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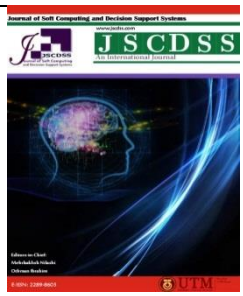

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Role of Mobile Health in Self-Care of Type II Diabetes Patients: A Literature Review

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Abstract

Diabetes is a progressive metabolic chronic disorder and a major public health problem increasing worldwide particularly in Low and Middle Income Countries (LMIC). Self-care makes patients to be involved in their own care and make decisions about treatment options offered by their clinician. The aim of this paper is to investigate role of mobile health in self-care of type II diabetes patients. To this end, all published papers related to the research topic were investigated from 2006 to 2018. To find the relevant Persian and English papers, six national and international databases including SID, Irandoc, Magiran, PubMed, Science Direct and ProQuest were searched using Persian and English keywords. The number of 270 papers were retrieved and after considering inclusion and exclusion criteria, 9 papers were recognized to be relevant. Results indicated that using cellphone based text messaging alone or together with other telemedicine methods can have a positive impact on the HbA1c level control, self-efficacy and foot ulcer treatment.

Keywords: Diabetes type II, Mobile health, Self-care, Literature review

1. Introduction

Diabetes is a progressive metabolic chronic disorder and a major public health increasing worldwide particularly in Low and Middle Income Countries (LMIC) (Alberti and Zimmet, 1998; Shrivastava et al., 2013). World Health Organization (WHO) has estimated that more than 220 million of people suffer from diabetes and this figure will increase to 336 million till 2030 (Holtz and Lauckner, 2012). The number of patients suffering from diabetes type II is increasing constantly demonstrating a global epidemic (Zareban et al., 2014). WHO estimated that the number of people affected by diabetes in Iran will be 5521000 till 2025 which is 8.6% of the population (Noohi et al., 2012) demonstrating a health priority (Nesari et al., 2009).

Diabetes is the fifth cause of death in the world and is responsible for the 9% of all death globally (MorovatiSharefabad and RohaneTonekabone, 2006). There is an estimation that in every 10 seconds, one patient die from diabetes (WHO, 2010). This is a growing serious threat in the world (Schoenberg et al., 2008). Although it is not curable, diabetes is preventable (Phipps, 2003). Inappropriate control of diabetes will lead to frequent hospitalization and lower life quality of affected patients (Funnell and Anderson, 2004). It also causes increase in sugar level of blood in long term followed by chronic complications and cardiovascular disease with high treatment cost (Keers et al., 2005).

Health experts believe that self-care is an important element in diabetes patients and patients and their families are responsible for diabetes control and care. They also believe that diabetes patients must control their disease with respect to their life style and culture (Funnell and Anderson, 2004; Heisler, 2005). Self-care empowers patients to provide care to themselves and have the ability of making decisions out of available treatment options (Lau, 2002). Patient education is a crucial element in diabetes control and helps increase self-care (Dunning, 2003; Lau, 2002).

Recent studies show that despite educational programs, there is a misunderstanding about diabetes and its control among affected patients (Holmström & Rosenqvist, 2005). To support diabetes patients having problem with self-care, it is vital to provide patients with a constant program with the aim of increasing awareness and improving the performance and attitude of patients in addition to educational programs. Treatment follow-ups are possible through in person visits or home visits but respecting diabetes incidence and the long procedure of treatment, it is important to apply an inexpensive functional method for a great number of patients (Peck, 2005).

Studies demonstrate that only 50% of patients visits a physician at healthcare centers and these visits are limited

to three to four encounters during a year. On the one hand, educational programs delivered during these visits are not sufficient to cover educational needs of patients and prevention purposes (Noohi et al., 2012). On the other hand, chronic disease patients require constant care and healthcare providers always complain of insufficient time to provide such care. In addition, a large number of patients live in remote areas and don not have access to comprehensive healthcare. Also, not all patients have the possibility to continuously attend educational classes. Thus, new methods must be applied to provide follow-ups and inexpensive education to patients.

Mobile based communication has provided this opportunity to deliver care outside of hospital and health care facilities. Various researches has been performed on chronic disease management using cellphones as a method of education and follow up but still there is need to do more research to show their effectiveness on various disease such as diabetes. Cellphones including smart phones are a crucial and inseparable element of today's life and one of the most basic functions of cellphones is text messaging which probably can be used a tool for educating patients (Kim, 2007; Moosavifar et al., 2011).

Cellphone technology similar to other ICT technologies has found its way to the domain of healthcare and has provided the opportunity of providing cellphone-based education to patients and alter the traditional method of delivering education which was previously performed through in person and face to face sessions. Cellphone-based education resolve time and place limitations and as major form of eHealth can be a valuable aspect in patients care plan (Vasquez, 2008). Mobile health is considered as a subcategory of eHealth and has been dominantly applied in industrious countries.

In recent years, it has been applied in developing countries as a growing demand as well which has roots in rapid growth of cellphones in LMIC because it does not need large investment on infrastructure and can be applied in a short time so this technology is being used largely in LMIC to improve healthcare quality.

Two factors contributed to the mobile health development. The first factor is limitation of healthcare systems in developing countries in terms of high population growth, lack of healthcare workers, large population in rural areas, high responsibility of confronting with disease incidence and limitations in financial resources to support healthcare infrastructure (Economist, 2009). The second factor is the increasingly use of cellphones between developing nations. Based on International Telecommunication Union (ITI), out of 7 billion people in the world, 2.6 billion are internet user and 5.9 billion are users of cellphones (Cole-Lewis and Kershaw, 2010). These two factors contributed to the discussion on how additional access to cellphones as an effective tool can play a role in decreasing the large pressure on healthcare systems of developing countries (Economist, 2009). This method has been used in healthcare domain in providing care to patients with diseases such as asthma, diabetes and chronic heart failure and the results were promising (Blake, 2008).

2. Methods

This study was a systematic literature review in which all published papers about role of mobile health in self-care of patients with diabetes type II in Persian and English languages were investigated. Time of 2006-2018 was considered to limit the number of researches. National Persian language bibliographic databases including SID, Irandoc and Magiran, and international English language databases including PubMed, Science Direct and ProQuest were searched for the relevant papers in the specified period.

2.1 Inclusion Criteria

Inclusion criteria were as follow:

- Relevant to the research topic: papers with focus on mobile health role (cellphones, softwares, etc.) in self-care of patients with diabetes type II were chosen.
- Diabetes type II
- Access to paper full text
- Both English and Persian papers
- Published between 2006-2018

2.2. Search Strategy

With respect to the research topic (i.e. role of mobile health in self-care of patients with diabetes type II), appropriate keywords in Persian and English were chosen with consultation with an information specialist. We used the following Mesh terms and text words to search PubMed: ((Diabete* Mellitu* OR type2 Diabete* OR TDM2) AND (Mobile Health OR Mobile Phone* OR Text message*) AND (Self-care* OR Self-management*)). PubMed search strategy modified as needed for use in other databases. Based on the search strategy 270 papers were retrieved all together.

Researchers firstly examined papers' titles to seek for potential duplicates. Abstracts then were studied to find out the relevancy of the papers. Irrelevant papers were removed at this stage. Then, the full texts were reviewed for the comprehensive check. Finally, out of 270 papers, nine were recognized to be relevant to the research topic. Figure 1 shows the search strategy and the review process of the papers.

3. Findings

Based on the literature search in six bibliographic databases from 2006 to 2018, 270 papers were retrieved in which nine were recognized to be relevant to the research topic (i.e. role of mobile health in self-care of patients with diabetes type II). Details of included and reviewed papers are shown in Table 1. Five papers have addressed text messaging technology to patients and four have addressed applied softwares. Out of nine relevant papers, four were in Persian and five were in English performed in the US, Japan, Norway and Belgium. Duration of performed researches were from 1 month to two years. Among Persian papers, two studies investigated HbA1c and simultaneous self-efficacy and one investigated foot treatment and one paper studied

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the self-care behavior based on health belief model. In the four papers, role of mobile health through sending messages were examined and feedbacks were receive from patients before and after the study using a questionnaire. In the two papers that investigated HbA1c and self-efficacy, self-efficacy increased in both groups and HbA1c decreased in one group and had no change in other group. In a study based on the health belief model, the average score of awareness and self-care behavior increased and in another study about foot treatment, a meaningful change in self-care behavior was seen.

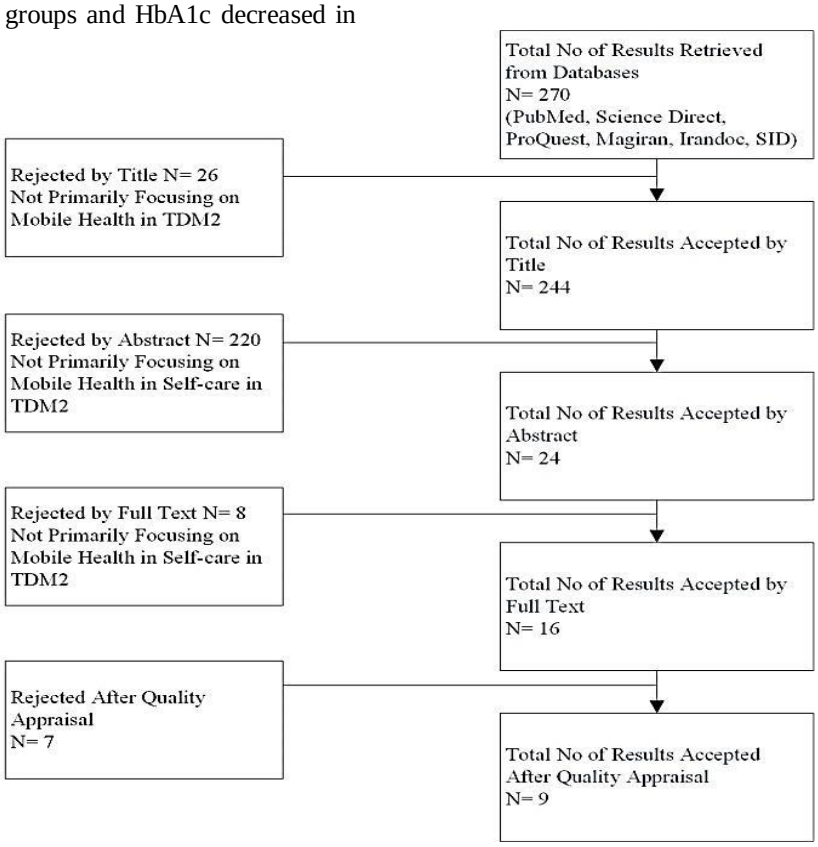

Fig. 1. Literature search flowchart

Table 1
Summary of reviewed papers

Author/ year	Numbers of subjects	Types of study/duration	setting	Type of apps	Summary of results
Goodarzi, 2015	*Int: n=43 Ctrl: n=38	Randomized controlled trials/3 month	Iran	Sending educational SMS	Self-efficacy score increased in intervention group 1.6, while in control group it decreased 0.1.
Peymani, 2016	Int1: n=50 Int2: n=50 Ctrl: n=50	Randomized controlled trials/3 month	Iran	Sending educational SMS	FBS had a significant reduction in the target group and non-target group in comparison with the control group. HbA1c did not change significantly in all three groups. Self-efficacy and self-care activities increased in both interventional groups.
Baghiani Moghadam, 2014	Int: n=45 Ctrl: n=43	Randomized controlled trials/1 month	Iran	Sending educational SMS	The mean score of the constructs of the HBM model (including self-efficacy) was significantly different between the control and intervention groups.
Baji, 2016	Int1: n=63 Int2: n=63 Ctrl: n=63	Randomized controlled trials/2 month	Iran	Sending educational SMS	The average of foot care scores in all three groups was significantly different after the training and the result of the loss-framed messages was higher.

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Table 1
Summary of reviewed papers (Cont.)

Author/ year	Numbers of subjects	Types of study/duration	setting	Type of apps	Summary of results
Van Olmen, 2017	Congo: n=315 Cambodia: n=382 Philippines: n=84	Randomized controlled trials/2 years	Congo, Cambodia, Philippines	Two groups: DSME-only as a control group that is a periodic alternate training session The DSME-DSMS intervention group, in addition to training, also received SMS in conjunction with the training program	HbA1c was 33.9% in the intervention group and 31.1% in the control group, which is not statistically significant. The foot ulcer in the intervention group was significantly reduced
Quinn, 2015	n=70	4 weeks/ just one group	USA	Installing PCS software on the mobile phone of patients with type 2 diabetes	Self-efficacy increased from 7.7 to 8
Holmen, 2014	Int1: n=51 Int2: n=50 Ctrl: n=50	Randomized controlled trials/1 years	Norway	A mobile phone ±based self-management system: Few Touch Application (FTA) mobile phone. Two intervention groups: FTA group and FTA-HC (health coaching) group.	All three groups: HbA1c level decreased but not signi®cantly different. FTA-HC group: The heiQ (health-related quality of life) domain skills and technique acquisition was signi®cantly greater.
Waki, 2014	Int: n=27 Ctrl: n=27	Randomized controlled trials/ 3 months	Japan	DialBetic software	In the DB group: HbA1c decreased by 0.4% and FBS decreased by 5.5 mg In the NDB group: HbA1c increased by 0.1% and FBS increased by 16.9 mg
Faridi, 2007	Int: n=15 Ctrl: n=15	Randomized controlled trials/3month	USA	Use of NICHE technology	In the intervention group, the level of HbA1c decreased by 0.1%, while in the control group it increased 0.3%.

*Int: intervention group; Ctrl: control group

In five English papers conducted in different industrious countries, four investigated softwares related to diabetes type II and one study examined use of messaging for diabetes patients. Moreover, in four studies, HbA1c level in two studies self-efficacy and in two other studies foot ulcers were researched. In the study focusing on text messaging, HbA1c was not changes but foot ulcers were reduced significantly in the intervention group. In two studies with focusing on self-efficacy, self-efficacy was increased and foot ulcers were reduced.

4. Discussion

The results of this study showed that mobile health and in particular messaging through cellphones has a positive impact on diabetes type II patients care. Pal et al (2014) have demonstrated that HbA1c decreased in patients who went under educational intervention based on computers and through self-care programs (Pal et al., 2013). In a systematic literature review focused on telemedicine interventions, a 0.4 percent decrease in HbA1c level was demonstrated (Marcolino et al., 2013); however, HbA1c level had no change in two other studies (Peimani et al., 2016; Van Olmen et al., 2017).

Additionally, in studies performed by Peimani et al the HbA1c decrease was not significant showing a contrast with previous results (Peimani et al., 2016). Also, in studies performed by Istepanian et al (Istepanian et al., 2009), Hanauer et al (Hanauer et al., 2009), Rossi et al (Rossi et al., 2009), Katz et al (Katz and Nordwall, 2008), Benhamou et al (Benhamou et al., 2007), and Rami et al (Rami et al., 2006) no significant changes in HbA1c level between control and intervention group was seen. In a study by Van Olmen et al HbA1c level remained constant in more than half of the patients. Researchers believed that high number of participants in this study and the long duration (two years) caused HbA1c to remain unchanged (Van Olmen et al., 2017).

Based on the reviewed literature, text messaging though cellphones alone or together with telemedicine methods can have a positive impact on glycemic control. There seem to be a number of factors affecting the outcome. They include sample size, study design, study strength , intervention type, duration of the study and consistency between intervention, diabetes type and sampling method (patients' age, disease severity, disease diagnosis duration, comorbidities) (Holtz et al., 2011; Mulvaney et al., 2011).

In studies with examining foot ulcers and its treatment, it was observed that ulcers were reduced. Piette et al demonstrated that foot ulcers in patients with diabetes type II improved significantly after a 12 month follow up (Piette et al., 2001). Moreover, Sanjay et al showed that sending educational messages by cellphones in three weeks increased the average score of foot treatment, taking fruits and vegetables, following a drug diet and self-efficacy (Arora et al., 2014). Given the fact that foot treatment is simple and inexpensive, it seems that delivering education to patients with diabetes type II with the aim of increasing patient's awareness in his/ her care can potentially contribute to diabetic foot prevention, pain management, discomfort release, and cost reduction in healthcare system (Oshvandi et al., 2014).

Also, Baji et al showed that loss-framed messages have had a more impact on foot ulcer (Z et al., 2016). Similarly, Bong indicated that loss-framed messages are

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effective in increasing patients' awareness, intention and behavior toward foot care and treatment in patients with diabetes type II (Lee and Gu, 2009). Conversely, Janet et al., (2011) in a study in the US with the aim of examining the impact of educational information on changing the knowledge, attitude and health-related behavior of diabetes patients showed that the score of foot care behavior increased considerably in groups who received positive messages after six months in comparison with the control group (Grady et al., 2011). One explanation for this could be due to the difference in the intervention period (i.e. the length of time when educational material were provided to patients) and the study design and methods. In Janet et al study, in order to improve the foot care behavior video tapes showing images of a healthy feet and diabetic feet in two different frameworks were used (Grady et al., 2011).

Out of six papers focusing on self-efficacy, five reported an increase in self-efficacy score. In a study by Atak et al, they pointed out a significant difference in terms of self-efficacy between the control and the intervention group and that the intervention group showed a considerable increase. In their study, they used a control and an intervention group and studied diabetes type II patients for a period of two weeks through a face to face educational program. The level of awareness and self-efficacy was measured through a self- report questionnaire before and after the intervention (Atak et al., 2008).

Another similar research is a study performed by Bayat et al in which during a three to six month educational program intervention performed for type II diabetes patients in two control and intervention groups and through face to face sessions. Results indicated that the increase in self-efficacy level of intervention group had a meaningful difference with the control group (Bayat et al., 2013).

Another similar instance is a research by Shi et al. They conducted a one month educational intervention for patients with diabetes type II and results indicated the usefulness of this intervention in controlling blood sugar and self-efficacy (Shi et al., 2010). Finally, in a study based on health belief model, although the average score for perceived self-efficacy of patients had an increase, there were no statistical difference. These results are in contrast with the studies discussed earlier. In their study, Baghiani moghadam et al pointed out text messaging is effective for increasing perceived sensitivity of patients with diabetes (Baghiani Moghadam et al., 2014) which is in line with the results of Yakhforoush et al (Yakhforoushha et al., 2009) in terms of applying health belief model in following a food diet effective for cardiovascular disease prevention.

5. Conclusion

One limitation of this study is the number of reciewed papers. Articles that were found specifically on the self-care in patients with type 2 diabetes had a low rate. Besides, in the articles found within the internal databases (Persian language), only educational text messages were used without any consideration to any specific software.
This systematic review has shown that diabetes self-management with M-Health apps may help to manage T2DM and have a moderate beneficial effect on glycemic control. More applicable M-Health apps should be designed, and more rigorous studies are needed to further explore aspects of diabetes self-management that can be brought into clinical practice.

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