

# Lifestyle Education Based on Electronic Media for Diabetes Management

## *A Systematic Review*

Komang Agus Jerry Widyanata<sup>1</sup>, Kusnanto<sup>2</sup> and Suprajitno<sup>3</sup>

<sup>1</sup> Magister of Nursing Student, Universitas Airlangga, Surabaya, Indonesia

<sup>2</sup> Faculty of Nursing Universitas Airlangga, Kampus C Mulyorejo, Surabaya, Indonesia

<sup>3</sup> Nursing Department, Poltekkes Malang, Indonesia

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Abstract : The number of deaths due to diabetes mellitus is still high and tends to increase, this is due to the lack of self-management of patients with diabetes mellitus. The purpose of this research is to identify education with electronic media to improve self-management of diabetes mellitus type 2. This study was used systematic review with a literature search using online reference databases: ProQuest, EBSCOhost, PubMed, Scopus, and Science Direct. The determination of the keyword is based on PICOT framework (P: diabetes mellitus type 2, I: internet, computer, telephone, electronics, telehealth, C: -, O: behavior, lifestyle, blood sugar control, self-management, T: 2009-2018). Studies were included if they described interventions with electronic media targeted at patients with type 2 diabetes, focused on behavioral, biomedical, and psychological changes. The review of 15 papers that met the criteria showed significant results in the use of electronic media to the level of knowledge, confidence, nutrition intake, physical activity, self-efficacy and empowerment. Electronic media also significantly affects biomechanics especially for HbA1c results. Electronic media can be one of the right choices in providing self-management education of type 2 diabetes mellitus.

## 1 BACKGROUND

Currently Indonesia is ranked fifth world as a country that has the largest number of diabetes mellitus cases (PERKENI, 2015). The International Diabetes Federation notes that by 2013 there are 382 million people in the world who suffer from diabetes mellitus, of which there are 175 million undiagnosed and threatened progressively unconscious complications resulting from without precautions. Data for the year is expected to increase to 592 million people who will suffer diabetes mellitus in 2035 (IDF, 2013)

In addition to the increasing number of cases, diabetes mellitus is also known to cause many complications that are divided into two, they are acute complications and chronic complications. Acute complications include hypoglycemia, diabetic ketoacidosis, and non-ketotic hyperosmolar, and chronic complications are macroangiopathy, microangiopathy and neuropathy (PERKENI, 2015).

The number of cases and complication problems put the case of diabetes mellitus in the third rank cause of the highest non-infectious disease mortality in Indonesia in 2016 (Departemen Kesehatan RI, 2014).

The main goal in the management of diabetes mellitus is the achievement of near-normal glycemic. by self management diabetes mellitus such as diet, exercise, blood sugar control and Diabetes mellitus treatment (Gb & Premkumar, 2016). Individuals with chronic diseases such as diabetes, require innovative methods of health education, individuals claim that they want information in as many formats as possible and as early as possible after diagnosis. (Booth et al., 2016). Making their own decisions for improving blood sugar levels and performing related self chosen actions and maintaining its long term performance is the key element in diabetes self care management (Gb & Premkumar, 2016)

International Diabetic Federation (2013) states that at the individual level of diabetes self-

management education that integrates clinical, behavioral and psychosocial aspects of diabetes self-management should be available and sustainable. Effective self-management can improve the health of diabetes and prevent or delay the onset of complications, yet difficult and complex to achieve. This can be realized by allowing patients to understand their condition, combined with a barrier resolution for compliance (Dale, Caramlau, Sturt, Friede, & Walker, 2009).

The use of technology in the treatment of diabetes can facilitate improved communication between nurses and patients, reliable data collection, and the provision of a comfortable life for patients. An important goal of treatment with electronic media is to give patients the opportunity to maintain their education effectively without interruption (Tavşanlı, 2013). Telenursing methods are beginning to demand as health services to support patients in home care (Higano, 2015). Telenursing refers to the use of telecommunications and information technology in the provision of remote nursing care, which can help solve patient problems, reduce distance and travel time, and maintain the health status of patients at home (Higano, 2015).

According to Tavşanlı (2013) in his research on the application of telenursing in patients with type 2 DM recommends that more research to study the impact of technical innovation on improving disease management and medical results and prevention of diabetes complications with good glycemic control. Computer-based tools represent one such approach that helps support diabetes education provided by healthcare professionals. Telephone interventions are very important. Interesting because they are relatively cheap, easily accommodated around individual schedules, and possibly improved health literacy skills than print interventions (Chamany et al., 2015).

There is some evidence that the use of Computer-based education can increase knowledge, motivation, and self-care behavior in diabetics. Booth *et al.*, (2016) In addition, several studies have demonstrated the efficiency of indirect forms of preventive interventions such as telephone, letters, and consultations via the Internet, may be better suited to provide preventive interventions, for high-risk populations at low cost, and allow treatment to involve more people compared with face-to-face method (Tokunaga *et al.*, 2014).

The main purpose of this review is to identify the study used Intervention-based electronic media education to promote diabetes education and lifestyle modification of adults with type 2 diabetes.

## 2 METHODS

### 2.1 Design

The design of this study is a systematic review, synthesis of findings from a study comparing the use of electronic media as a medium of education with usual care in patients with diabetes mellitus.

### 2.2 Search Strategy

The method used in this systematic review begins with topic selection, then the keyword is determined to search the journal through several databases such as ProQuest, Ebsco, PubMed, and Science Direct. The determination of the keyword is based on PICOT framework (P: diabetes mellitus type 2, I: internet, computer, telephone, electronics, telehealth, C: -, O: behavior, lifestyle, blood sugar control, self-management, T: 2009-2018). A full of literature search and study selection process in accordance with the PRISMA guidelines. Studies are included when describing interventions with electronic media targeted at patients with type 2 diabetes, focusing on behavior, biomedical, and psychological.

### 2.3 Sample

Based on the search results obtained 1072 articles and 15 articles that meet the inclusion criteria. Each study creates educational interventions using electronic media designed to promote diabetes education and some changes in health behavior. From 15 journals reviewed 13 articles with randomized control trial design (RCT) while 2 papers used quasi-experimental design. Each study uses electronic media designed for the promotion of diabetes education. There are 5 out of 15 reviewed papers focusing on behavior change, 11 out of 15 papers focusing on biomedical changes, and 7 out of 10 papers focusing on the psychological aspects.

### 2.4 Eligibility Criteria

Articles selected for review based on studies that match inclusion criteria. The inclusion criteria are electronic use and are not limited by the type of electronics used as educational media that target adults with type 2 diabetes mellitus, focusing on behavioral, biomedical, and psychological changes. Studies that focus exclusively on glucose monitoring or electronic health records/web portals to upload data are not included.

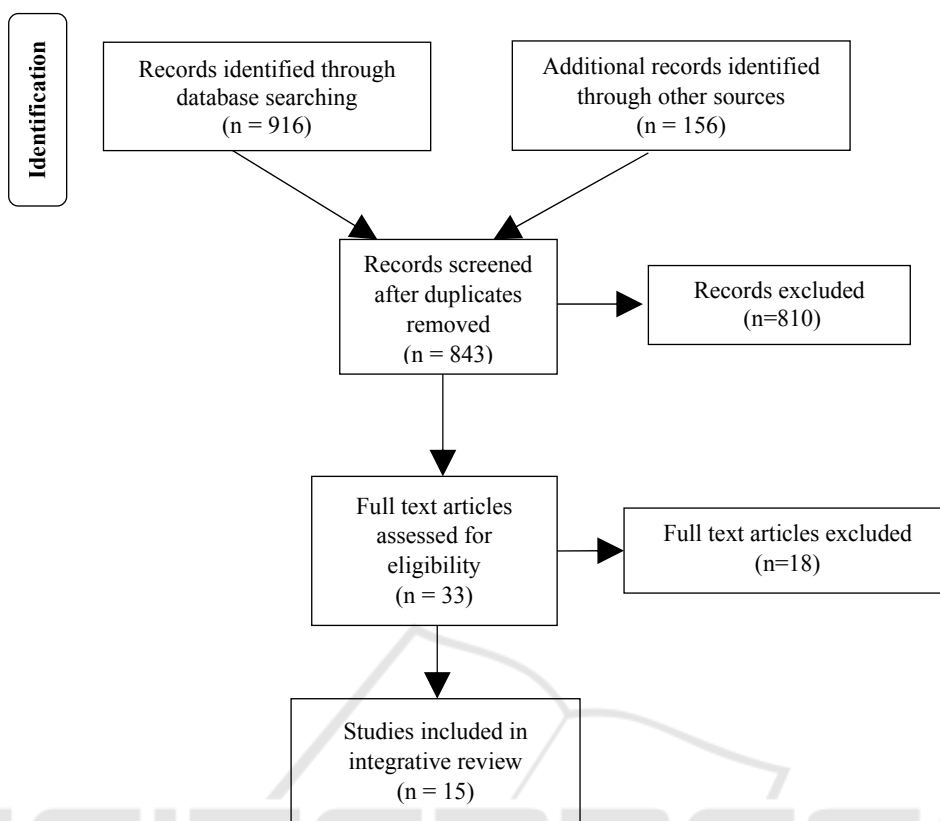


Figure. 1: flow diagram of search results for lifestyle education based on electronic media for diabetes management according with the PRISMA guidelines.

### 3 RESULTS

#### 3.1 Overview of Studies

Based on the search results obtained 1072 articles and 15 articles that meet the inclusion criteria, 13 articles with randomized control trial design (RCT) while 2 papers used quasi-experimental design. Electronic media used from all articles are 8 articles using telephone, 1 article using DVD, 1 article using a computer, 1 article using television, 1 article using videoconveren, and 3 articles using web based.

#### 3.2 Outcome

There are three main results obtained in this review that is the effect of electronic media as a medium of education on behavioral, on biomedical, and on the psychological aspects of patients with type 2 diabetes mellitus.

#### 3.2.1 Behavioral Outcomes

Half of the studies reviewed looked for outcomes for changes in activity (5/10). Changes in activities assessed are diet and physical activity. Tokunaga *et al.*, (2014) reported that computer-based lifestyle interventions decreased significantly greater energy intake six months after baseline ( $p = 0.0099$ ), Karim *et al.*, (2011) reported had no significant effect on diabetic self-care behavior after obtaining a multimedia-based (video) education intervention. Educational interventions using telephone media can increase physical activity and decrease nutrient intake ( $p = 0.02$ ) (Chamany *et al.*, 2015; Swoboda, *et al.*, 2017). (Greef *et al.*, 2011) reported that behavioral modification interventions with the phone increased their / day move in 2744, their total PA by 23 minutes / day ( $p < 0.001$ ) and decreased their sedentary behavior by 23 minutes/day ( $p < 0.05$ ).

### 3.2.2 Biomedical Outcomes

The most widely measured biomedical outcome was the HbA1c value. All of the biomedical assessments all measured HbA1c (11/15). Eight research reported a greater decrease in HbA1c values in the intervention group than in the control group (Aguiar et al., 2016; Chamany et al., 2015; Goodarzi et al., 2012; Karim et al., 2011; Moattari et al., 2012; Davis et al., 2010; Tavşanlı, 2013; Yoo An et al., 2010) Education with telephone effective to decreases the HbA1c value at six month compared with the control group ( $p = 0.013$ ) (Tavşanlı, 2013). Meanwhile, according to Tokunaga Metal., (2014) no difference HbA1c in the intervention group with the control group in the use of the computer as educational media. Dale et al., (2009); Pacaud et al., (2012) also reported no difference HbA1c in the intervention group with the control group in the use of telephone as educational media. Another biomedical that is also measured is the body mass index. The use of DVD-based educational media can significantly reduce BMI ( $p < 0.0001$ ) (Aguiar et al., 2016). However, telephone-based education

interventions have no effect on BMI (Karim et al., 2011; Tokunaga et al., 2014).

### 3.2.3 Psychology Outcomes

There are seven studies reviewed with outcome psychology. Psychology outcome that many in measure is self efficacy (6/10). According to (Lari et al., 2018) the use of teaching cd base can improve self efficacy of type 2 DM patients compared with control group ( $P < 0.001$ ). Similarly, (Goodarzi et al., 2012; Swoboda et al., 2017) support telephone coaching intervention can improve self efficacy significantly compared to the control group (0.002) and also effectively reduce stress (0.004), Pacaud et al., (2012) reports that there is an increase in self-efficacy after education with web-based. Whereas other research reported no effect of multimedia-based education and telephone on self efficacy (Dale et al., 2009; Karim et al., 2011). Other psychological data reported by research that electronic-based education can improve the empowerment of people with diabetes mellitus type 2 (Zamanzadeh et al., 2016; Swoboda et al 2017)

Table 1: Measured outcomes and results of electronic based type 2 diabetes studies meeting inclusion criteria

Author, year	Study Design	Sampel	Outcome			results
			behavior	biomedical	psychological	
(Tokunaga-nakawatase, Nishigaki and Taru, 2014)	RCT	patients with diabetes mellitus aged 30-60 years n=141	energy intake physical activity levels	BMI HbA1c Colesterol		a significantly greater decrease in energy within six months from the beginning of the intervention, compared with control ( $p = 0.0099$ ) and No differences were found in physical energy expenditure.
(Zamanzadeh, Zirak and Hemmati, 2016)	RCT	patients with type 2 diabetes n = 66			The empowerment	There was a significantly increased empowerment in the intervention group compared with the control group after three months of distance education ( $p < 0.00$ , EF = 1.16).

(Lari, Tahmasebi and Noroozi, 2018)	quasi-experimental	Patient with type II diabetes in the city of Bushehr, a southwestern province in Iran. n = 80	Physical activity		Self efficacy Friend support	There were significant differences between the intervention group and the control group, health status (p = 0.032), self-efficacy (p <0.001), peers support in physical activity (p <0.001), physical activity (P <0.001), (p <0.001) and equivalent metabolic task (MET) (p <0.001).
(Karim and Gerber, 2011)	RCT	Ethnic minorities with type 2 diabetes received care from a local clinic in Chicago, Illinois. n = 129	Physical activity	HbA1c	Self efficacy	The results obtained were an increase in the number of oral diabetes drugs (p = 0.017). HbA1c (p = 0.06). There was no difference between the intervention and control groups in self-efficacy, blood pressure, and diabetes-related behaviors. The exercise increased in the control group compared with the multimedia group (p = 0.016)
(Chamany et al., 2015)	RCT	Adults with diabetes mellitus n = 941		HbA1c BMI	Physical activity	The results obtained decreased HbA1c in the intervention group 0.9 and in the control group 0.5 (p = 0.01). Both groups experienced similar improvements in self-care activities, medication adherence, and intensification.
(Dale et al., 2009)	RCT	Patient with diabetes melitus. n=231		HbA1c BMI	Self efficacy	The results obtained are no statistically significant difference self-efficacy score (p = 0.68), HbA1c (p = 0.87) or other secondary outcome measures between the intervention group and the control group
(Swoboda, Miller and Wills, 2017)	RCT	Patient with diabetes melitus from a metropolitan area in the Midwestern United States n=54	Healty eating indext		Self efficacy Diabetes empowerment Diabetes distress	The results obtained were increased empowerment of diabetes (p = 0.045), diet quality, self-efficacy, diabetes empowerment, and depressive symptoms (all p <0.05) occurred in the intervention group.
(Greef et al., 2011)	quasi-experimental	Patient with diabetes melitus in endocrinology department of the Ghent University Hospital, Belgium n=92	Physical activity			The results obtained were increased physical activity in the intervention group compared with the control group (p <0.001). After 1 year the intervention group still had total physical activity (p <0.001).

(Aguiar et al., 2016)	RCT	Men with Type 2 diabetes, New South Wales, Australia n=101		HbA1c BMI weight		The results obtained were the differences in weight loss between the intervention group and the control group ( $p < 0.001$ ), BMI ( $p < 0.05$ ), and glycated hemoglobin ( $P < 0.002$ )
(Tavşanlı, 2013)	RCT	Patient with diabetes melitus n=48		HbA1c Blood glucose		The results obtained at the end of six months monitoring that the individual A1c levels in EG were preprandial blood glucose levels of diabetic patients in EG were lower than that of preregulated diabetic blood glucose in CG significantly.
(Goodarzi et al., 2012)	RCT	Patient with diabetes melitus n=81		HbA1c, cholesterol triglycerides HDL LDL	Self efficacy	The results obtained were significant differences between experimental groups compared with HbA1c control ( $p = 0.0024$ ), LDL ( $p = 0,019$ ), cholesterol ( $p = 0.002$ ), and self efficacy ( $p < 0.001$ ).
(Pacaud et al., 2012)	RCT	Patient with diabetes melitus n=79		HbA1c	Self efficacy	The results of the comparison between the intervention group and the control group were increased diabetes knowledge ( $p = 0.005$ ), self efficacy ( $p = 0.019$ ), and self-care ( $p = 0.006$ ). Not significant between group differences in HbA1C
(Moattari et al., 2012)	RCT	Patient with diabetes melitus n=48		HbA1c total cholesterol HDL LDL		The results of the differences between the intervention and control groups were HbA1c ( $p < 0.001$ ) and LDL ( $P < 0.02$ )
(Yoo et al., 2010)	RCT	Patient with diabetes melitus n=40		HbA1c blood pressure, body mass index, triglycerides, HDL LDL		The result was a significant decrease in HbA1c value in the intervention group compared with the control group ( $p = 0.031$ ), but no other value difference between the groups
(Davis et al 2010)	RCT	Patient with diabetes melitus n=165		HbA1c LDL		The results obtained were significant decreases in the first 6 months of HbA1c values in the intervention group compared with the control group ( $p = 0.003$ ), baseline to 12 months ( $p = 0.004$ ), and LDL cholesterol from baseline to 12 months ( $p = 0.02$ )



## 4 DISCUSSION

People with a family history of type 2 diabetes often lack sufficient knowledge of lifestyle behaviors in preventing diabetes and it is difficult for medical professionals to motivate them to change their lifestyle habits (Tokunaga *et al.*, 2014). An effective and efficient medium is needed to assist in the delivery of information to patients.

This study synthesizes evidence of the use of electronic media in the provision of lifestyle education in people with type 2 diabetes mellitus. The most widely used electronic media is the telephone. There are 7 papers that use the phone as an educational media and the each other use computers, CDs, DVD, multimedia (television) and web-based.

Two studies have shown improvement in diit after obtaining educated electronic education (Swoboda *et al.*, 2017; Tokunaga-nakawatase *et al.*, 2014). These two studies use different electronic media, one using a computer (Tokunaga-nakawatase *et al.*, 2014) and one using a telephone (Swoboda *et al.*, 2017). This shows that the use of the phone is not necessarily better than the computer and vice versa. Two studies have also shown improvement in physical activity after receiving telephone-based education interventions (Chamany *et al.*, 2015; Greef *et al.*, 2011).

In biomedical results, four studies showed improvement of glycemic profile (HbA1c) compared with control group (Aguiar *et al.*, 2016; Chamany *et al.*, 2015; Karim *et al.*, 2011; Tavşanlı, 2013). Interventions applied were education with phone media (Chamany *et al.*, 2015; Tavşanlı, 2013) with DVD-multimedia (Aguiar *et al.*, 2016) and television multimedia in patient waiting room (Karim & Gerber, 2011). While the other 3 studies show the opposite result where educational intervention with computer electronic media (Tokunaga-nakawatase *et al.*, 2014) and telephone (Dale *et al.*, 2009) did not show significant result in lowering HbA1c.

Further research is needed to examine effective methods of using electronic as an educational medium and an optimal utilization pattern is required and how the pattern varies according to the target behavior / outcomes by individual users with the assumption of some optimal "dose" interaction with the required electronic-based program (Cotter, Durant, Agne, & Cherrington, 2014). Another point that is also often measured in the biomedical aspect is BMI, from three studies that measured BMI showed no effect of electronic-based educational

intervention on BMI (Karim & Gerber, 2011; Tokunaga-nakawatase *et al.*, 2014). This is because it requires a continuous program in a long time to generate changes in the value of BMI.

Psychology results in some studies focus more on self efficacy. Self efficacy is a belief in one's ability to perform a task that will produce the desired result. Utilizing self-efficacy counseling skills is an effective way to improve patient compliance with self-care activities (Gb and Premkumar, 2016). There are four studies showing that electronic-based education intervention can increase self efficacy significantly (Goodarzi *et al.*, 2012; Lari *et al.*, 2018; Pacaud *et al.*, 2012; Swoboda *et al.*, 2017) and two studies show no influence (Dale *et al.*, 2009; Karim and Gerber, 2011). This is because many factors influence the self-efficacy so that it is required to tightly control the other variables that may affect.

Factors that may affect self efficacy are the previous positive and negative experiences experienced by others, other people's experiences, support or ambition from others, psychological and emotional conditions (Bandura, 1994). In addition to self-efficacy other factors assessed are stress and empowerment. Electronic-based education can reduce stress and increase the empowerment of people with diabetes mellitus type 2 (Zamanzadeh, Zirak and Hemmati, 2016; Swoboda, Miller and Wills, 2017). The greatest challenge of any kind of educational intervention including by involving electronic media is to achieve patient adherence to healthy behaviors over time.

## 5 CONCLUSIONS

The rapid development of informatics technology can be utilized in the provision of optimal health services in patients, especially patients with diabetes mellitus type 2. Use of electronic media is the most widely used is the telephone due to its practicality. The use of electronic media can be an option in providing educational intervention in patients with diabetes type 2 can be more effective and efficient. The study discussed in this paper demonstrates the ability of electronic-based education interventions to successfully reach patients and promote appropriate lifestyle modifications. The results shown can be concluded that the use of electronic media as an educational medium in diabetes patients is effective in changing the behavior, blood sugar control and patient psychological aspects. This intervention provides an appropriate choice to facilitate independent management processes outside of

clinical settings. However, further research on utilization patterns that conforms to the assumption of some optimal "dose" interaction with the necessary electronic-based programs is required.

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