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Impact of Mobile Learning on Stress and Self-Efficacy among Diabetic Patients with COVID-19

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Abstract

Background:

Currently, the whole world is struggling with a crisis known as the COVID-19 pandemic, which has been proven as a highly fatal and contagious disease. Many diabetic patients who are currently recovering from the convalescence period of the COVID-19 disease face some other problems caused by this disease such as depression, loneliness, and stress, as well as lack of sufficient knowledge in self-care other than the physical and psychological problems that they have already experienced due to diabetes. Accordingly, this situation was particularly intensified since the existence of various and sometimes contradictory sources of information and the absence of media literacy provided the context for the emergence of anxiety and inability in making decisions on the accurate and appropriate use of the relevant information. The easy and

wide access to mobile services, including SMS service, has nowadays provided specific features, which could effectively serve in health interventions such as providing low-cost and available care for everyone.

Objectives:

This study aimed to explore the impact of mobile learning (m-learning) on the stress and self-efficacy among diabetic patients infected with the COVID-19 disease, with the hope to help them to improve their physical and mental conditions.

Methods:

The study population in this randomized clinical trial included patients with both types I and II diabetes who were infected with COVID-19. Accordingly, 70 eligible patients in terms of the inclusion criteria were enrolled in the study and then they were randomly divided into the intervention and control groups. During a 3-month period, three contents per week, including motivational items, daily care process, healthy lifestyle, nutrition, doing exercise, and warning signs about both diabetes and COVID-19 were sent to the intervention group, while the control group received no content in this regard. As well, we used the demographic Information Questionnaire, Perceived Stress Questionnaire, and the diabetes management self-efficacy scale to collect the required data. Correspondingly, these questionnaires were completed both before and after the intervention. Finally, the SPSS17 software and inferential statistics (including Chi-square, independent t-test, paired t-test, and Kolmogorov-Smirnov) were employed for data analysis.

Results:

The results of this study reveal the positive impacts of mobile learning on reducing stress and increasing the self-efficacy among diabetic patients infected with the COVID-19 disease. The studied subjects in both the intervention and control groups showed statistical differences in terms of stress and self-efficacy following performing the intervention, suggesting the statistical effectiveness of this intervention on the two variables of stress and self-efficacy ($P < 0.001$).

Conclusions:

Nowadays, providing training via mobiles (cell phones) seems to be more effective than employing other available methods due to some features such as availability, no time and space restrictions, and time- and cost-effectiveness. Of note, the patient's education is a core component of nursing care, and if it will be provided in a variety of ways and using available technologies, it can be very effective and efficient. Thus, we could use this method to improve self-efficacy and to reduce stress among diabetic patients infected with the COVID-19 disease.

Keywords: Mobile-learning (m-learning), Diabetes management self-efficacy; Stress

1. Background

According to the World Health Organization (WHO), Telehealth refers to the provision of health care applying technologies in all diagnosis, treatment, and prevention areas by all health care workers(1). In recent years, remarkable advances have been achieved in communication and information technologies. Moreover, new terms such as e-learning and m-learning were formed with the increased use of modern communication technologies. E-learning involves the use of information and communication technologies such as the Internet and multimedia systems, with the aim of enhancing the quality of learning through facilitating the access to educational resources and services as well as the provision of distance interactions and participation. Moreover, the capability of learning at any time and place is considered as one of the e-learning features, which has been better realized with the development of mobile learning technology. It is noteworthy that mobile learning is indeed an e-learning model, which takes place through many technologies such as mobile phones and tablets (2).

In December 2019, a new type of coronavirus, called SARS-COV-2, has been identified in Wuhan, China, with the increased referrals to medical centers by patients with pneumonia without any specific cause and with the failure of available treatments (5). The disease rapidly spread throughout China as well as other parts of the world, and ultimately considering the increased transmission levels and the enhanced strength and severity of the disease, it was declared a pandemic by the WHO on March 11, 2020(6). The disease has continued its increasing trend with the rising number of patients and its spread to 214 countries around the

world so far, and it still leaves casualties behind. Up to August 31, 2021, 217902943 people have been reported to be infected with the COVID-19 disease, of whom, 4,523,778 have lost their lives (7).

According to the findings of a previous study, those who were in quarantine, worked in high-risk environments, whose friends and relatives had contracted the coronavirus, and those who lost their sources of income due to the COVID-19 outbreak are two or three times more vulnerable to develop post-traumatic stress disorders (PTSD). Accordingly, this issue can consequently cause some problems concerning physical and mental health statuses on a global scale besides an extensive effect on each country's economy.

The risk factors of developing COVID-19 and the possible Complications were recognized by many researchers as follows: having coronary artery disease (CAD), diabetes, hypertension, hyperlipidemia, a history of stroke, and a history of renal diseases (9, 8, 3).

The relationship between diabetes and COVID-19 was described as “the confrontation between two pandemics” since diabetes is known as the most common chronic and non-contagious diseases. Moreover, it appears to be one of the risk factors for developing the complications related to COVID-19 and a higher rate of mortality (10). According to the IDF estimations, 463 million people currently have diabetes worldwide, and this number with a 51% growth rate is expected to reach 700 million people by 2045. Countries in the Middle East and North Africa (MENA), including Iran, are expected to face the highest rate of developing diabetes by 2045 (11). Up to now, many factors are identified with the potential to affect the control of diabetes, including psychosocial support, health beliefs and attitudes, self-efficacy, and both economic and social conditions (12). Following the diagnosis and during the treatment process of the disease, patients with diabetes are usually suffering from psychological symptoms and mostly report the experience of stress during the process of being adapted to their disease. Additionally, the stress and anxiety of chronic patients, especially diabetic patients with other acute or chronic diseases, have been demonstrated to be associated with the reduced self-efficacy and the increased health care costs (13, 4).

Self-efficacy is a substantial concept derived from social cognition theory, which refers to an individual’s beliefs and judgments on his or her abilities regarding doing his/her duties and

responsibilities. Albert Bandura believes that human beings possess a kind of a system composing of self-control and self-regulatory powers to control their thoughts and behaviors. The sense of self-efficacy enables people to do extraordinary performances using their skills in dealing with obstacles faced during this process. Hence, self-efficacy seems to be an important factor for having a successful performance and the required basic skills (14). Those who are confident with their self-efficiency redouble their efforts to overcome obstacles and problems throughout their lifetime. On the other hand, the chance of developing mental illnesses was found to be higher among people with diabetes, which may negatively affect their self-efficacy. Diabetic stresses are a group of moods, including anxiety, feelings of conflict, frustration, and discouragement, which can consequently weaken the problem-solving skills in patients, and in turn, negatively affect their self-control. Diabetic patients need high levels of self-efficacy in order to manage the relevant daily challenges, which can improve their self-care process (15).

Both the necessity and significance of educating patients are more highlighted due to the increasing need of society for education, especially regarding health education, and particularly in terms of chronic diseases that are known as the "silent epidemic of the 21st century" (16). By performing this training, the patient takes some steps to be well-adapted to the problems related to this disease. Performing all specialized and non-specialized care measures is basically seen as the executive goal of the patient's education programs, since providing an ideal education leads to the enhanced participation and cooperation of the patient during the treatment process. Educating the patient has its certain priority during the whole hospitalization period until discharge and even after discharge. In fact, the patient's success in obtaining independence in self-care is the major goal of health care system (17).

The COVID-19 led to the emergence of new needs for citizens, health workers, and even government agencies. For example, currently citizens require to adapt themselves to the latest social distance guidelines, observe isolation, and acquire adequate knowledge on the important symptoms for monitoring themselves and planning the process of their self-control (18). In this regard, different strategies and tools have been employed to support patients with diabetes, but these are not recognized to be valid enough yet. However, the use of mobile messaging is known as the most important basic tool of communication in the world. Using mobile phones had a remarkable growth, especially in Asian countries by considering an estimation that about 96% of

the population in these countries use mobile phones. Meanwhile, the SMS service is known as a powerful communication tool among many people. Compared to other communication channels, text messages benefit from the advantage of a fast transmission with low cost. Even if the cell phone is turned off or it is out of the signal range, when the cell phone is turned on or receives a signal within 24 hours, the message will be delivered as well. Due to its time and money saving properties, text messages seem to be a better tool than phone calls and even printed messages. Moreover, some features such as availability, no temporal and spatial limitations, direct and instant accessibility, and saving messages in the coming days allow the use of mobile phones, especially SMS services, for transmitting health information (19).

Many previous diabetic patients who are currently recovering from the convalescence period of the COVID-19 disease reported other problems such as depression, loneliness, and stress, caused by the COVID-19 disease as well as lack of sufficient knowledge in self-care other than the physical and psychological problems already experienced by them due to diabetes. The situation is particularly intensified due to the existence of various and sometimes contradictory sources of information along with the absence of media literacy. Several interventions, called "SMS and its effect on diabetes" have been made, and intervention with a mobile phone in many of them has not lead to obtaining a positive result due to the short duration of the intervention or variability of patients' demographic characteristics. In another group, intervention performed by mobile phone has not shown a significant difference compared to other methods, including face-to-face training or the use of software. Of note, this has increased the knowledge on diabetes self-care. In these studies, only one type of diabetes has been evaluated. So, the current study was designed and conducted with the aim of determining the impact of mobile learning on the stress and self-efficacy among diabetic patients infected with COVID-19 with a hope to improve their physical and mental conditions.

2. Objectives

This method can be used in providing better training and services as well as setting training protocols in terms of the health priorities of the Ministry of Health and Medical Education.

3. Methods

This study was a clinical trial, started after receiving the code of ethics from the Joint Organizational Research Ethics Committee of the School of Nursing and Midwifery and the School of Rehabilitation of Tehran University of Medical Sciences, with the IRCT code (IRCT20210302050555N1). Moreover, this was conducted after obtaining permission from the Head of Selected Hospitals of Tehran University of Medical Sciences with the highest admission rate of patients with COVID-19 disease in order to use these patients' information. With an official letter of introduction, the researcher referred to the hospital at first and then prepared a master list of all patients who were eligible in terms of the inclusion criteria by searching the hospitals' databases. Thereafter, the included subjects were divided into the two intervention and control groups using the "blocking randomization" method. The sampling was done within a 10-day period. Next, the consent was obtained from the participants in the study through phone contact (the consent was taken verbally from the subjects since the pandemic conditions in the country did not allow to set a face-to-face meeting and obtain written consent form). The questionnaires were then completed via phone calls. In order to re-evaluate the reliability of the questionnaire, data were collected from 30 samples who met the inclusion criteria and Cronbach's alpha value was calculated to be in the acceptable range. Thereafter, the demographic information, the diabetes management self-efficacy scale, and the Perceived Stress Questionnaire were completed through phone calls over two sessions per day at maximum, in order to avoid the tiredness among the participants. The phone calls were made within the interval set by the patients due to their possible job restrictions. These subjects were also asked about their preferred learning method (audio or text methods), and as a result, all of them preferred the text method and sending SMS over the audio and telephone call methods. Subsequently, the intervention was conducted in Tehran from 2021.05.02 to 2021.07.24. By starting the procedure, a short message was sent, including a re-introduction of the research project and welcoming the selected participants. In the initial text message, it was also mentioned that they can contact the researcher by the phone number provided to them if they had any question or problem. For three months, three contents, including motivational items, daily care measures, healthy lifestyle, nutrition, exercise, warning signs, and the occurrence of complications related to the COVID-19 and diabetes were presented to the intervention group (37 in total) between 8 and 12 o'clock in the morning on Saturdays, Mondays, and Wednesdays every week. The contents of short

messages were prepared from authentic scientific sources by the researcher under the supervision of the research team professors. In addition, scientific validity was confirmed through consulting with the selected faculty members. The researcher changed his phone settings to the "Receiving the confirmation of message delivery" option to ensure that the messages are sent. The message would be re-sent if the confirmation of message delivery was not received from the subjects within three hours after the first sending time. Of note, two consecutive messages were not received by one subject during the intervention. Thus, we called the landline number to find out its reason and then we get informed of the unfortunate death of the subject due to cardiac arrest in sleep. The subjects included in the control group received no SMS during the intervention period. Accordingly, we just made a phone call once a month to ask their condition and ensure not to lose them. None of the control subjects were excluded from the research up to the end of the study. Upon the end of the 3-month intervention, which was started from the time of sending the first educational SMS, we completed the relevant questionnaires according to the previous procedure via phone calls in one to two sessions per day. The obtained data were analyzed using the SPSS Ver.17 software. The provided content was also sent to the control group as a file through WhatsApp at the end of the intervention to observe the ethics in the research.

4. Results

The studied cases' demographic characteristics included gender, level of education, employment status, and marital status.

The composition of the gender variable in both the intervention and control groups included 51.4% and 54.3% women, respectively, suggesting the presence of more females in the groups.

In terms of the educational level variable, 34.3% of the subjects had an under diploma degree in both intervention and control groups, which had a higher percentage compared to other educational levels.

Concerning the employment status variable, the frequency of employed people in the intervention and control groups was obtained as 51.4% and 48.6%, respectively, suggesting higher frequency of the employed cases in the intervention group compared to the control group.

In regard to the marital status variable, the frequency of married people in the intervention and control groups was equal to 62.9% and 65.7%, respectively, indicating higher frequency percentage of married people in the groups.

The results of chi-square test regarding the demographic characteristics revealed the homogeneity of all the subjects in the two intervention and control groups in terms of gender ($p = 0.811$), level of education ($p = 0.917$), employment status ($p = 0.811$), and marital status ($p = 0.803$). Moreover, the independent t-test was homogeneous in terms of the age variable ($p = 0.094$) in both intervention and control groups.

Since the variables related to the demographic information appear to be homogenous in these two groups, it can be assumed with more confidence that the obtained results are under the effect of the intervention process. Hence, the study results would have a higher rate of generalizability.

According to the results of statistical tests in this study, the mean scores of stress and self-efficacy that were achieved using the independent t-test ($P = 0.491$ and $P = 0.490$, respectively) before the intervention, showed no statistically significant difference between the two groups. The absence of a significant difference suggests that the patients in both intervention and control groups used the same sources to raise their awareness regarding the principles of self-care and reducing stress in diabetes. Correspondingly, these sources may possibly include hospital education during hospitalization and even at the time of discharge, mass media, and cyberspace (20) (21).

However, the mean score of stress following performing the intervention in the two intervention and control groups showed a statistically significant difference based on the results of the independent t-test ($P < 0.001$). Furthermore, the mean stress score in the intervention group after the intervention was significantly lower than that of the control group. Besides, a statistically significant difference was found between the mean scores of stress before and after the intervention in the control group ($P < 0.001$). However, the percentage of these changes demonstrated an 18% increase in the stress score in the control group after performing the intervention. The mean scores of stress before and after the intervention were also found to have a statistically significant difference in the intervention group ($P < 0.001$). Moreover, the percentage of changes showed that the stress score in the intervention group decreased by 34%

after the intervention compared to before the intervention. Correspondingly, this proves that the intervention was significantly effective on reducing stress.

The mean score of self-efficacy showed a statistically significant difference in the two intervention and control groups based on the results of the independent t-test after the intervention ($P < 0.001$). In addition, after the intervention, the mean score of self-efficacy was found to be significantly higher in the intervention group compared to the control group. Besides, a statistically significant difference was seen between the mean scores of self-efficacy before and after the intervention in the control group ($P = 0.011$). However, the percentage of these changes showed a 7% decrease in the self-efficacy score in the control group after the intervention. Of note, the mean scores of self-efficacy obtained before and after the intervention showed a statistically significant difference in the intervention group ($P < 0.001$), while the percentage of these changes showed that the self-efficacy score in the intervention group increased by 19% after the intervention compared to before the intervention. Therefore, it can be said that the intervention was significantly effective on enhancing self-efficacy.

The results of this study suggest the positive effects of mobile learning on the stress and self-efficacy of diabetic patients infected with COVID-19 disease. Our findings were consistent with those of the Goodarzi et al.'s study (2012), who have evaluated the effect of education through SMS service on the knowledge, attitude, performance, and self-efficacy of patients with type II diabetes. A research performed by Abaza et al. (2017) have also reported that the use of SMS can improve diabetes self-management in low- and middle-income countries. According to the Abaza's research results, providing education via SMS is an accessible method effective on improving blood sugar control and self-care behaviors, so it is superior to traditional and paper-based methods. Their findings were also consistent with those of the present study.

In this study, the effectiveness of mobile learning via SMS on the stress and self-efficacy of diabetic patients with COVID-19 disease was demonstrated. However, our results are contradictory to those reported in the research by Owolabi et al. (2019) entitled "Assessing the effectiveness, efficiency, and accessibility of SMS in improving glycemic control and other health outcomes". Accordingly, in the Owolabi's study, participants were satisfied with the sent and received text messages. However, no significant differences had been observed in their blood sugar levels and other health parameters. One reason for such a result may possibly be

attributed to the failure of using appropriate indicators in this regard. As well, Fottrell et al. (2019) conducted a research entitled "The use of group therapy or mobile messaging to prevent and control type II diabetes and pre-diabetes". As a result of this study, the prevalence rate of diabetes in the mobile phone intervention group showed a lower reduction rate compared the group with no differences in other health outcomes, which seems to be inconsistent with the results of the present study. One limitation of their study was related to the questionnaires used, which lacked both validity and reliability. However, both variables of self-efficacy and perceived stress were assessed and validated in our study through credible questionnaires with Cronbach's alpha coefficients of 0.88 and 0.85, respectively. Thus, the results of our research logically seem to be more reliable compared to others.

Hooshmand Jah et al. (2018) performed a study to examine the effect of mobile learning on diabetes self-care behaviors. According to their findings, one can conclude that providing adequate information using an attractive and effective method has the potential to improve learning in individuals as well as enhancing their attention and interest in learning, which will ultimately improve learning outcomes. The above-mentioned reasons can be justifications for using mobile phones in order to improve self-care behaviors, suggesting their consistency with our study. They have also found some evidence implying that mobile education can be effective on other implications like stress for patients with diabetes, which have not been examined in the present study.

5. Discussion

The results of this study demonstrate that mobile learning has positive impacts on reducing stress and increasing the self-efficacy among diabetic patients infected with COVID-19 disease. As well, in the intervention and control groups, statistical differences were found after the intervention in terms of stress and self-efficacy, suggesting the statistical effectiveness of the performed intervention on these two variables. Education via mobile phones due to having some features such as availability, no time and place constraints, and saving time and money, seems to be more effective compared to other available methods. Education is known as a core component of nursing care, and if this training is provided in a variety of ways using available technologies, it can be very effective and efficient. Thus, we can use this method to improve self-efficacy and

reduce stress in diabetic patients with the COVID-19 disease. Additionally, by presenting the results of this research to hospital education officials, we can provide the necessary conditions to make these trainings more applicable, especially in terms of chronic diseases and during the COVID-19 crisis.

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