

Obesity Management using Mobile Health Applications: A Case Study from Umm Al-Qura University, Saudi Arabia.

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ABSTRACT

Background: Health applications in mobiles have revolutionized self-monitoring strategies in weight management. These applications analyze and summarize health data of an individual in an easy-to-understand manner to meet specific goals of the users or patients. This study aims to find out the usefulness of health applications in smartphones to prevent obesity and maintain good health and fitness among students studying at Umm Al-Qura University (UQU).

Materials and Methods: A cross-sectional study was conducted on 195 students in UQU. Stratified-random sampling method was used, and a self-administered questionnaire was used for collection of data. Descriptive statistics (frequencies and percentages) were conducted. Also, the chi-square test of association was performed.

Results and Discussion: It was found that 22.05% of the respondents were overweight and 10.26% were obese. Different purposes and levels of use were reported by the participants. The participants' perceptions about Mobile Health Applications (believe in their effectiveness, believe in their privacy, purposes from using these applications (apps), and average use of these apps had significant associations with the participants' weight.

Conclusion: The health applications in smartphones have the potential to serve as an effective tool for the benefit of patients and individuals in the management and prevention of obesity. A good lifestyle coupled with BMI monitoring after specific periods can help to keep a better and healthy life.

Keywords: Obesity prevention, healthcare applications, smartphones, healthcare management, BMI

1. BACKGROUND

A healthy life and a good lifestyle are very important for all individuals. Obesity is one of the lifestyle diseases that most individuals are suffering from nowadays. Excess fat in our body can cause serious health consequences such as diabetes, high blood pressure, high blood lipids and various chronic disorders. Any person who has excess fat tissue and his body mass index (BMI) value is above 30 can be called obese [1]. The BMI is a tool that is used to measure normal weight or gained weight. Nowadays, mobile health is a very broad term used to describe how mobile communications techniques are used to provide health care to patients and to contribute to wellness improvement [2,3]. The mobile phone client provides the opportunity to enter the calorie consumption and outflow, view present caloric balance, lookup for food intake and activity data, monitoring past entry history, and fix daily reminder timings for prompts or alerts [4]. Mobile health applications are satisfactory, easy to use, and obliging in the quest for weight loss goals by individuals and patients and improvement of an individual's health status and fitness. They follow up on the physical health and fitness data of an individual and the vital signs to generate the health data of an individual [5,6]. These applications analyze and summarize this data in an easy-to-understand manner and provides illustrations, charts, and tips founded on the specific goals of users or patients and also help in prevention of obesity [7,8,9,10,11]. It also benefits the user's enthusiasm through positive feedback and incentives by sharing results on social media platforms and the benefit of personal training and individual follow-up. This study aims to find out the usefulness of health applications in smartphones to prevent obesity and maintain good health and fitness among students studying in the Faculty of Public Health and Health Informatics at UQU.

2. RELATED WORK

This segment provides a comprehensive review of literature for the use of mobile health applications to prevent various lifestyle diseases particularly obesity. All the articles that were published between the year 2000 to 2020 in numerous computerized databases, journals, authoritative texts, and hand searches were considered for this section. Initially, it brings out the perceptions about various research in the associated fields, thus revealing the contribution of this paper. A similar study was conducted to use some visualization tools and suggested a prototype system that used a smartphone with a fitted camera, having network connectivity, and integrated with image analysis providing an accurate account of daily eaten food and consumption of nutrients [12]. In another study, monitoring of real-time caloric balance was carried out using a mobile phone application called the Patient Centered Assessment and Counseling Mobile Energy Balance (PmEB) [13]. Another study [14] used an updated caloric reminder for the client, stored food, and information on activity, keeping updated data about the user's daily calorie intake and all this was server connected. This application called StepUp is a step counting application installed in mobile phones (sensor-enabled) and automatically counts the walked user steps. The key goal was to measure the quantity of user's daily activities and to enable a healthy competition thereby serving a source of positive feedback. One of the objectives in this study [14] was to analyze the factors influencing the acceptance of mobile obesity management applications, which they applied to the public as they used the mobile healthcare technology acceptance model. In the fourth study, the authors suggested an innovative weight loss intervention that integrates the theory with

mobile technologies that are emerging and will lead to increased weight loss due to improved behavioral compliance[15]. Another study tried to explore a system of mobile health for monitoring and assessment of diet called SapoFit. This application allowed recording of an individual's daily personal health information like food intake and his/her daily exercises and sharing this with a social network. [16]. In another study, weight management was used as an effective strategy for controlling chronic disease and maintaining physical health, recognizing prevailing evidence of mobile health technology and its efficacy in facilitating weight management activities, such as consumption of healthy food and physical activities. [17] Another study was undertaken with a purpose to create and test a smartphone application for obesity management based on clinical guidelines. The application developed in this study might be useful for weight management. However, further investigation was still required regarding the clinical effectiveness of this application [18]. A research study tried to test smartphones as a way to deliver key components of proven and empirically validated behavioral weight loss (BWL) care, with focus on self-monitoring adherence. [19]

3. MATERIALS AND METHODS:

Design and Sampling: This cross-sectional study was undertaken in the Faculty of Public Health and Health Informatics. This Faculty is situated in the Aziziya campus of UQU, Makkah, Saudi Arabia [20]. This Faculty comprises of 6 departments namely - Health Information Technology and Management department (HITM), Epidemiology department (EPI), Environmental Health department (EH), Health Education and Health Promotion department (HEHP), Health Services Management department (HSM) and Occupational Health and Safety department (OHS). The study participants included students studying in the second, third and fourth years of the four departments excluding OHS and HSM departments because no students had been admitted in these two departments when this study was conducted. The total number of students in the four selected departments was 637. Stratified Proportionate Random Sampling method (see table 1 below) was used in this study to draw a proper sample from this universe (student population). The selected student population represented two different campuses of the University, one in Aziziya and the other in Abdiya. The male students studied in the Aziziya campus, and the female students studied in the Abdiya campus. In this study, approximately 30% stratified proportionate random sample was chosen from the total student population of 637. Therefore, the final sample size was 195 students.

Inclusion Criteria: All the students who were studying in the Faculty of Public Health and Health Informatics at UQU. Both female and male students were included in this study to minimize the chances of gender bias.

Exclusion Criteria: The exclusion criterion was to exclude students who were doing their internship (compulsory training) in different healthcare organizations and no longer attend regular classes in the University.

Survey Development: The data collected in this study was done with a pre-designed and self-administered survey questionnaire. The questionnaire consisted of 3 sections and contained 26 questions. It contained questions regarding students' demographics, study departments, BMI, their

interest in mobile health applications, their uses for these applications, and perceived benefits after using these applications. The awareness about obesity and health practices, the reality of using mobile health applications, the benefits and usefulness of mobile health applications were also enquired. Few questions also intended to measure the prevalence of obesity amongst the community and know whether it is a risk- factor or not.

Validation: The survey questionnaire was reviewed by a faculty member with expertise in Epidemiology and Survey Research Methods to increase its content validity.

Recruitment: This survey questionnaire was programmed in Google Forms, a free survey administration software, and then the survey link was distributed among students through their class leaders in the four departments in the faculty. The survey was open for three months and students were reminded periodically to participate in this study.

Statistical Analysis: Descriptive statistics (frequencies and percentages) were performed and presented in the form of tables. The association between participants' characteristics and their weight was made using chi-square test of association. The statistical analysis was performed using Stata/SE 16.0 and the alpha was set at 0.05.

Table 1: Sampling				
Name of the Departments in the Faculty of Public Health and Health Informatics	No. of Male students in all the years of study	No. of Female students in all the years of study	Total number of students	Random Sample
EPI	76	0*	76	24
EH	53	0*	53	16
HITM	87	181	268	94
HEHP	67	173	240	61
			Total=637	Total=195
* No female students have been admitted into this department				

4. RESULTS

The study sample included 195 participants. The majority of the participants (97.95%) were between the age of 20-25 years, and most of them (63.08 %) were female. The department-wise distribution of the study sample showed that (48.21%) of the participants were from the HITM department, (12.31%) were from the EPI department, (31.28%) were from the HEHP department and only (8.21%) were from the EH department. Regarding the BMI, more than half of the participants

(54.87%) were maintaining normal weight, (22.05%) were overweight, (12.82%) were underweight and (10.26%) were obese. Table 2 below shows the demographic characteristics of the study sample.

Table 2: Demographic Characteristics of the Study Sample		
Total Number of Respondents	195	
	N	(%)
Age in years		
20 – 25	191	97.95
> 25	4	2.05
Gender		
Male	72	36.92
Female	123	63.08
Department of Study		
Health Information Technology and Management department (HITM)	94	48.21
Epidemiology department (EPI)	24	12.31
Environmental Health department (EH)	16	8.21
Health Education and Health Promotion department (HEHP)	61	31.28
Body Mass Index		
Underweight	25	12.82
Normal Weight	107	54.87
Overweight	43	22.05
Obese	20	10.26

Table 3 below is showing the participants' perceptions about Mobile Health Applications. The majority of the participants (98.46%) believed in the effectiveness of the Mobile Health Applications to help in maintaining good health, and a large portion of them (72.82%) believed in the apps' privacy and information security. Different purposes for using Mobile Health apps were reported by the participants. The highest percentage (31.28%) was reported for the purpose of calculating calories followed by monitoring weight purposes (26.67%), then exercising (22.05%) and eating regulations (15.90%). Also, different levels of use of these apps were reported by the participants. The highly reported level of use was the moderate level (39.49%), whereas the low level was the second (29.74%), followed by the rare use (16.41%) and then the high use (14.36%). In terms of the barriers that prevent people from taking advantage of/using these apps, participants thought that lack of interest and the apps are not commonly known for people were the common barriers, (35.90%) and (28.72%), respectively.

Table 3: Participants' Perceptions about Mobile Health Applications		
	N	(%)
Believe in effectiveness of Mobile Health Apps in Daily life		
Yes	192	98.46

No	3	1.54
Believe in the privacy of Mobile Health Apps		
Yes	142	72.82
No	53	27.18
Purposes from Using Mobile Health Apps		
Follow up on weight	52	26.67
Calculate calories	61	31.28
Eating regulation	31	15.90
Exercising	43	22.05
Other Activities	4	2.05
Not-users	4	2.05
Average Use of Health Apps		
High	28	14.36
Moderately	77	39.49
Low	58	29.74
Rarely	32	16.41
Barriers prevent People from Using Health Apps		
Expensive cost	44	22.56
Lack of interest	70	35.90
Difficult to use	25	12.82
Not commonly known	56	28.72

Table 4below shows the results of the chi square tests of association between participants' characteristics and their weight. The demographic characteristics (age and gender) had insignificant associations with participants' weight. Among the perceptions, believe in the apps' effectiveness, believe in the apps' privacy, purposes from these apps, average use of these apps had significant associations with participants' weight. Those who maintain normal weight were significantly more likely to be those who believed in the effectiveness of the apps compared to those who did not believe in their effectiveness ($\chi^2 = 10.773$, $p = 0.013$). Those who maintain normal weight were significantly more likely to be those who believed in the privacy of the apps compared to those who did not believe in their privacy ($\chi^2 = 8.775$, $p = 0.032$). Also, those who maintain normal weight were significantly more likely to be those who used the apps for purposes, regardless of the purpose ($\chi^2 = 34.158$, $p = 0.003$). Finally, those who maintain normal weight were significantly more likely to be those who highly or moderately use the apps compared to those who were low or rare users for these apps ($\chi^2 = 17.257$, $p = 0.045$).

Table 4:Comparisons between Participants Groups						
Variables	Body Mass Index (%)				Chi ² Value(χ^2)	p-value
	Underweight	Normal Weight	Overweight	Obese		
Age						
20 -25	12.57	54.45	22.51	10.47	2.093	0.553

>25	.0025	.0075	0.00	0.00		
Gender						
Male	5.56	54.17	26.39	13.89	7.152	0.067
Female	17.07	55.28	19.51	8.13		
Department of Study						
HIMT	15.96	44.68	30.85	8.51	15.804	0.071
EPI	8.33	66.67	12.50	12.50		
EH	0.00	56.25	25.00	18.75		
HEHP	13.11	65.57	11.48	9.84		
Believe in their effectiveness						
Yes	13.02	55.21	22.40	9.38	10.773	*0.013
No	0.00	33.33	0.00	66.67		
Believe in their privacy						
Yes	10.56	61.27	19.01	9.15	758.7	0.032 *
No	18.87	37.74	30.19	13.21		
Purposes from Using Apps						
Follow up on weight	9.62	53.85	32.69	3.85	34.158	*0.003
Calculate calories	8.20	50.82	16.39	24.59		
Eating regulation	16.13	61.29	22.58	0.00		
Exercising	23.26	48.84	20.93	6.98		
Other Activities	0.00	100.00	0.00	0.00		
Non-users	0.00	100.00	0.00	0.00		
Average Use of Health Apps						
High	10.71	64.29	21.43	3.57	17.257	0.045 *
Moderately	5.19	66.23	18.18	10.39		
Low	20.69	36.21	29.31	13.79		
Rarely	18.75	53.13	18.75	9.38		
Barriers prevent People from Using Health Apps						
Expensive	11.36	54.55	20.45	13.64	5.976	0.742
Lack of interest	18.57	52.86	20.00	8.57		
Difficult to use	8.00	64.00	16.00	12.00		
Not commonly known	8.93	53.57	28.57	8.93		
* p< 0.05, the significant level						

5. DISCUSSION

The present study findings offer important evidence that mobile health applications can be satisfactorily used for monitoring our health and fitness goals. The first part of the findings from the demographic characteristics of the study sample showed that the individuals were between the age range of 20-25 years and it consists of individuals from both the genders and from different disciplines in the

UQU. It was found that after considering the BMI, more than half of the study participants (54.87%) were maintaining a normal weight, (22.05%) were overweight, (12.82%) were underweight and (10.26%) were obese. This finding can be supported by another study done by Jeon et al. (2015) which also consisted of both genders and it indicated a high percentage of female participants having a high BMI as compared to male participants with regards to their age [21].

The second part of the findings reported that most of the participants (98.46%) believed in the effectiveness of the mobile health applications to help in maintaining good health. Also, a large portion of respondents (72.82%) believed that the applications' safeguarded their privacy and provided information security. The respondents had used these applications for different purposes like calculating calories followed by monitoring weight purposes, then exercising and eating regulations. The above findings are consistent with the findings of the study done by Kim and Seo (2020), where they reported evidence of improvement in weight control, physical activity, and BMI of young adults' after using mobile health programs [22,23]. The present study findings also reported different levels of use of these apps by the participants with highest reported level of use was for the moderate level followed by the low level, then by the rare use and finally by the high use of these applications. In terms of the barriers that prevented people from taking advantage of using these applications, participants stated expensive cost, lack of interest, difficult to use and the apps were not commonly known by the participants. These findings relate to the findings of Eunjoo et.al, (2015) which discussed some of the factors that affected the acceptance of smartphone applications for the purpose of obesity management [24].

The third part of the results tried to find out the association between some of the variables. The demographic characteristics (age, gender, and study department) had insignificant associations with participants' weight. However, the perceptions like believe in the apps' effectiveness, believe in the apps' privacy, purposes from these apps, average use of these apps had significant associations with participants' weight. Those who maintained normal weight were significantly more likely to be those who believed in the effectiveness of the apps compared to those who did not believe in their effectiveness ($\chi^2= 10.773$, $p= 0.013$) which signifies that these applications offered some benefits to the respondents because of which they were using it. Those who maintain normal weight were significantly more likely to be those who believed in the privacy of the apps compared to those who did not believe in their privacy ($\chi^2= 8.775$, $p= 0.032$). Also, those who maintain normal weight were significantly more likely to be those who used the apps for different purposes, regardless of the purpose ($\chi^2= 34.158$, $p= 0.003$). Finally, those who maintain normal weight were significantly more likely to be those who highly or moderately use the apps compared to those who were low or rare users for these apps ($\chi^2= 17.257$, $p= 0.045$). Various other studies [25,26,27,28] found that mobile phone applications were used for management of obesity and various comorbid conditions. Also, the above findings can be supported by a study done by Bennett et al. (2018) who attributed that obesity treatment digitally, combined with resources from the health care system, could lead to clinically meaningful outcomes for weight loss amongst socially weak and poor patients with high cardiovascular risk factors [29].

Therefore, we can suggest that the present study findings clearly show a statistical significance between the use of mobile health applications and BMI of the respondents. These findings were consistent with findings from the studies of Mateo et al. (2016), Thomas and Wing (2013), Juliana

etal.(2015) and Go'mez-de-Regiletal. (2020) where a difference in physical activity was observed between the two groups and suggested the benefits of these mobile health applications as well as the efficiency of these mobile health applications as a useful tool in reducing the obesity to a certain extent [30,31,32,33].

Our study has two main limitations. First, using a convenience sample of students studying at College of Public Health and Health Informatics at UQU could have created a sampling bias and lack of representativeness of students studying at UQU as well as the general Saudi population living in Saudi Arabia. The potential sampling bias and lack of representativeness could have limited the generalizability of the study's findings. The second limitation was the cross-sectional design of this study, which has a limitation of not being able to assess the causality. Despite these limitations, our study might contribute to the future research in the area of mobile health applications and their utilizations and effectiveness to prevent chronic diseases and maintain good health especially in the Kingdom of Saudi Arabia.

6. CONCLUSION

The health applications in smartphones have the potential to serve as an effective tool for the benefit of patients and individuals in the management and prevention of obesity. We can say that good lifestyle and BMI monitoring through mobile health applications after specific periods can help to keep a better and healthy life. These applications can be used everywhere and by all individuals who are interested in following their body weight with standard and brief results compared to other traditional methods. The emphasis is that obesity is an important risk factor that contributes to many chronic conditions, such as diabetes mellitus and hypertension, and if it is neglected, it will increase the burden on the health care system.

Conflict of Interest: None declared.

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