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Mobile Learning Impact on Blood Glucose Control among People at Risk of Type 2 Diabetes Referring to Ahvaz Diabetes Consultation Center

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Abstract

Aim: Type 2 diabetes is a preventable disease and can be prevented in people at risk by doing appropriate interventions and selecting new educational practices. Mobile learning is one of the modern educational techniques used for providing opportunities for the transmission of information, as well as strengthening and improving lifelong learning for learners. We aimed to investigate mobile learning impact on blood glucose control in people with type 2 diabetes referred to Ahvaz Diabetes Consultation Center.

Methods: This semi-experimental study was conducted on 60 samples selected by the random stratified sampling method. The subjects were divided into two groups: experimental group and control group. In this study, data were measured using the fasting blood sugar, DPS software and the demographic questionnaire. Before the start of the intervention, demographic profile and fasting blood sugar level were recorded in the relevant form. A designed software program was loaded on the cell phones of the experimental group. After three weeks, the blood samples were taken. Data were analyzed using the descriptive-analytical statistics tests. The significance level was considered to be less than 0.05.

Findings: The findings showed that the positive effect of implementation the training program by mobile learning method was statistically significant in the control of blood sugar in the experimental group ($P<0.001$).

Conclusion: Mobile learning is one of the modern educational practices that can be used to control blood glucose in people at a higher risk of type 2 diabetes. The use of educational technology can be considered as a good way to help the improvement of the health outcomes and behavior of people at risk for diabetes.

Keywords: Mobile learning, Type 2 diabetes, Ahvaz

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Introduction

Changes in people's lifestyle, phenomena such as urbanization and industrialization of communities, and changes in epidemiological diseases along with the increase in life expectancy of patients with non-communicable diseases have caused the dramatic growth of diseases like type 2 diabetes [1]. Diabetes is a common disease and one of the biggest health problems of all countries so that the World Health Organization (WHO) named it as a silent epidemic [2]. The importance of addressing diabetes is due to ignorance of about half of patients of their disease and its irreversible effects [3]. In 2012, the number of sufferers of the disease was 317 million people, which is estimated to rise to 552 million patients up to the year 2030 [4]. On the one hand, by increasing 122% of the population of patients with diabetes by the year 2025, and creating inestimable costs and short-term and late complications as the scourge of the recent century, more than 10% of the health care costs will be devoted to this disease [5].

Diabetes is not treatable but can be the prevented with a change in lifestyle, nutritional behavior and physical activity [6]. Generally, a society that has an increased obesity, large caloric intake, low physical activity, and few genetic contributing factors is associated with the increased prevalence of type 2 diabetes [7]. Diabetes requires especial self-care behaviors during the whole life [8], and studies have shown that only a small share of chronic diseases such as diabetes is treated by specialized measures, and the majority of diseases are managed by the individuals and the families [9]. Therefore, it is necessary for the health systems to make efforts in order to empower people for more controlling and improving their wellness [10] and thus strengthen the process of empowering people to their self-care [11]. In addition, to empower people in order to increase control over their health, it is necessary that appropriate tools be designed to promote and strengthen activities associated with self-care [10]. While the use of these tools in the self-care is relatively new, the role of communication technologies and information systems in accelerating and helping in the empowerment and training of people is irrefutable [12]. New technologies have split information, space, and distance at the time, and have destroyed physical boundaries by creating virtual communities and using electronic equipment [13]. Now that we are in the digital and wireless age, one of the aspects of communication technologies is mobile technology, which with 5.3 billion of subscribers all over the world, is the fastest technology adapted in the history [12]. The potential of learning at anytime and anywhere, gaining access to knowledge and data throughout the world, and no need for physical training like other communication technologies have entered into the teaching and learning areas and the realm of training in the form of mobile learning, and created the opportunity to provide a platform for easy and extensive publishing and exchanging of information at any time and place [14]. The most popular tool of mobile technology for mobile learning is a mobile phone [15]. The potential available on the cell phone platform can be a bridge for learning [16] and innovation in the health deliverable service cycle, which cause the shift of the role of the treatment to care and prevention [12].

The first research done in relation with mobile learning began in 2000. During 2002-2006, many studies were done and indicated the development of education, and to some extent, its Inclusiveness in most of the educational environments [17]. The study conducted by Sultan & Mohan showed that mobile learning could improve the self-care process in patients with type 2 diabetes [18]. The results of another study conducted by Pacaud revealed that learning through electronic media improves the clinical implications in diabetic patients [19]. Other studies indicated the positive role of this method in improving the clinical implications in diabetic patients [20, 21]. A limited research has been conducted in the field of mobile learning's role in the control of blood glucose in diabetic people in Iran. For example, a clinical trial conducted in order to show the impact of E-learning on the knowledge, attitude and practice of self- care in patients with type 2 diabetes in Kerman, the E-learning improved their knowledge, attitude and self-care practice, as well as their average blood glucose level [22]. In addition, in a clinical trial conducted by Borhani on patients in the Endocrinology ward in Valiasr Hospital in Tehran, the results showed the effect of the mobile software application in reduction of glycated hemoglobin in type 2 diabetic patients [23]. However, despite the many advantages of mobile learning, this type of learning in our country is faced with challenges, including a lack of sufficient specialists in designing mobile-based educational programs (M-learning), and lack of awareness of the benefits of this type of learning compared with traditional methods, as well as the negative attitude of the organization towards the learning [17].

Undoubtedly, advanced technologies must be used to join the convoy of science and the development in order to provide the field of production and distribution of information; also concurrent with the changes in the pattern of people's lives and the departure from the traditional formats in the education of public health, new methods must be used to deliver the message of health, and education must enter inside the people's houses and their place of work [12]. Therefore, this study aimed to investigate the impact of mobile learning on blood glucose control in type 2 diabetic people.

Materials and Methods

In this quasi-experimental study, the statistical society was all people (314 people) at risk of type 2 diabetes, referred to the Diabetes Consultation Center of Ahvaz in 2014. According to the inclusion and exclusion criteria, to collect data, 60 samples with the age range of 25-55 years, who had the ability to use the Android system based-mobile phones, did not have a training history of diabetes topics during the past three months, and were willing to participate in the study, were selected using a random stratified sampling method by the gender. Then they were allocated to the test and control groups.

Given that the number of women studied in the Diabetes Consultation Center of Ahvaz was four times more than men, so for every four women, one man was selected. In this way, the number of women in each group was 22 people and the number of men in each group was eight people.

Data collection tools included: measurement of fasting blood sugar, Diabetes Prevention Self-care software (DPS), and a written questionnaire. Data were collected by completing a questionnaire and doing a direct interview before and after the educational intervention. Before the start of the intervention, demographic profile and the level of fasting blood sugar were recorded in the relevant form. By a biochemical method, the level of fasting blood sugar was measured using the *ACCU-CHEK Active* (made by Roche Company, Germany) in the Diabetes Consultation Center of Ahvaz.

To know how to use the educational software by the users, at first, in the first week, a familiarizing stage was held for the samples during a one-hour session. In this session, the researcher introduced himself, specified the objectives of the study, clarified the different stages of the study, and described how to use the educational DPS software and how to contact with the researcher in the event of any problems during the study.

Address and telephone number of the subjects were taken in order to send the results to them, as well. Then the designed educational software was loaded on the cell phone of the subjects in the test group. Next its effectiveness was controlled on the phones of the test group. In collaboration with them, the use of the software was studied. The educational intervention lasted for three weeks, and during this period, the control group did not receive any training programs on behalf of the researcher, and were followed by the Diabetes Consultation Center only in accordance with current trends and care approaches. The content of this educational program was designed based on Android, which included five sections and contained information on the types of diabetes, signs and symptoms, risk factors, people at risk for the disease with emphasis on the role of nutrition, obesity, mobility, and smoking in causing diabetes, economic profits and losses caused by the disease, ways to prevent risk, and physical and lifestyle recommendations. In addition, in the software, the section "contact us" was designed to resolve potential problems during the intervention, as well as the ease of communication between the test group and the researcher.

The tool's validity was determined based on the content and formal validities. Thus, the researcher presented the software's content to 10 people of internal specialists and professors, and experts of health affairs of Ahvaz Jundishapur University. Using the comments and amendments proposed by them, the validity of the tool's content was approved. Then, for formal validity, the tool was presented to 10 persons at risk for diabetes, and necessary changes were applied.

The questionnaire used in this study had 13 questions with audience demographic information questionnaire include age, sex, the first time referring to the center, weight, height, growth rate in the first visit, a family history of the disease in first-degree relatives, and other demographic parameters.

After completing the restart of the intervention period, all subjects' blood samples were taken. Finally, the analysis of the information obtained before and after the study was done using descriptive statistical methods. In addition, to compare the two groups and to review the impact of mobile learning on controlling blood glucose, we used statistical inferences, including Covariance analysis test, Levene's test and SPSS software (ver. 22).

It is worth noting that after the end of the study, in order to observe the research ethics, the designed software was set on the cell phones of the people in the control group, and they learned how to use the software.

Results

A total of 60 people at risk for type 2 diabetes participated in this study. Among the samples, 26.7% were male, and 73.3% were female. The results showed that 90.18% of the samples in the test group and 83.8% in the control group were in the age range of 30 to 59 years. Most of the samples in the test (93.3%) and control (96.6%) groups were married. Education level of 10% of the test group and 20% of the control group was academic. All individuals participated in the screening plan of diabetes, which had been done in the year 2011, but they were not followed-up.

The results of the covariance statistical tests showed that both groups in terms of underlying confounding variables that can somehow affect the study results had no statistically significant difference; in other words, the two groups were homogeneous (P> 0.05) (Table 1).

Table 1: Demographic profile of the individuals at risk of type 2 diabetes referring to the Diabetes Consultation Center of Ahvaz

Variable		Test group		Control group	
		N	%	N	%
Age	Less than 30	1	3.3	2	6.6
	30-39	8	26.7	10	33.3
	40-49	11	36.7	7	23.3
	50-59	8	26.7	8	26.7
	More than 60	2	6.6	3	10
Gender	Female	22	73.3	22	73.3
	Male	8	26.6	8	26.6
Body mass index (kgm²)	18.5-24.9	0	0	0	0
	25-29.9	19	63.3	20	66.6
	30-34.9	7	23.3	8	26.7
	35-39.9	1	3.3	2	6.6
	Equal to or greater than 40	3	10	0	0
Marital status	Single	2	6.6	1	3.3
	Married	28	93.3	29	96.6
Job status	Employee	5	16.6	10	33.3
	Housewife	19	63.3	18	60
	Self-employment	3	10	1	6.6
	Retired	2	6.6	1	6.6
	Unemployed	1	3.3	0	0
Level of education	A fifth-grade student	5	16.6	7	23.3
	Elementary school	4	13.3	1	3.3
	High school	18	60	16	53.3
	Collegiate	3	10	6	20

The findings of the study showed that the mean and standard deviation of fasting blood glucose of the samples in the test group before the intervention was 116.53± 7.49, which decreased to 94.57 ±4.76 after the intervention. In addition, the mean and standard deviation of fasting blood glucose of the samples in the control group before the intervention was 115. 63± 8.81, which increased to 116.17±14.19 after the intervention. This difference between the two groups before and after the educational intervention was statistically significant ($p< 0.05$).

Covariance analysis results showed that the amount of impact or difference was equal to 55%. In other words, 55% of individual differences in the post-test scores of the blood glucose level were related to the impact of education by M-Learning method (Table 2).

Table 2: A comparison of the amount of blood glucose test scores between the two groups before and after the educational intervention

Variable	Group	Before educational intervention		After educational intervention		The test result
		Mean	SD	Mean	SD	P-value
Blood sugar levels	Test	116.53	7.49	94.57	4.76	P<0.001
	Control	115.63	8.81	116.17	14.19	P=0.477

Discussion and Conclusion

Mobile technology like other communication technologies has found application in education and learning [17]. This potential has been able to create new educational fields and realize target of training at any time and any place [16]. Pacaud pointed out that the use of electronic technology and M-learning improves blood glucose control as well as indicators and clinical implications in patients with type 2 diabetes. Others have shown that M-learning technology can be used to improve the quality of health services in people and enhance their quality of lifestyle [21].

The results of this study showed that the highest percentage of people at risk for diabetes in both groups belonged to women. According to a study conducted by Wild et al. regarding world's diabetes incidence, the rate of diabetes in women was more than men, which is consistent with the current study [24].

In relation to the impact of the intervention carried out on the blood glucose level, the results of this study showed that after the use of M-learning approach, in the test group, the average score of fasting blood sugar of people at risk for type 2 diabetes was dropped significantly.

This result is consistent with the results of Bassam et al.'s study on the impact of training through M-learning on reducing blood glucose in type 2 diabetic patients. In another study, Connelly et al. showed that after the use of the mobile phone-based manner, a decrease was seen in the blood sugar level in people with type II diabetes, which is consistent with the present study [25].

The results of a systematic study on the management of type 2 diabetes by cell phone showed that mobile learning can be used to reduce the blood glucose level in diabetic patients, which is consistent with the present study.

The results of this research are inconsistent with results of Scheibe et al.'s study on the impact of training through M-learning on the control of blood glucose in diabetic 50 years and above patients. The reason for this would be due to the lack of appropriateness of educational content and software to the target group or age requirements of the samples. According to the self-reports of the subjects in

Scheibe et al.'s study, functions offered through this educational method were not suitable for therapeutic needs, and were not homogeneous with the needs of the target group in terms of previous knowledge, age, the type of diabetes and its treatment [26].

In the present study, the educational content was designed based on the need of the test group using the new educational methods; and due to the attractiveness of educational method and high cell phone penetration rate, it increased the active role of the test group and put a positive training effect in the M-learning way in controlling blood glucose levels in the people at high risk of diabetes. So, it can be said that the changes in the fasting blood sugar levels in the test group have been caused by the intervention.

Conclusions

The results of this study showed that the use of M-learning caused blood sugar control in the people at risk for type 2 diabetes. It seems that an improvement in the blood glucose level in people at risk has been because of a change in the type of training, the people's increased active role in taking care of themselves and their increased motivation for learning. In addition, M-learning can cause efficiency and innovation in the health deliverable service cycle, as well as expansion and improvement of health care. Due to be inevitable training in the adoption of healthy behaviors in prevention of chronic diseases, especially diabetes, M-learning has created a valuable opportunity as data transfer tool in touch with the people. In this way, many people at risk or even patients within the geographical extensive scope can be educated. Furthermore, it can change training approaches, realize universal education, and be available to all recipients in the health service field. It is recommended that employees in the health system, by changing their policy and with a focus on M-learning, create a new learning environment that diversifies training. They can also, with the change from the current educational practices to the new educational approaches, take a positive and new step in the education field; this, in turn, would reduce the burden of disease cases and increase the health level of people, and consequently, the family and the community.

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