management. We conducted online focus group discussions (FGDs) with five groups (25 participants) comprising overweight and weight-conscious individuals. Seven major themes emerged: (1) lifestyle, (2) behavior, (3) social support and social factors, (4) technology, (5) education and awareness, (6) motivation and commitment, and (7) online support and coaching. Results indicate that obesity or being overweight can be managed and controlled through a stable lifestyle, social influences, and the willingness of the individual. Several features were proposed for inclusion: diet management, lifestyle, exercise, time and activity planning, goal setting, knowledge, and social support. These features will be incorporated into a framework to design mobile applications for sustainable weight management.

Keywords: obesity, focus group discussion, weight management, mHealth, mobile applications.

设计可持续的移动体重管理应用程序：焦点小组的观点

摘要：肥胖是一种普遍存在的慢性疾病。尽管已经采取了许多体重管理干预措施，但肥胖症的患病率仍在持续上升。我们需要长期的解决方案，使个人能够通过调节体重来掌控自己的健康。这项研究有两个主要目标：(1)了解参与者在当前体重管理计划中面临的问题；(2)确定移动体重管理应用程序应提供的预期用户体验。在这项研究中，我们研究了超重和注重体重的人对导致体重过度增加的因素、阻止他们使用移动应用程序来管理体重的挑战以及如何最好地设计移动应用程序以帮助可持续体重的观点和经验。管理。我们与五个小组（25名参与者）进行了在线焦点小组讨论（烟气脱硫），其中五个小组由超重和注重体重的个人组成。出现了七个主要主题：（1）生活方式，（2）行为，（3）社会支持和社会因素，（4）技

术，(5) 教育和意识，(6) 动机和承诺，以及(7) 在线支持和辅导。结果表明，肥胖或超重可以通过稳定的生活方式、社会影响和个人意愿来管理和控制。提出了几个纳入的特征：饮食管理、生活方式、锻炼、时间和活动规划、目标设定、知识和社会支持。这些功能将被纳入一个框架中，以设计可持续体重管理的移动应用程序。

关键词：肥胖、焦点小组讨论、体重管理、移动医疗、移动应用程序。

1. Introduction

Over the past 50 years, the prevalence of overweight and obesity has steadily increased worldwide. The need for intervention has grown more urgent because of the significant difficulties in maintaining sustained lifestyle changes and the heavy burden of comorbidities brought on by increased body weight [1]. Over 2 billion people (or 39% of the adult population worldwide) were overweight (BMI > 25) in 2020. Over 600 million of these people (BMI > 30) were obese. Over 50% of people in Europe are overweight (BMI > 25), and up to 30% are obese (BMI > 30) [2]. Numerous associated comorbidities, such as type 2 diabetes, cardiovascular disease, fatty liver disease, obstructive sleep apnea, musculoskeletal problems (such as osteoarthritis), and specific forms of cancer, are highly prevalent in this population [2], causing a decline in quality of life [3]. These dangers increase the complexity and immediate necessity of good weight management [4]. While it is generally agreed upon that excessive caloric intake and lack of physical activity are significant contributors to obesity, it is important to note that the causes of obesity are multifactorial and can vary from person to person. The development of obesity is influenced by a complex interplay of genetic, physiological, behavioral, environmental, and socio-cultural factors. Emotional factors, such as stress, emotional eating, and certain mental health conditions, can also play a role in weight gain and obesity in some individuals [5]. Subjective factors such as distance to the nearest produce market or emotional regulation difficulties influence excessive caloric intake and lack of physical activity [6]. To treat obesity, all these factors must be eliminated simultaneously to achieve long-term success.

When employing mobile technology and telephone support, the percentage of patients who lost at least 5% of their body weight increased by three times, to 44%, from 15% when using conventional techniques [4]. Patients frequently view mobile health applications (apps) as satisfactory, simple to use, and beneficial in their pursuit of weight loss objectives. Mobile health applications can help people lose weight because they can improve treatment adherence through techniques such as self-monitoring [8].

Interventions that target many levels (e.g., individual, societal, and environmental) and specifically use systems-level approaches in terms of food production and policy-level changes are the most effective for treating overweight and obesity. The most effective interventions are those that focus on individual behavior because implementing such interventions is difficult due to financial and other obstacles.

Using mobile and persuasive technologies has many benefits for weight management and obesity interventions [9]. The main advantages of obesity interventions delivered through mobile technology over traditional face-to-face interventions are as follows: (1) mobile interventions are less expensive to develop and maintain, particularly over long periods required for obesity treatments; (2) mobile interventions are more convenient, making them more accessible to obesity sufferers precisely when they need them; (3) mobile interventions are much easier to tweak, making them more responsive to user needs [10].

Research also suggests that many apps do not contain techniques or features that have been shown to be effective in behavior change, such as the ability to be customisable to users' needs or personal characteristics or to be responsive to change, despite some studies reporting on the behavior change content of apps, such as smoking cessation, alcohol reduction, physical activity, or for specific medical conditions. Additionally, there is a chance that using applications carelessly, without supervision, or in a way that conflicts with existing advice could hurt users [11].

Culture plays a significant role in explaining how different groups respond to persuasive design principles [12]. When responding to persuasive strategies, people from individualistic cultures (e.g., North Americans) differ significantly from those from collectivist cultures (e.g., Asians) [13]. This is likely to play a significant role in obesity interventions, given to what extent pervasive individualistic frameworks are spread among the interventions in the reviewed literature. Different populations tend to have varying susceptibilities to certain persuasive designs or methods. Hence, adjusting obesity therapies to user cultures may be required rather than opting for an individualist framework by default.

Commercial smartphone apps for managing weight lack key evidence-based features, do not involve healthcare professionals in their creation, and have not undergone thorough scientific testing [14]. When the availability and usage of these tools are rapidly rising, this scenario throws into doubt the veracity of apps' claims regarding their efficacy and safety. High-quality, evidence-based mobile applications for weight loss/management need to be created and evaluated by a team that includes developers, researchers, doctors, and patients before they are widely disseminated in commercial markets [14].

The quality and features of most App Store apps included in most research remain poor, despite the abundance and ease of access to weight management apps [15]. Information content has to be improved, and improvements to Arabic apps have been few. In general, we discovered that the content quality and graphic design of programs from the App Store are their weakest points. In addition, there is a lack of adherence to evidence-informed practices, with most apps including only one or two of the 13 recommended features. Future app developers should consider this functionality because app customers request the ability to speak with a specialist [15].

Self-monitoring, goal setting, action planning and control, boosting self-efficacy, and strategies that encourage autonomous motivation are among the most effective evidence-based behavior change tools for weight loss maintenance (WLM). Techniques for controlling emotions and stress can stop relapses and weight gain [16].

This study has two main objectives: (1) to understand the issues/challenges faced by the participants in their current weight management initiatives and (2) to understand the participants' experiences of using mobile weight management applications to manage their weight and expressed positive opinions about such programs. We examined the perspectives of overweight and weight-conscious individuals through online FGD.

This paper reports and discusses the findings of the FGD and is organized as follows. Section 2 describes the methodology employed in conducting the FGD. Section 3 discusses the results of the FGD, and Section 4 discusses the key findings and implications of the results obtained. Finally, Section 5 concludes the paper.

2. Methodology

FGD is widely utilized as a qualitative method to comprehend social concerns in-depth. Instead of using a statistically representative sample of a larger population, this approach seeks data from a carefully chosen set of individuals [17]. FGD allows the identification of users' requirements from the participants easily as participants feel comfortable discussing issues with someone experiencing the same problem. A thematic analysis technique for assessing

qualitative data involves looking through data collection to find, examine, and document recurring themes. It is a technique for summarizing data, but it also involves interpretation when choosing codes and creating themes. Thematic analysis may be used in various theoretical and epistemological frameworks, research topics, methods, and sample sizes. However, some academics have claimed that thematic analysis belongs to the category of ethnography [18]. Fig. 1 summarizes the research methodology that visualizes the study process.

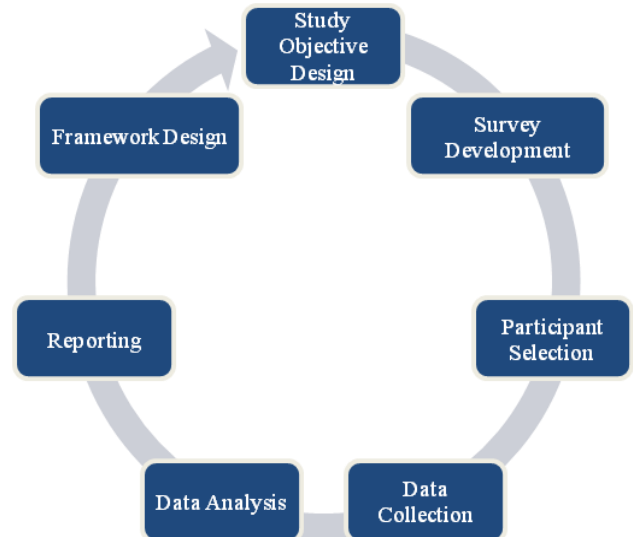


Fig. 1 Research methodology flowchart (The authors)

2.1. Participants

An online Google survey was distributed to Omanis for four weeks, with questions that screened their suitability to be recruited as participants and their interest in joining future discussions. A total of 30 participants answered the online survey and agreed to participate in future online discussions. These participants came from different sources, such as diet center members, related families, and social media. Based on the responses gathered from the survey, only 25 respondents were selected and invited to participate in the FGD. A total of 5 participants were eliminated from the selection process due to poor feedback and their unwillingness to be part of FGD due to privacy reasons. Participants were selected from various age groups, genders, and experiences with weight management and were either overweight or currently undergoing weight management based on self-reporting during the online survey for selection. Table 1 shows the demographic profile of the FGD participants. Weight status was classified on the basis of participants' feedback, with no BMI classification information provided. In addition, participants who were engaged in diet centers or gym centers to manage their weight are classified under the "Engagement in a Weight Management Program" category.

Table 1 FGD participant demographics (The authors)

Category	No. of participants (%)
Age range (years)	

Category	No. of participants (%)
18–24	2 (8%)
25–34	7 (28%)
35–44	10 (40%)
45–54	5 (20%)
55–64	1 (4%)
Gender	
Male	22 (88%)
Female	3 (12%)
Weight status	
Overweighed	4 (16%)
Engagement in a weight management program	21 (84%)

2.2. Procedures

FGD was conducted with 25 participants divided into five groups (5 participants each) via online Microsoft Teams from January to March 2022. The participants were divided into groups based on age group as 4% from each range. The online FGD lasted for approximately 45 min to an hour and a half per group. A short introduction was provided at the beginning of each FGD session to explain the aim of the study. Seven open-ended questions were used to prompt the discussion based on the discussion with the diet expert. A moderator was selected from a diet center on the basis of their experience with diet programs. The role of the moderator was to ask questions only to stimulate and facilitate the discussion session. The participants were encouraged to provide their comments and opinions throughout the discussion. The outcome of FGD helped determine the essential features to be included in weight management mobile applications. Informed consent was obtained from all participants. In addition, during the online survey for the participants' selection process, the participants had already stated their willingness to join any future discussion.

2.3. Data Analysis

All FGDs were video recorded and later transcribed for analysis using thematic analysis. Thematic analysis was employed because it is a suitable and effective technique for comprehending a collection of experiences, ideas, or actions within a body of data [18]. Although it is a technique for representing data, the selection of codes and the development of themes involve interpretation. One of its distinguishing characteristics is the ability of thematic analysis to be employed within several theoretical and epistemological frameworks and applied to various study questions, designs, and sample sizes [18].

The facial expressions during the discussion were also observed and considered while interpreting the data because they can provide the impression of negative and positive feedback shared during the session. However, because not all participants were willing to turn on their cameras during the discussion, data on facial expressions can only be made on those

who had their cameras on.

The first stage was the familiarization stage to examine the data. The audio records were transcribed into text and read several times to understand the data. The verbatim technique was used to translate audio into text. We examined the participants' distinctive experiences by reading verbatim transcripts of qualitative research interviews. We designed a template table based on the questions. The next step involves coding the text into theoretical codes based on emerging themes. The third step was to look into common themes across each code that are significant with the data. The final step was to finalize the themes to ensure data alignment and no overlapping themes.

3. Results

From the analysis, the following seven themes emerged from the FGD: lifestyle, behavior, social support and social factors, technology, education and awareness, motivation and commitment, and online support and coaching. In addition to the identified themes, the findings from FGD highlight mobile technology challenges and recommended features for weight management applications.

3.1. Identified Themes

3.1.1. Lifestyle

Most participants claimed that they were aware of the need for lifestyle changes to monitor and manage their body weight and food consumption. The number of meals taken, the number of calories consumed, the amount of exercise performed, and the hours of sleep are essential measures to consider in achieving a healthy lifestyle. One participant said, "I gained weight by eating so much food with high calories and sugar while working at the office desk." Another participant had the issue of organizing meal timing, especially when starting a new job. Most participants agreed that a lack of physical activity leads to being overweight. Changes in lifestyle at different stages of life, such as starting a new job, getting married, or a newborn in the family, cause them to live a busy life with less time for exercise.

Six participants reported that meal and sleep management are critical to controlling weight. Trackers such as sleep reminders, food quantity, and calorie intake are useful for managing weight. In addition, they claimed that the availability of gyms, fields, and other relevant facilities nearby for physical activities is essential to living an active lifestyle. Otherwise, people will need to drive long distances to look for such facilities to stay fit, which may demotivate them from staying physically active. Eating at irregular times and sleeping less than usual were also identified as contributing causes of obesity.

Furthermore, the rising usage of meal delivery

services and the time spent playing video games have contributed to a sedentary lifestyle. Taking charge of one's lifestyle by controlling the quantity of food consumed and doing sufficient exercise was mentioned as the best way to reduce or maintain weight. One participant shared that fathers should be role models for their families to exercise regularly and eat healthy food. Self-discipline is necessary to live a healthy lifestyle. Table 2 shows quotes from the participants' feedback on lifestyle.

Table 2 Supporting quotes for lifestyle factors (The authors)

Meal Management

- 1 "Eating late meals as my full day was busy with work and family."
- 2 "Due to my career change, I am working in the private sector and eating randomly because I don't have proper break time."
- 3 "I am eating randomly and sometimes more than four meals."

Time Management

- 1 "I am working at a desk for a long time, and this is affecting my time management."
- 2 "I have difficulty in managing sleep timing, and sometimes, I am sleeping late."

Environment

- 1 "We have less nearby facilities such as gyms and walk streets to have an active lifestyle."
- 2 "The weather is almost hot during the year, and this affects doing outside activities."

Physical Activity

- 1 "Lifestyle changes such as when they get married as time used for physical activities is less and commitments are more."
- 2 "I am holding an inactive lifestyle and doing fewer physical activities."

3.1.2. Behaviour

Several behavioral factors lead to an unhealthy lifestyle, such as physical inactivity, junk food consumption, and insufficient sleep. The participants emphasized that positive behavior toward a healthy lifestyle is affected by several factors, including stress, food consumed, and body measurement control level. Sitting at a desk at work for long periods causes stress, as expressed by four participants. The other four participants shared that they were stressed due to increased life responsibilities and duties. Stress often causes most diseases and contributes to obesity [20].

A minority of participants agreed that being away from home for an extended period increased the consumption of junk food, carbs, and sugar. Having less time to exercise and control food intake also impacts behavior. One participant said, "I changed my job career from the public sector to the private sector, and my work hours increased. I had less time for physical activity and ate more junk food". These behavior shifts experienced by the participants are due to changes in working hours, new responsibilities, and time availability.

One participant also mentioned uncontrolled eating habits. Ideally, one should grasp how one's behavior

impacts one's health in the long term and make the necessary changes, such as following a suitable diet and exercise plan. It is helpful to keep track of daily food consumption (e.g., type of food and the time it was eaten), which would help one become more conscious of inadvertent eating. Keeping the main goal in mind, such as losing weight or improving your health, and figuring out how to get there can be daunting. Staying focused on the goal and making simple tweaks to one's routine can significantly impact one's health. Table 3 shows quotes from the participants' feedback on behavior.

Table 3 Supporting quotes for behaviour factors (The authors)

Stress Impact

- 1 "I have work stress, which causes me to eat unhealthy food with random meals."
- 2 "Having many responsibilities leads me to life stress and affects my food intake and sleep time."
- 3 "Stress increases cortisol hormone levels and affects sugar intake."

Food Consumption Control

- 1 "I have uncontrolled eating habits that cause me weight gain."
- 2 "Control food consumption in case of behavior change."

Body Measurement Control

- 1 "Being away from home for a long time reduces time to do exercises."
- 2 "I changed my career, and this has caused me to take less care of my body weight gain."

3.1.3. Social Support and Social Factors

Social support is critical for achieving health goals. Social support refers to having assistance from other people, mostly as social network support. Support can be emotional, informational, companionship, tangible, such as financial support, or intangible, such as personal advice.

Nine individuals stated that they needed social support from family members, friends, or groups of people to manage their weight. Participants shared that the mindset toward exercise or physical activity of family members and nearby relatives influences one another. One participant said, "As a role model at home, I often engage my family in physical activity. We can influence the attitudes of others toward healthy living, especially those living nearby." They claimed that people might inspire or discourage others in various areas of life, including diet and fitness.

Furthermore, participants mentioned that group competitions would motivate them to exercise more to achieve their fitness targets. Group competitions, such as weight loss challenges, can also be initiated within an organization involving a small group of employees. Winners should be rewarded for encouraging people to exercise more and eat healthier foods. In addition, advice from others based on their own experiences that help in engaging in an appropriate diet plan is beneficial. Family and group encouragement and competition are primary forms of social support that can influence one's willingness and desire to maintain a healthy physique.

However, social factors are the primary drivers of weight gain and lack of physical activity. Social factors can be defined as matters that affect behavior and lifestyle in terms of health, habits, income and level of education. For instance, Omani families often organize social gatherings and events regularly. During these events and gatherings, traditional foods containing high amounts of calories and carbohydrates are consumed. Social relationships and customary family gatherings make it difficult to stick to a diet plan.

3.1.4. Technology

During the FGD, four participants shared that the rapid use of technology and mobile applications causes an inactive lifestyle, leading to weight gain. Food delivery apps also make ordering food easier. The participants also shared their past experiences with mobile weight management applications. The participants claimed that most of these mobile weight management applications are primarily built for marketing and profit-making without considering the long-term effects and impacts on health. Authorities should verify these apps for weight management to ensure data integrity and security. One participant shared, “The government should verify available apps for weight management to ensure that the contents are valid.” Although numerous weight management apps exist, there is a lack of evidence that users are following a good diet and health plan and making progress. Data privacy can be compromised when data on daily meals are fed into the apps and used for other purposes, such as advertising or big data analytics. In addition, most apps provide indicators if the captured data falls within the obese range but without a remedy to achieve a healthy diet. Certain apps also provide coaching services, which can be risky unless the services are carefully designed and authorized to play such a role. In addition, weight management apps are mostly designed for Western countries. Therefore, the suggested meals may not be suitable for people in other countries. As one participant mentioned, “Multi-language interface with an Arabic option and content should be developed.”

3.1.5. Education and Awareness

Participants shared that most people lack knowledge about nutrition and physical activity. Most people eat randomly without being aware of the number of calories and sugars contained in each meal. Even at the public level, the availability of such information is almost non-existent. There is also a lack of understanding about obesity and calories because it is rarely taught in schools. Some participants claimed that even nutrition centers have poor knowledge of diet because their target is to sell products. There is a lack of credibility in weight management information found on the Internet. Participants are skeptical of

information presented in applications because it is typically released without professional review. Most of this information is published by non-healthcare professionals and should be verified and published by nutrition specialists.

People must be educated on nutrition and fitness. Most participants were concerned about the effect of their weight on their health because obesity causes diabetes and other diseases. People should also be taught about the connection between calories, body harmony, and hereditary factors such as the thyroid gland. One participant shared, “Special interface in an app that gives education in such Ketogenic diet.” It is essential to ensure that the diet plan recommended by mobile applications for managing obesity considers the medications people take. Health-related apps should consider measures to ensure that language is not a barrier for users, and medical terminology should be supplemented with information to aid comprehension.

3.1.6. Motivation and Commitment

According to the participants, several factors motivated them to control their weight. Participants frequently indicated that being healthy was the primary reason for weight management. They generally desire to lose weight through diet and exercise routines and assist family members and friends in attaining an ideal body. Lack of motivation, which contributes to weight gain, is mainly caused by participants’ lack of clear targets and planning. Several participants claimed that being on a diet plan for a long period is a big commitment. Participants noted that strong willingness and commitment are the most challenging aspects of weight control. One participant expressed, “Family motivation is essential in the stage of weight management, which gives support.”

Another point was that self-motivation forces the person to keep going with a target that can be achieved. As mentioned by one participant, “The personal desire of people to lose weight in terms of eating and sporting regimen and encouraging family members and friends to get an ideal body free from health problems that cause weight gain.” The primary motivators and incentives that drive people to use a weight management application system are mainly being healthy and having a good body shape.

3.1.7. Online Support and Coaching

Participants shared that online support is an essential part of weight management applications. Professionals, such as coaches or nutrition specialists, can advise on proper diet and regular physical activity depending on lifestyle. Special online coaching may motivate people to lose or control their weight because most users will continue to use the applications if they obtain such benefits. Likewise, online psychiatric consultation can advise users on an alternative

approach to relieving stress rather than indulging in food. Professionals can also inspire users to maintain an active lifestyle and never give up.

Training apps could include physical exercise videos to guide users through physical activities correctly. Participants agreed that having a nutritionist online is preferable to visiting one in person. Online coaching includes various features, such as online group exercises, online lessons, and competitions. Eight participants agreed that online coaching and expert advice are vital features of weight-loss solutions. As part of this, online specialists can follow up with users to ensure that they are following the established plans. One participant shared, "Having an online nutritionist for weekly consultancy will ensure that you are on the correct track with food consumption and physical exercise." It would be more cost-effective for users to meet nutritionists and trainers online rather than in person.

3.2. Mobile Technology Challenges and Recommendations

This section identifies challenges and recommended features associated with mobile technology for weight management applications.

3.2.1. Challenges

Participants shared their experiences with existing weight management application systems. Smartphone applications mostly face difficulties because at the moment, healthy persons are somewhat interested in apps that assist changes in behavior connected to health. The use of apps was significantly influenced by accuracy, authenticity, security, effort required, and instant effects on mood [21]. The capacities to log and monitor behavior and objectives and obtain guidance and information "on the move" were valued [21]. Table 2 shows participants' quotes on the challenges they experienced when using smartphones for health.

Calories management was noted as challenging based on physical activities and food intake. Calories data should be managed by the app interface to have clear statistics. Because there is a clear relationship between the number of calories and the required physical exercises, managing such data is challenging for most users.

Another point was the accuracy of feedback-based data entry. Data available in the application was marked as challenging because no validation was performed on the application information. Data privacy is a challenge for users as they claim that some apps use user data for advertising purposes. This scenario leads to the absence of trust in the apps as they target revenue rather than benefits. Data accuracy is based on users' feedback, as apps mostly provide information and feedback without validating such data. In addition, most plans and targets are based on untrusted data, which should be managed by experts such as nutrition

specialists.

Moreover, the language barrier was highlighted. Difficult words with terminologies lead to an unclear understanding of the app's content. The cost of the application compared to its benefit was also mentioned as a challenge, as users expect to benefit from paid services and data. Participants also claimed that apps are catalog-based and not based on users' health profiles or characteristics. Apps should have profile-based targeted content to have a suitable plan and target. User trust in the app is challenging because most users claim that useful free apps are mostly non-existent. The absence of app notifications and alerts that manage food intake with high carbohydrates is a challenge. Alerts can help users manage their daily activities and make clear plans.

Knowledge and information available in the app should also be clear and understandable as some apps provide international meals, which are difficult for local Omanis to prepare.

A prior qualitative study on the difficulties of using health apps to promote changes in behavior revealed that users generally perceived health apps to be time-consuming, unexpectedly expensive, and lacking the option to consult an expert [7].

Table 4 Supporting quotes for challenges in using weight management mobile applications (The authors)

Calories Management	
1	"Calories management based on meal and physical activities."
2	"Calories data should be managed to have clear statistics of food intake."
Accuracy of the Feedback	
1	"The accuracy of feedback from the application is an essential feature that is much needed."
2	"Knowledge and information available in the application without any validation."
Data Privacy	
1	"Misinterpreting the data, I feel that the systems share my data for advertisement."
2	"Data privacy is the main challenge that leads to distrust of the application."
Data Accuracy	
1	"Sometimes, the application equalizes itself as a coach, and it understands nothing about weight management."
2	"Apps have no such personalized plans with clear targets that fit user needs and expectations."
Language Barrier	
1	"Arabic interface is not found as part of current apps that are free or with cost."
2	"The app designed includes difficult words and terminology, which are difficult to understand."
Cost versus Benefit	
1	"App cost compared with benefits gives fewer expectations and outcomes."
2	"The application cost compared to benefits is the most challenging part."
Profile-Based Targeted Content	
1	"The apps programed with the catalog are not based on user profiles as off-the-shelf programs."
2	"Special profiling based on user demographics and situations."
User Trust	
1	"Currently, there are no such usable free apps that can help."
2	"There are no customized apps that serve personal needs."
Notification and Alerts	

Continuation of Table 4	
1	“Application to notify me during incorrect food intake with high carbohydrates.”
2	“Alerts should be provided daily to manage clear plans for exercises.”
Knowledge and Information	
1	“Some apps give international meals difficult to cook.”
2	“App language with difficult words and terminology.”
Ease of Use	
1	“Ease of use, such as performing muscle exercises and weight bearing.”
2	“Friendly interface to ease use.”

Table 5 summarizes the challenges of the existing weight management application systems. The biggest challenge was the cost of the app compared to its benefits, as users spend a lot of money using the app, but the contents are not meeting the user’s expectations. Accuracy of data and feedback were the second and third challenges most frequently mentioned by participants. Data is critical for users to gain trust and continue using the app. In addition, data privacy and language are the next challenges shared by participants. The Arabic interface is important because some people know little about the English language and terminology. Moreover, many important features are missing, which indicate challenges for the users in most apps, such as accurate calorie management and ease of use. Profile-based targeted content would use data from a user profile to suggest a specific target plan.

Table 5 Weight management application system challenges (The authors)

Challenges	Number of Participants	Percentage
Cost versus Benefit	8	32%
Data Accuracy	8	32%
Accuracy of the feedback	6	24%
Data Privacy	6	24%
Language Barrier	6	24%
Calories Management	4	16%
Notification and Alerts	4	16%
User trust	4	16%
Knowledge and Information	4	16%
Profile-based Targeted Content	4	16%
Ease of use	4	16%

3.2.2. Recommendations for Essential Features

Participants shared essential features that they found useful in the current weight management application systems. Table 6 shows the participants’ statements about the essential features of a weight management application.

Table 6 Recommendation of features to include in weight management applications (The authors)

Notifications and Alerts		
1	“The application should notify you if you consume more calories than you should and provide advice on required physical exercises.”	
2	“Notification and alerts are important features in any app so	

that users can monitor their weight daily.”		
User Profiling		
1	“Profiling features for age, gender, weight, and level of physical activity.”	
2	“The app should ask what your main target is for using the app, such as losing weight to be healthy or looking good.”	
Online Support		
1	“Online nutrition and specialists to provide proper food and daily physical activities based on lifestyle.”	
2	“The app should have an online psychiatrist specialist who can advise me on how to avoid eating more food when stressed.”	
Online Experts		
1	“Online experts, such as coaches or nutrition specialists.”	
2	“Experts with certified lessons who guide you on a weekly basis via live or online coaching.”	
Physical Exercise Management		
1	“Time consumed based on the walking period.”	
2	“Physical exercise causes you to burn calories.”	
Monitoring Behaviour		
1	“Monitoring changes in behavior caused by stress and lifestyle changes.”	
2	“Controlling food consumption when stressed or changing modes.”	
Calories Management		
1	“Define daily calories for each meal.”	
2	“There is a relationship between food and water consumption.”	
Data Dashboard		
1	“Monitoring daily activities as the main interface of the application.”	
2	“Dashboard for daily exercise in each application and monthly dashboards for all physical activities with the number of calories lost.”	
Meal Management		
1	“Daily meal setup for the whole day.”	
2	“Meal management based on personal lifestyle.”	
Meal Ingredient Measure		
1	“A measure of the meal ingredients and sugar is required.”	
2	“Application should be able to identify meal ingredients.”	
Healthy Recipes		
1	“Healthy recipes should be part of mobile applications.”	
2	“Knowledge available for healthy food.”	
Teaching Healthy Cooking		
1	“Teaching how to cook healthy food.”	
2	“The application should provide good alternatives to food cooking.”	
Multi-Language Interface		
1	“Friendly interface to ease use with such options.”	
2	“Multi-language interface with Arabic option.”	
Online Coaching		
1	“Online coaching for some exercises that require skills.”	
2	“Online nutrition and specialists to provide proper food and daily physical activities based on lifestyle.”	
Reward		
1	“System of rewards based on achievements.”	
2	“And award prizes to the winner of each competition.”	
Recommendation		
1	“The system should give advice on food intake.”	
2	“Predefined tips and advice based on data entry.”	
Group Competition		
1	“Group with a team and a common classification.”	
2	“Group competition and challenges, even within an organization with a group of staff.”	
Auto Data Entry		
1	“Auto data entry rather than manual entry, such as using small chips to give accurate data.”	
2	“Smart apps so that users can take pictures of the meal and understand the number of calories ”	

Continuation of Table 6

Education Interface

- 1 “A unique interface that provides information on ketogenic diets.”
- 2 “Education interface that has special information about diet plans.”

Target Plan Based on the User Profile

- 1 “Target plan based on data entry of the user’s weight and length.”
- 2 “Customised diet plan based on the patient’s profile, such as age, weight, medical history, experience level, and living location.”

Essential features were identified based on participants’ feedback and coded into themes and sub-themes. Themes were chosen based on the information technology features found in weight management mobile applications. Table 7 summarizes the categories of identified features that are essential to be incorporated in any weight management mobile app.

Table 7 Feature identification by category (The authors)

Category	Identified Features
Feedback and reminders	Notifications and alerts
Custom interface	Recommendations
	User profiling
	Multi-language interface
	Auto data entry
Online support	Target plan based on the user profile
	Online experts
	Online coaching
Exercises management	Physical exercise management
Monitoring	Monitoring behaviour
	Data dashboard
Calories management	Calories management
	Meal ingredient measure
Meal management	Meal management
Teaching	Healthy recipes
	Teaching healthy cooking
	Education interface
Rewards	Rewards
	Group competition

The features that are highly mentioned are notifications and alerts, user profiling, and online experts, followed by physical exercise management and monitoring. Features least mentioned by the participants are auto data entry, education interface, and target plan based on user profile data.

Notifications and alerts have garnered the most attention because participants perceive this feature as critical for improving control over daily food management, sleep time, and physical exercise. People typically need to be notified to have greater control over their eating habits and reminders to exercise regularly. Participants believe that people require a personalized diet plan based on their profile, including age, weight, medical history, experience, location of residence, and culture. Participants proposed that the app include Online Experts features, noting the importance of having access to nutrition experts with certified lessons that provide weekly counseling based on weight management progress and goal accomplishment.

Fig. 1 shows that Notifications and Alerts has the highest percentage among all the features. This observation indicates that such a feature is essential in weight management applications. Next was User Profiling, which represented approximately 40% of the total. Being on target and having a clear plan are necessary for such a category. The percentage of Online Support is also 40%. Online support leads to clear target plans with continuous monitoring and observation. Monitoring Behavior shows a good percentage as weight is affected by personal attitudes and lifestyle.

4. Discussion

Finding effective strategies to encourage behavior change and boost motivation in the population with low adherence or for whom the applications have not been beneficial appears to be one of the most serious issues with the use of mHealth applications [4]. Any weight management intervention, whether in person or through mHealth (mobile health applications), must focus on behavioral elements, including self-monitoring and customised feedback. By maximizing these, the current technology would be much more effective at managing weight than any technical advancement [4]. The findings also indicate that users, especially young individuals, would find features that assist them in creating personalized goals, such as the number of calories they should be consuming per day, beneficial. Many applications now include features such as barcode scanners and personalized routines to make food and exercise reporting quicker and simpler for young people, which increases the effective use of these applications [19].

Results from the FGD indicate that most participants were persuaded by the community to have and use a weight management application system to assist them in managing weight and preventing obesity. In addition, participants believed that such technology would aid in managing their behaviors toward a healthy lifestyle. Weight management application systems can function as integrated systems, providing many features to help users achieve their health goals. From the FGD participant demographic data, we discovered that a few participants were overweight and unaware of the consequences of being in that state of the body. Carefully designed weight management application systems can educate and prevent them from developing life-threatening diseases. When personalization is based on a user’s profile and lifestyle, such systems will be an effective tool for preventing obesity and managing weight.

In addition, lack of education and awareness was part of the study outcome, which indicates the main factor behind the increase in obesity and overweight. Motivation and commitment are influenced by several variables that are mostly related to weight management and control, both in terms of the knowledge that is

available in mobile applications and the accuracy of this data. Strong willingness and commitment are the most challenging aspects of weight control.

The lifestyle theme indicated that life changes impact weight management and control. Behaviour changes can affect weight control and should be part of the mobile application for weight management. In addition, social support and social factors primarily affect weight control and maintenance. The technology theme discussed the effects of new technologies on data accuracy and application development. App development affects data privacy and usability, for example.

Furthermore, having an online consultation with experts and coaching is advantageous for responding to users' inquiries instantly and at any time. This feature mainly benefits shy or unconfident individuals looking for help or discussing something in person. Online education would be beneficial because it aids users in gaining a wealth of knowledge and increasing awareness in society, which can lead people to live healthy lifestyles. A customized system that suggests food based on ingredients and calories would aid in weight management. If the user consumes more calories, the system sends a notification alert.

Moreover, challenges and recommended features have been identified in this study. Several challenges were based on the participants' current experience with mobile technology for weight management applications. These identified challenges should be addressed and serve as guidelines to improve the development of future mobile applications for weight management. In addition, participants recommended essential features that should be included in the mobile application. Such features will help manage weight in terms of physical exercises, calorie management, and other aspects such as monitoring, competition, and ease of use.

5. Conclusion

Research and application of mobile health interventions for obesity management are ongoing. Some studies argue that mHealth technology (mobile health) facilitates scaling interventions and making them accessible to the broader community [4], but the evidence is mixed and not entirely compelling.

Obesity is still prevalent, and existing solutions generally lack features that encourage long-term use. We gaged the perspectives of overweight and weight-conscious individuals using online FGD. Respondents shared their insights and experiences that would aid in establishing the needs and requirements for realizing innovative approaches for managing weight and preventing obesity. Several themes emerged from the FGD, highlighting users' challenges in using mobile weight management applications, and features addressing these challenges were discussed. These

challenges highlight opportunities to develop new mobile applications for long-term weight management.

One of the most pressing problems with the usage of these apps is the lack of effective techniques to stimulate behavior change and enhance motivation in the subset of the population with poor adherence or for whom the applications have not been useful. The recommended features should be included in weight management mobile applications. Feedback and reminders are useful features because most user engagement depends on alerts and notifications. Moreover, custom interfaces with different options, such as target plans based on user profiles, were addressed in the results. In addition, online support and teaching are useful techniques in weight management. In addition, the results show that meal and exercise management are essential features. Rewarding and group completion play a vital role in any weight management application. It is crucial to design the application's interaction with the end user in mind while providing customized content based on user profiling and date input.

The obtained findings will contribute to the development of a design framework for sustainable mobile weight management applications to promote long-term weight management. The results obtained would enable application developers to design weight management apps that would meet the needs of health consumers in managing their weight.

Acknowledgments

We appreciate the time, patience, and insightful feedback provided by all participants in the FGD and expert review.

References

- [1] HRUBY A., & HU F B. The epidemiology of obesity: a big picture. *Pharmacoeconomics*, 2015, 33: 673–689. <https://doi.org/10.1007/s40273-014-0243-x>
- [2] A-MANSIA BIOTECH. *Obesity and diabetes in the world*, 2022. <https://www.a-mansia.com/obesity-and-diabetes-in-the-world>
- [3] EL GHOSH M., & FAKHOURY R. Challenges and new directions in obesity management: lifestyle modification programmes, pharmacotherapy and bariatric surgery. *Journal of Population Therapeutics and Clinical Pharmacology*, 2019, 26(2): e1–e4. <https://doi.org/10.15586/jptcp.v26i2.599>
- [4] GHELANI D. P., MORAN L. J., JOHNSON C., MOUSA A., and NADERPOOR N. Mobile Apps for Weight Management: A Review of the Latest Evidence to Inform Practice. *Frontiers in Endocrinology*, 2020, 11: 412. <https://doi.org/10.3389/fendo.2020.00412>
- [5] CLAASSEN M. A., KLEIN O., BRATANOVA B., CLAES N., and CORNEILLE O. A systematic review of psychosocial explanations for the relationship between socioeconomic status and body mass index. *Appetite*, 2019, 132: 208–221. <https://doi.org/10.1016/j.appet.2018.07.017>
- [6] SAINSBURY K., EVANS E., PEDERSEN S.,

MARQUES M., TEXEIRA P., and LÄHTEENMÄKI L. Attribution of weight regain to emotional reasons amongst European adults with overweight and obesity who regained weight following a weight loss attempt. *Eating and Weight Disorders-Studies on Anorexia, Bulimia, and Obesity*, 2019, 24(2): 351-361. <https://doi.org/10.1007/s40519-018-0487-0>

[7] ALJURAIBAN G. S. Use of Weight-Management Mobile Phone Apps in Saudi Arabia: A Web-Based Survey. *JMIR mHealth and uHealth*, 2019, 7(2): e12692. <https://doi.org/10.2196/12692>

[8] DOUNAVI K., & TSOUMANI O. Mobile health applications in weight management: a systematic literature review. *American Journal of Preventive Medicine*, 2019, 56(6): 894-903. <https://doi.org/10.1016/j.amepre.2018.12.005>

[9] BADAWI H. F., DONG H., and EL SADDIK A. Mobile cloud-based physical activity advisory system using biofeedback sensors. *Future Generation Computer Systems*, 2017, 66: 59-70. <https://doi.org/10.1016/j.future.2015.11.005>

[10] BAEZ M., NIELEK R., CASATI F., and WIERZBICKI A. Technologies for Promoting Social Participation in Later Life. In: NEVES B., & VETERE F. (eds.) *Ageing and Digital Technology*. Springer, Singapore, 2019: 285-306. https://doi.org/10.1007/978-981-13-3693-5_17

[11] MCKAY F. H., WRIGHT A., SHILL J., STEPHENS H., AND UCCELLINI M. Using health and well-being apps for behavior change: a systematic search and rating of apps. *JMIR mHealth and uHealth*, 2019, 7(7): e11926. <https://doi.org/10.2196/11926>

[12] ORJI R., ORJI F., OYIBO K., and AJAH I. A. Personalising health theories in persuasive game interventions to gamer types: an African perspective. *Proceedings of the Second African Conference for Human Computer Interaction: Thriving Communities*, Windhoek, 2018, pp. 1-12. <https://doi.org/10.1145/3283458.3283467>

[13] ORJI, R. Persuasion and culture: Individualism-Collectivism and Susceptibility to Influence Strategies. *Proceedings of the Personalisation in Persuasive Technology Workshop*, Salzburg, 2016, pp. 30-39. <https://ceur-ws.org/Vol-1582/16Orji.pdf>

[14] RIVERA J., MCPHERSON A., HAMILTON J., BIRKEN C., COONS M., IYER S., AGARWAL A., LALLOO C., and STINSON J. Mobile apps for weight management: a scoping review. *JMIR mHealth and uHealth*, 2016, 4(3): e5115. <https://doi.org/10.2196/mhealth.5115>

[15] ALSHATHRI D. M., ALHUMAIMEEDY A. S., AL-HUDHUD G., ALSALEH A., AL-MUSHARAF S., and ALJURAIBAN G. S. Weight Management Apps in Saudi Arabia: Evaluation of Features and Quality. *JMIR mHealth and uHealth*, 2020, 8(10): e19844. <https://doi.org/10.2196/19844>

[16] STUBBS R. J., DUARTE C., PALMEIRA A. L., SNIEHOTTA F. F., HORGAN G., LARSEN S. C., MARQUES M. M., EVANS E. H., ERMES M., HARJUMAA M., TURICCHI J., O'DRISCOLL R., SCOTT S. E., PEARSON B., RAMSEY L., MATTILA E., MATOS M., SACHER P., WOODWARD E., MIKKELSEN M. L., SAINSBURY K., SANTOS I., ENCANTADO J., STALKER C., TEIXEIRA P. J., and HEITMANN B. L. Evidence-Based Digital Tools for Weight Loss Maintenance: The NoHoW Project. *Obesity Facts*, 2021, 14(3): 320-333. <https://doi.org/10.1159/000515663>

[17] NYUMBA T. O., WILSON K., DERRICK C. J., and MUKHERJEE N. The use of focus group discussion

methodology: Insights from two decades of application in conservation. *Methods in Ecology and Evolution*, 2018, 9(1): 20-32. <https://doi.org/10.1111/2041-210X.12860>

[18] KIGER M. E., & VARPIO L. Thematic analysis of qualitative data: AMEE Guide No. 131. *Medical Teacher*, 2020, 42(8): 846-854. <https://doi.org/10.1080/0142159X.2020.1755030>

[19] STEPHENS J., MOSCOU-JACKSON G., and ALLEN J. K. Young adults, technology, and weight loss: a focus group study. *Journal of Obesity*, 2015, 2015: 379769. <https://doi.org/10.1155/2015/379769>

[20] VAN DER VALK E. S., SAVAS M., and VAN ROSSUM E. F. C. Stress and Obesity: Are There More Susceptible Individuals? *Current Obesity Reports*, 2018, 7(2): 193-203. <https://doi.org/10.1007/s13679-018-0306-y>

[21] DENNISON L., MORRISON L., CONWAY G., and YARDLEY L. Opportunities and challenges for smartphone applications in supporting health behavior change: qualitative study. *Journal of Medical Internet Research*, 2013, 15(4): e86. <https://doi.org/10.2196/jmir.2583>

参考文献:

- [1] HRUBY A., & HU F. B. 肥胖流行病学：大局。药物经济学，2015，33：673-689. <https://doi.org/10.1007/s40273-014-0243-x>
- [2] 阿曼西亚生物科技。2022年世界肥胖和糖尿病。 <https://www.a-mansia.com/obesity-and-diabetes-in-the-world>
- [3] EL GHOSH M., & FAKHOURY R. 肥胖管理的挑战和新方向：生活方式改变计划、药物治疗和减肥手术。人口治疗与临床药理学杂志，2019，26（2）：e1-e4. <https://doi.org/10.15586/jptcp.v26i2.599>
- [4] GHELANI D. P., MORAN L. J., JOHNSON C., MOUSA A. 和 NADERPOOR N. 用于体重管理的移动应用程序：对指导实践的最新证据的回顾。内分泌学前沿，2020，11：412. <https://doi.org/10.3389/fendo.2020.00412>
- [5] CLAASSEN M. A., KLEIN O., BRATANOVA B., CLAES N. 和 CORNEILLE O. 对社会经济地位与体重指数之间关系的心理社会解释的系统回顾。食欲，2019，132：208-221. <https://doi.org/10.1016/j.appet.2018.07.017>
- [6] SAINSBURY K., EVANS E., PEDERSEN S., MARQUES M., TEXEIRA P. 和 LÄHTEENMÄKI L. 欧洲超重和肥胖成年人在尝试减肥后体重反弹，体重反弹归因于情绪原因。饮食与体重失调——厌食症、暴食症和肥胖的研究，2019，24(2): 351-361. <https://doi.org/10.1007/s40519-018-0487-0>
- [7] ALJURAIBAN G. S. 沙特阿拉伯体重管理手机应用程序的使用：基于网络的调查。JMIR移动医疗和优健康，2019，7(2)：e12692. <https://doi.org/10.2196/12692>

- [8] DOUNAVI K., & TSOUMANI O. 体重管理中的移动健康应用：系统文献综述。美国预防医学杂志，2019，56(6)：894-903。 <https://doi.org/10.1016/j.amepre.2018.12.005>
- [9] BADAWI H. F., DONG H. 和 EL SADDIK A. 使用生物反馈传感器的基于云的移动身体活动咨询系统。下一代计算机系统，2017，66：59-70。 <https://doi.org/10.1016/j.future.2015.11.005>
- [10] BAEZ M., NIELEK R., CASATI F. 和 WIERZBICKI A. 促进晚年社会参与的技术。见：NEVES B. 和 VETERE F. (编辑) 老龄化与数字技术。施普林格，新加坡，2019：285-306。 https://doi.org/10.1007/978-981-13-3693-5_17
- [11] MCKAY F. H., WRIGHT A., SHILL J., STEPHENS H. 和 UCCELLINI M. 使用健康和福祉应用程序来改变行为：对应用程序的系统搜索和评级。JMIR移动医疗和优健康，2019，7(7)：e11926。 <https://doi.org/10.2196/11926>
- [12] ORJI R., ORJI F., OYIBO K. 和 AJAH I.A. 对游戏玩家类型的说服性游戏干预中的个性化健康理论：非洲视角。第二届非洲人机交互会议论文集：繁荣的社区，温得和克，2018年，第1-12页。 <https://doi.org/10.1145/3283458.3283467>
- [13] ORJI, R. 说服与文化：个人主义-集体主义和影响策略的敏感性。说服性技术个性化研讨会论文集，萨尔茨堡，2016年，第30-39页。 <https://ceur-ws.org/Vol-1582/16Orji.pdf>
- [14] RIVERA J., MCPHERSON A., HAMILTON J., BIRKEN C., COONS M., IYER S., AGARWAL A., LALLOO C. 和 STINSON J. 用于体重管理的移动应用程序：范围界定审查。JMIR移动医疗和优健康，2016，4(3)：e5115。 <https://doi.org/10.2196/mhealth.5115>
- [15] ALSHATHRI D. M., ALHUMAIMEEDY A. S., AL-HUDHUD G., ALSALEH A., AL-MUSHARAF S. 和 ALJURAIBAN G.S. 沙特阿拉伯的体重管理应用程序：功能和质量评估。JMIR移动医疗和优健康，2020，8(10)：e19844。 <https://doi.org/10.2196/19844>
- [16] STUBBS R.J., DUARTE C., PALMEIRA A.L., SNIEHOTTA F.F., HORGAN G., LARSEN S.C., MARQUES M.M., EVANS E.H., ERMES M., HARJUMAA M., TURICCHI J., O'DRISCOLL R., SCOTT S.E., PEARSON B., RAMSEY L., MATTILA E., MATOS M., SACHER P., WOODWARD E., MIKKELSEN M. L., SAINSBURY K., SANTOS I., ENCANTADO J., STALKER C., TEIXEIRA P. J. 和 HEITMANN B. L. 证据-基于数字工具的减肥维护：不如何项目。肥胖事实，2021，14(3)：320-333。 <https://doi.org/10.1159/000515663>
- [17] NYUMBA T. O., WILSON K., DERRICK C. J. 和 MUKHERJEE N. 焦点小组讨论方法的使用：二十年保护应用的见解。生态学与进化方法，2018，9(1)：20-32。 <https://doi.org/10.1111/2041-210X.12860>
- [18] KIGER M. E., & VARPIO L. 定性数据专题分析：亚美伊指南第131号。医学教师，2020，42(8)：846-854。 <https://doi.org/10.1080/0142159X.2020.1755030>
- [19] STEPHENS J., MOSCOU-JACKSON G. 和 ALLEN J.K. 年轻人、技术和减肥：焦点小组研究。肥胖杂志，2015，2015：379769。 <https://doi.org/10.1155/2015/379769>
- [20] VAN DER VALK E. S., SAVAS M. 和 VAN ROSSUM E. F. C. 压力与肥胖：是否存在更易受影响的个体？当前肥胖报告，2018，7(2)：193-203。 <https://doi.org/10.1007/s13679-018-0306-y>
- [21] DENNISON L., MORRISON L., CONWAY G. 和 YARDLEY L. 智能手机应用的支持健康行为改变方面的机遇和挑战：定性研究。医学互联网研究杂志，2013，15(4)：e86。 <https://doi.org/10.2196/jmir.2583>