#### **ORIGINAL ARTICLE**

# Short Message System media as an alternative education in reducing blood sugar levels of type 2 diabetes mellitus patients

ADI SUCIPTO<sup>1</sup>, FURAIDA KHASANAH<sup>2</sup>, SITI FADILILAH<sup>1</sup>, DEDEN IWAN SETIAWAN<sup>1</sup>, NAZWAR HAMDANI RAHIL<sup>1</sup> <sup>1</sup>Respati University, Yogyakarta, Indonesia

<sup>2</sup>Poltekkes Kemenkes Yogyakarta, Yogyakarta, Indonesia

Corespondence to Furaida khasanah, Email: furaida.khasanah@poltekkesjogja.ac.id, Poltekkes Kemenkes Yogyakarta JI. Tata Bumi No. 3, Gamping Sleman

#### ABSTRACT

Non-adherence to management in type 2 DM patients causes uncontrolled blood sugar thereby increasing the risk of various complications. This study aims to evaluate the effect of giving DM education through SMS (Short Message Service) on the decrease of blood sugar of Type 2 Diabetes Mellitus patients. This research is a quasiexperimental study with pre and post control group design with a total of 60 respondents (30 treatments; 30 controls). Data were analyzed using the paired t-test for 2-hour post-prandial (GDPP) blood sugar levels. Based on the results of research, it is shown that using SMS media can reduce GDPP levels (by 71.4 mg/dl) and statistically there are differences (P-value 0.0001), the comparison of the control and the intervention group has a significant difference (P value 0.0001) with differences in GDPP level of 81.63 mg/dl. The use of education media in the form of SMS can be used as an alternative way to improve blood sugar control in patients with Type 2 diabetes so as to reduce the level of GDPP of patients. Continuous education needs to be done for each DM patient by providing education through various media, one of which is using SMS when the patient is at home. **Keywords:** diabetes mellitus, SMS, exercise

#### INTRODUCTION

Diabetes mellitus (DM) is a degenerative disease that affects many people in the world. In Indonesia, diabetes mellitus causes five percent of the population deaths per year (WHO, 2011). The incidence and prevalence rates of diabetes mellitus (DM), throughout the world from various epidemiological studies, tend to show an increase from year to year. For Indonesia itself, the world health organization (WHO) predicts that Indonesia will experience an increase from 4.8 million in 2000 and to around 21.3 million in 2030. The high morbidity rate makes Indonesia ranked 4<sup>th</sup> in the world after China, India and the United States.

Without effective prevention and control programs, the prevalence will continue to increase (Perkeni, 2011). It is a very big number considering that DM will have an impact on the quality of human resources, social and high health costs. All of this is certainly related to complications arising from DM. Therefore, anticipation to prevent and overcome the outbreak of DM patients must have been started from now.

Diabetic patients need to be given some treatments so that they do not get worse and experience complications that can cause health problems both macroangiopathy and microangiopathy such as cerebrovascular disease, coronary heart disease, leg vascular disease; and eyes, kidneys and nerves complications. Therefore, these diseases must be managed properly by controlling blood sugar levels and so as not to cause complications and a variety of chronic complications. If blood sugar levels can always be controlled properly, it is expected that all these chronic complications can be prevented so that patients can live their lives normally (Suyono and Slamet, 2011). From observations at several hospitals in Yogyakarta, most DM patients do not get a complete and structured DM material education by nurses. The education provided is usually more in the form of lectures and seminars. In addition, nurses in providing education or health care to patients are only limited to suggestions and motivations for controlling blood sugar levels. Even if arranged, the material provided is incomplete and not well-structured so that it has not been able to solve the problems experienced by the patients. In addition, no follow-up has been done to maintain consistency in controlling blood sugar that can be done at home.

#### **METHODS**

This is a quasi-experimental research with the pre and post control group design. This research was conducted in the Outpatient of Panembahan Senopati Hospital Bantul from July until September 2017. The population in this study was type 2 diabetes mellitus patients who underwent outpatients in Panembahan Senopati Bantul Hospital which met the inclusion and exclusion criteria. The sample size in this study was 27 samples in each group. So that the total sample amounted to 54 samples for the two study groups. In this study, the researcher added 10% of the total sample to avoid the possibility of a study sample dropped out during the study, so the total sample in this study amounted to 60 respondents. The sampling technique in this study used the Random Sampling Technique. The variables in this study are DM education via SMS and blood sugar control. While the research instruments used were anthropometry, questionnaires, 7 x 24 hours Form Sport recall used to record the type and dose of exercise. The 7 x 24-hour Sports Form recall was modified by ADA (2015) and PERKENI (2011) by simplifying and adjusting the types of exercise commonly practiced by people and DM patients in Indonesia. Retrieval of blood sugar data of 2 hours postprandial was done in a laboratory using a Hematology Analyzer (Sysmex XT-1800i) that has been calibrated every year.

- a) A paired t-test that was used to determine the difference in a mean difference of 2 means blood sugar levels 2 hours post-prandial before and after providing education through Short Message Service (SMS). This test was carried out in the control and intervention groups before and after the provision of DM education through SMS (Short Message Service).
- b) Independent t-test that was used to determine the mean difference of 2 mean blood sugar levels 2 hours post-prandial between the control and the intervention group. In this study, the results of the statistical analysis were declared meaningful if the value of Pvalue <0.05 is obtained and very significant if the value of P is <0.01.</p>

### **RESULT AND DISCUSSION**

Table 1 Characteristics of Respondents by Gender, Age, Educational Level, Occupation, History, and Duration of DM

Variable	Intervention		Control		Total	%age
	Frequency	%	Frequency	%		0
Gender						
Woman	19	31.7	21	35.0	40	66.7
Man	11	18.3	9	15.0	20	33.3
Total	30	50.0	30	50.0	44	100.0
Age Category						
Late Adult (36-45)	0	0.0	4	6.7	4	6.7
Early Elderly (46-55)	14	23.3	16	26.7	30	50.0
Late elderly (56-65)	16	26.7	10	16.7	26	43.3
Total	30	50.0	30	50.0	60	100.0
Level of education						
not Schools	1	1.7	2	3.3	3	5.0
Elementary school (SD)	7	11.7	5	8.3	12	20.0
Junior High school (SMP)	10	16.7	5	8.3	15	25.0
Senior High school (SMA)	9	15.0	15	25.0	24	40.0
College	3	5.0	3	5.0	6	10.0
Total	30	50.0	30	50.0	60	100.0
	Respondents Jo	b				
Retirement / not working	9	15.0	5	8.3	14	23.3
PNS / TNI / Police	4	6.7	3	5.0	7	11.7
entrepreneur	4	6.7	4	6.7	8	13.3
Private employees	2	3.3	5	8.3	7	11.7
Housewife	11	18.3	13	21.7	24	40.0
Total	30	50.0	30	50.0	60	100.0
Long-suffering from DM						
≤ 1 year	2	3.3	2	3.3	4	6.7
2 - 5 year	13	21.7	13	21.7	26	43.3
6-9 year	11	18.3	11	18.3	22	36.7
10 - 14 year	3	5.0	3	5.0	6	10.0
≥ 15 year	1	1.7	1	1.7	2	3.3
Total	30	50.0	30	50.0	60	100.0
History of DM in the Family						
None	10	16.7	9	15.0	19	31.7
Exist	20	33.3	21	35.0	41	68.3
Total	30	50.0	30	50.0	60	100.0

The socio-demographic characteristics of respondents by sex indicate that the majority of respondents were female as many as 40 people (66.7%). There is no literature that stated that gender is a risk factor for type 2 diabetes mellitus. The results of this study are almost the same as the results of research conducted by Malathy R (2011) which stated that the prevalence of type 2 diabetes mellitus that occurs in women is 62%, higher than the prevalence in men. According to O Donovan, DO, Byrne, S., & Sahm, L. (2011) that women are more prone to suffer from type2 DM with a ratio of women and men 1.8: 1. This is also in line with research delivered by Pullen, L, C., & Vega, CP (2011) which states that there are variations in the prevalence of type 2 DM disease between men and women in a number of areas. In some areas, the prevalence of type 2 diabetes in women is higher whereas in other regions a higher prevalence is found in men. The results of this study are also supported by Alfiati's research (2015), showing that most sexes are women with as many as 22 respondents (55%). Age is a risk factor for DM that cannot be modified and a woman's age in the menopause age range (40-45 years) will accelerate the decline in estrogen production and insulin resistance. The faster the menopause of women is, the more the risk of type 2 diabetes mellitus will be. Postmenopausal women with metabolic disorders, obesity, and steroid hormone disorders increase the incidence of metabolic syndrome, type 2 diabetes, cardiovascular disease, and malignancy (Fitria, E. 2015).

Respondents included in the inclusion criteria of this study were patients with type 2 diabetes mellitus who went to the general polyclinic of Panembahan Senopati Hospital in Bantul with an age range between 40 to 65 years old. The choice of age range was based on the consideration that the process of developing type 2 DM in Indonesia is generally diagnosed after the age of 40 years. Grouping of patients by age was done to find out in what range the type 2 DM cases usually occur.

Based on table 4.1, it is found that DM patients are mostly found in the age category of the early elderly with as many as 30 respondents (50%). Early elderly experienced an increase in the number of cases in the age range of 46 -55 years according to the Ministry of Health of The Republic of Indonesia (2009) where 14 respondents (23.3%) are in the intervention and 16 respondents (26.7%) are in the control group. This data is in accordance with a statement from the American Diabetes Association (ADA), that age over 45 years is one of the risk factors for type 2 diabetes. According to PERKENI (2011), the risk of developing type 2 diabetes increases with age (Perkeni, 2011). In addition, a number of changes will occur with age, including anatomy, physiology, psychology and sociology. Bilous R, Donelly R. (2014) suggested that age is one of the risk factors for health problems such as DM. The incidence of DM increases with age (Suyono and Slamet 2011). This is supported by data from the National Health and Nutrition Examination Survey (NHANES) of the United States in 2010, showing that DM sufferers in the United States were more than 60 years old (26.9%) compared to those over 20 years old (11.3%).

Rochmah, (2006) explained that the prevalence of DM was more prevalent in adulthood, wherein adulthood (30 years) blood sugar levels had increased to 1-2 mg/year during fasting and would rise around 5.6 - 13 mg at 2 hours post-prandial. DM patients in Indonesia are mostly aged between 45 to 64 years (Suyono and Slamet, 2011). At the age of more than 45 years, most patients develop DM due to lifestyle factors. At that age, an increase in glucose intolerance begins. The existence of the aging process causes reduced ability of pancreatic ß cells to produce insulin accompanied by the emergence of lifestyle impacts at a young age (teenagers and productive), thereby it increases the risk of developing DM. Unhealthy lifestyles such as cigarettes and alcohol and not doing routine health checks at a young age make patients prone to diabetes mellitus in middle age. At the age of 60 years, there is a 35% reduction in mitochondrial activity in muscle cells. This is related to an increase in muscle fat levels of 30% and triggers insulin resistance. In Indonesia, most people with diabetes are caused by lifestyle. Therefore, most patients suffer DM in the middle age (Trisnawati and Soedijono, 2013).

The education level of respondents in this study varied from low to high. The highest education level of respondents is at the senior high level with 24 respondents (40%). There is no literature that said that there is a correlation between education level and risk of type 2 diabetes mellitus. The high number of respondents at this level of education only shows that the condition of education in Indonesia is much better. The higher the level of one's education, the higher his awareness of efforts to maintain his health. This may also be the cause of the highest number of respondents at this level of education. It was also found in the study of Fitria, E (2015) that type2 DM could be suffered at all levels of education, but medical adherence was more successful in persons with sufficiently high education than those with low education.

socio-demographic Another description of respondents is based on employment status. It was found that as many as 24 respondents (40%) were housewives (not working). This is because most respondents are housewives. According to Trisnawati and Soedijono (2013), the type of work is also closely related to the incidence of DM. This work variable has a correlation with physical activity. Physical activity can control blood sugar. Glucose will be converted into energy during physical activity. Physical activity causes insulin to increase so that blood sugar levels will decrease. In people who rarely exercise, food substances that enter the body are not burned but piled up in the body as fat and sugar. If insulin is insufficient to convert glucose into energy, DM will occur.

Based on the length of suffering from DM in table 4.1, it appears that the most experienced by patients is during the span of 2-5 years with 26 respondents (43.3%), whereas based on the history of DM in the family, most of the patients have a family history of DM that is as many as 41 people (68, 3%).

Variables that were carried out by normality tests were post-prandial blood sugar (PP) levels before and after the provision of education via SMS using the Shapiro-Wilk test. Normality test data results can be seen in the following table:

Education Via SMS					
	Kolmo	Kolmogorov-Smirnov			
	Mean	Df	Sig.		

Table 2: Normality Tests Data Before and After Providing

	Kolmogorov-Smirnov			
	Mean	Df	Sig.	
GDPP Before education via SMS	272.18	60	0.955	
GDPP After Education via SMS	251.62	60	0.593	

a. Lilliefors Significance Correction

\*This is a lower bound of the true significance

The results of the normality test data showed that the normality test for the post-prandial blood sugar variable (GDPP) before education via SMS is 0.955 and postprandial blood sugar (GDPP) after education via SMS is 0.593. The p-value of GDPP before and after the provision of education via SMS showed a value of > 0.05 which means that the GDPP variable before and after the provision of education via SMS has a normal data distribution

Control of GDPP before and after providing education via SMS to the control group

The following are the results of hypothesis testing using the paired t-test for GDPP control before and after providing education via SMS to the control group:

Table 3: GDPP comparison control before and after providing education via SMS to the control group

GDPP	N	Mean	Mean different	SD
GDPP Before education	30	262.17	30.26	48.737
GDPP After Education	30	292.43		43.88
Total	44			

P value 0.001

The average blood sugar level 2 hours post-prandial (GDPP) in the control group before giving education by SMS (pretest) is 262.17 mg / dl with a standard deviation of 48.737 mg / dl, while the average blood sugar level 2 hours post-prandial (GDPP) (post-test) is 292.43 mg/dl with a standard deviation of 43.88 mg/dl. The results of the mean difference before and after providing education in the control group obtained an increase in the average value of blood sugar after providing education that is 30.2. Statistical test results obtained p-value = 0.001, which means that in alpha 5%, it appears that in the control group there were significant differences in average blood sugar levels 2 hours post-prandial between before and after education provision via SMS. The result of this study is different from studies conducted by Lubis, I.K. et al (2016) which stated that the control group that was not given treatment showed insignificant results. The difference in the results before and after research in the control group is possible because there are several factors that affect blood sugar levels in the control group. Trisnawati, S. K and Soedijono S. (2013) emphasized that the blood sugar levels of diabetic patients were influenced by diet, type of activity, adherence to control and therapy (treatment).

Control of GDPP before and after giving education via SMS to the intervention group

The following are the results of hypothesis testing using paired t-test for GDPP control before and after the provision of education via SMS to the Intervention group:

Table 4: GDPP comparison control before and after the provision of education via SMS to the intervention group

GDPP	N	Mean	Mean different	SD
GDPP Before education	30	282.2	71.4	65.62
GDPP After Education	30	210.8	-71.4	59.01
Total	60			

P value 0.000

The average blood sugar level 2 hours postprandial (GDPP) in the intervention group before counseling (pretest) was 282.20 mg/dl with a standard deviation of 65.62 mg/dl, while the average blood sugar level o 2 hours post-prandial (GDPP) (post-test) decreased to 210.8 mg/dl with a standard deviation of 59.01 mg/dl. The mean difference results before and after the provision of education showed a decrease in the average value of blood sugar after the provision of education with -71.4. Statistical test results obtained p-value = 0.000, which means that in alpha 5%, it appears that in the intervention group there was a significant difference in average blood sugar levels of 2 hours postprandial between before and after giving education via SMS.

Control of GDPP between control and intervention group before the provision of education via SMS

The following are the results of the hypothesis test using the independent t-test of GDPP control between the control and intervention group before providing education via SMS:

Table	5:	GDPP	comp	arison	control	between	the	control
and int	erv	ention	group	prior to	providi	ng educati	ion v	ia SMS

GDPP	N	Mean	Mean different	SD
Intervention group	30	282.20	65.62	10.77
Control group	30	262.17	40.78	8.01
Total	60			

P value 0.185

The average blood sugar level 2 hours post-prandial (GDPP) in the control group before giving education via SMS (pretest) was 262.17 mg/dl with a standard deviation of 48.74 mg/dl, while the average blood sugar level of 2 hour post-prandial (GDPP) in the intervention group was 282.20 mg/dl with a standard deviation of 65.62 mg/dl. Statistical test results obtained p-value = 0.185, which means that in alpha 5%, it appears that, in the control and intervention group before giving education via SMS, there were no significant differences.

Control of GDPP between the control and intervention group after the provision of education via SMS

The following are the results of the hypothesis test using the independent t-test of GDPP control between the control and the intervention group after providing education via SMS:

Table 6: GDPP comparison control between the control and intervention group after providing education via SMS

<u> </u>				
GDPP	Ν	Mean	Mean different	SD
Intervention		210.9	50.01	12 627
group	30	210.0	12 00	13.037
Control group	30	292.43	43.00	8.416
Total	60			
<b>D</b> 1 0 000				

P value 0.000

Table 7: Summary of GDPP compliance between control and intervention groups before and after the provision of education via SMS

Variable	P value
GDPP Before and After Education at Control Group	0.001
GDPP before and after Education at Intervention	
Group	0.000
GDPP between control dan Intervention group	
before education	0.185
GDPP between control dan Intervention group after	
education	0.000

The average blood sugar level of 2 hours post-prandial (GDPP) in the intervention group after giving education by SMS (posttest) is 210.8 mg / dl with a standard deviation of 59.01mg/dl, while the average blood sugar level at 2 hour post-prandial (GDPP) in the control group (post-test) was 292.43 mg/dl with a standard deviation of 43.88 mg/dl. Statistical test results obtained p-value = 0,000, which means that at 5% alpha, it appears that there is a significant difference between the intervention and the control group after being given education via SMS.

The following is a p-value summary of the postprandial blood sugar (GDPP) in the control and intervention group before and after giving education via SMS:

## The Effect of Providing Education Via SMS on the Control of Post-prandial Blood Sugar (PP) of Diabetes Mellitus patients.

From the results of the statistical tests in table 4.3, it was shown that in the control group before and after giving education, a mean difference is 30.26 mg/dl and a p-value is = 0.001. It means that in the control group there is a significant difference in average blood sugar levels of 2 hours post-prandial between before and after education by SMS with an average increase in blood sugar levels of 30.26 mg/dl. Whereas in the intervention group, the mean difference value was -71.4 and p-value was = 0.000. It means that in the intervention group there is a significant difference in average blood sugar levels of 2 hours postprandial between before and after being given education via SMS with a decrease in the mean average blood sugar level of -71.4 mg/dl. Therefore, It can be concluded that the provision of education via SMS is very significant in reducing post-prandial blood sugar levels of diabetes mellitus patients.

In addition, the data of the study results before giving education by SMS to the control and intervention groups obtained p-value of 0.185. It means that in those two groups, before providing education by SMS, there was no significant difference in the average of blood sugar level 2 hours post-prandial. There were significant differences between the control and the intervention group after being given education via SMS with a p-value of 0.000. The Decrease of blood sugar levels 2 hours post-prandial after providing education via SMS showed that the treatment given affects the knowledge and attitudes of patients so that it will lead to actions to comply with the management of DM which includes diet, exercise and medication undertaken.

Giving education by SMS is part of the continuing action in providing services to diabetic patients. Education through this SMS is the provision of education, understanding of knowledge and skills in diabetes management that is given to each diabetic patient to improve the knowledge and attitudes and patient compliance in management of controlling blood sugar levels.

Providing education through SMS to DM patients is very important in controlling the patient's blood sugar levels. Given that DM is a chronic degenerative disease that can only be controlled by managing blood sugar levels well by increasing compliance with therapeutic management. In addition, education through SMS is also expected to prevent or at least inhibit the emergence of chronic or acute complications that are feared by DM patients. The provision of DM education aims to change knowledge, attitudes, and behavior. This behavior change is the most difficult to implement. The provision of this education is very important because diabetes is a disease associated with the patient's lifestyle. Therefore, to achieve the success of diabetes therapy, there is a need for collaboration between patients, families and health workers in this case nurses or counselors who provide education directly or via SMS. By providing education via SMS, it is expected that the patients have sufficient knowledge about diabetes, which can further change attitudes and behavior so that they can control the condition of the disease and blood sugar levels and improve the quality of life (Vervloet M, et al. 2012).

It can also be said that giving Interventions using SMS media can increase patient knowledge about DM management. This is also in line with the results of previous research conducted by Kusfriyadi MK (2012) who concluded that cell phones are one type of communication technology that is effective and feasible to provide information through sending SMS contents as reminders (reminder) in efforts to promote public health. Research in Iran also showed the effectiveness of interventions using SMS via cell phones on knowledge in the management of type 2 diabetes mellitus. An increase in knowledge can be caused by the advantages of the SMS media including messages that can be sent in a fast time and read at the appropriate time. The existence of two-way communication and SMS is cheaper than other print media (Fjeldsoe BS, et al 2019).

This study is also in line with research conducted by Lubis et al who said that giving SMS reminders to these patients is a strategy to remind patients to make regular visits to health services. Based on that, sending a reminder SMS can be one of the strategies to support patient compliance in controlling their health to health services (Lubis, I. K., 2016)

In addition to increasing patient compliance, giving SMS is also proven to have benefits for patients and is a cost-effective method for supporting health professionals to provide quality and quality services. Hussein et al. (2011) have evaluated the feasibility of using SMS between clinic visits that have a positive effect on blood sugar control in patients with type 2 diabetes. Heatley et al. (2013) proved that the SMS reminder system is an effective method of increasing the presence of women with gestational diabetes to routinely follow controls at the Hospital.

The results of this study are also supported by Lanita's research (2015) which stated that health education media through the combination of SMS plus booklets is the most effective or best media in increasing knowledge in overweight and obese adolescents. The health education intervention via SMS plus the booklet also showed that the combination of the two media is influential in increasing adolescent knowledge about obesity. As mentioned, the incorporation of several media can increase one's knowledge. The combination of SMS plus booklet media will be easily learned and understood. This is because they can read and view the contents of the material contained in the booklet, and also get additional information via SMS sent to them every two days.

#### CONCLUSION

Characteristics of respondents by sex showed that most of the respondents are female as many as 40 people (66.7%). The age category is mostly in the early elderly category (45 - 55 years) which is as many as 30 respondents (50%). The highest education level of respondents is senior high school level (SMA / SMU) which is as many as 24 respondents (40%). The most work status is Housewife (not working) as many as 24 respondents (40%). The longest-time suffering from DM is in the range of 2-5 years that is as many as 26 respondents (43.3%). There is a significant difference between post-prandial blood sugar (GDPP) before and after providing education via SMS to the intervention and the control group. There is a significant difference in the control of GDPP between the control and the intervention group after providing education via SMS.

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