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SMS education for promotion of type 2 diabetes self-management at the national center for diabetes and hypertension (NCDH) in Cameroon

Abstract

Therapeutic education is defined as a set of tools for training the patient to acquire adequate know-how in order to achieve a balance between his or her life and optimal control of the disease. It is threrefore one of the pillars of diabetes management. Therefore, with the use of mobile phones, it is now possible to use digital tools to train people with diabetes to effectively manage their disease themselves. Therefore telephone messaging interventions such as Short Message Service (SMS) may present practical and cost-effective ways to support diabetes self- management and thus improve metabolic control in patients with diabetes. Thus the objective of our study was to évaluate the effect of educational text messages on the metabolic control of type 2 diabetes. To do so, we conducted a randomized clinical trial from february 7 to june 2022 in two hospitals in the city of Yaounde: the National Center for Diabetes and Hypertension (NCDH) of the Central Hospital of Yaounde (CHY) and the General Hospital of Yaounde (GHY). This study included two groups: an intervention group that receive educational and personalized text messages and a control group that receive placebo messages. The minimum sample size was 23 participants in each group using the Whitney and Ball; sociodemographic data, history, clinical data parameters were entered and analysed on SPSS 26.software and Excel 2013 for plots. Neymar mac test was used to search for association between variables. We recruited 60 participants, 30 in the intervention group and 30 in the control group. Each participant was followed up for a period of 3 months and after 3 months of follow-up, after measurement of glycated haemoglobin variables. We had a significant decrease of 1,64% (P=0,047) in glycated haemoglobin in the intervention group versus 0,82% in the control group. In addition,we had a significant improvement in the level of knowledge (P<0,001), self-efficacy in physical activity(p=0,021) and self-monitoring of blood glucose in favour of the intervention group(P=0,018). More than half of the participants indicated a high level of satisfaction with the programme and said they would recommend it to orthers. Therapeutic message education improves not only the metabolic education improves not only the metabolic control of patients, their level of knowledge but also their efficacy in managing their disease.

Keywords: Diabetes, self-management, SMS, mobile phones, education, glycemic control, HbA1c, NCDH of yaounde center hospital, general hospital of yaounde, awareness, text messaging

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Introduction

Diabetes mellitus is a serious metabolic disorder characterized by chronic hyperglycemia. It may be due to a defect in insulin synthesis or to resistance to the peripheral actions of insulin, or to both.[1] It is a major public health problem that has reached alarming rates. The global prevalence of diabetes in 2021 is estimated at 10.5% or 537 million people aged 20-79 and is expected to increase to 11.3% or 643 million people by 2030.[2] In Africa, however, the prevalence of diabetes is lower with 4.5% or 24 million people, but it is expected to increase to 4.8% or 33 million people by 2030. In Cameroon, on the other hand, it is estimated at 4.8% or approximately 620,800 adults aged 20-79.[2]

Halting the epidemiological increase in diabetes and controlling the disease burden associated with diabetes is a global health service priority.[3] The balance of diabetes, however, has the particularity of associating modern drug treatment with dietary management and regular physical activity. However, several studies show that these measures taken in isolation are insufficient to ensure good control of diabetes. Many patients prove to be insufficiently observant of the recommendations issued by doctors because they are inclined to forget their doctor's advice or possibly ignore them after leaving the clinic because of the insufficient time allocated during outpatient appointments.[4] Therefore, therapeutic education becomes one of the pillars of the management of diabetes but is not always easy to implement.[5]

Therapeutic education helps the patient to become independent and to prevent the occurrence of avoidable complications, while maintaining or even improving his quality of life.[6] It is therefore essential in the treatment of diabetes because it is necessary for the patient's motivation and acquisition of knowledge, skills and appropriate attitudes to deal with the disease.[7] However, diabetes self-management education has been shown to improve metabolic balance and may reduce long-term complications.

Nowadays, with the increasing use of mobile phones, the internet, it is now possible to use digital tools to train people with diabetes to manage their disease themselves. There are a number of mobile applications[22] and websites available such as *diabetes journal, prognosis diabetes,* to provide basic diabetes education. It should be noted that patient access to such systems has significantly reduced primary care office visits. However, the implementation of diabetes

self-management education programs may not be feasible for all institutions, even in developing countries due to the lack of available resources.[8]

The introduction of educational text messages is therefore more accessible in Africa and has proven beneficial elsewhere. In addition, mobile phone messaging interventions such as short message services (SMS) may present practical and cost-effective ways to support diabetes self-management.[9] It is therefore very important to evaluate the effect of therapeutic education by SMS in type 2 diabetic patients in order to highlight the impact of educational text messages on their metabolic balance.[4]

It is with this in mind that some studies have been conducted to assess the impact of educational text messages on the metabolic balance of diabetics. For example, a study carried out in Iraq in 2014 to assess the feasibility and usefulness of short message services demonstrated a decrease in HbA1c of 0.7% compared to baseline.[10] Moreover, in 2017, a randomized clinical trial in Egypt to examine the feasibility as well as the impact of educational text messages demonstrated that there was a decrease in HbA1c of 1.05% as well as a considerable improvement, treatment compliance, self-efficacy and knowledge scores in favor of the intervention group.[4] Therefore, the use of mobile phones to provide self-management support, however, enables patient-centered care at the frequency and intensity desired by patients outside of the clinic environment.[3] This would thus contribute to reducing the risk of contamination during this period of the COVID 19 pandemic. It is with this in mind that we have proposed in this study to evaluate the effect of educational text messages on the metabolic balance of diabetics followed at the National Center for Diabetology and Hypertension in Yaoundé and at the General Hospital in Yaoundé. Therapeutic education by SMS improves the metabolic balance of diabetic patients.

The general objective of the present work consisted of evaluating the effect of educational text messages on the metabolic balance of type 2 diabetics followed at the National Center for Diabetes and Hypertension Yaounde Central Hospital (NCDH) and in the Endocrinology and Metabolic diseases unit of the General Hospital of Yaoundé (GHY).[11-17]

Materials and method

Study design

This was a 7-week randomized controlled intervention study. Patients were randomized and divided into two groups:

I. An intervention group that received diabetes educational SMS messages in addition to reminder prompts to take tests and record readings.

II. A control group that received no SMS messages.

III. Both groups, however, received a booklet of diabetes care instructions at the beginning of the study. The booklet was meant to introduce intervention patients to diabetes management before receiving short SMS messages on the subject. It also intended to make control patients feel that they belonged to the program and encourage them to stay through the end of the study.

IV. Both groups also received a monitoring table to record their blood glucose measurements and return it after completion of the study.

Educational SMS messages were sent on a daily basis. Intervention patients received one message per day; each day from a different category of messages. This allowed for a variety of information to be sent and covered seven message categories (diet, physical activity, complications, etc.) throughout the week. After 7 weeks, each patient had received 7 warning messages from each category making a total of 49 educational messages per patient and 9 reminder messages making total of 58 messages.

Patients were monitored by the hospital's outpatient clinic of internal and general medicine. They were invited to measure their blood glucose once a week according to a preset schedule, and take the HbA1c test at the beginning and end of the study period. As an incentive, all tests and measurements were provided free of charge. Further, patients were permitted to see the clinic's doctor when necessary without paying any admission fees. A free dose of diabetes medications was planned to be offered to those who complete the study, should extra incentives come to need. Follow-up interviews and feedback questionnaires were also conducted throughout and after the study period. Blinding was only applicable to the outcome assessors (lab and clinic nurses), but to participating patients, the study remained unblinded.

Study location and team

The study took place in the city of Yaoundé at the National Diabetes and Hypertension Center of Yaoundé (NCDHY) and in the Endocrinology and Metabolic Diseases unit of the Yaoundé General Hospital (HGY). Our study took place in the outpatient clinic of internal and general medicine, which operates every day except Fridays and admits up to 40 patients per day. Besides the study's researcher, the study team comprised a diabetes specialist, internal medicine doctors, and clinic and lab nurses.

Recruitment

Upon receiving approval from both the DHNCY Director and the head of Endocrinology and Metabolic Diseases unit, the researcher was authorized to attend patient examinations in the hospital and identify appropriate candidates for the study. The hospital worked daily from 9 am to noon and accepted patients on a first come first serve basis through a small admission system and a low priced examination ticket. Patients visited the Center for multiple and various reasons, one of which was diabetes and its complications.

Baseline HbA1c testing, interview, and pre-study questionnaire

Between February and June 2022, patients were contacted to complete the pre-study questionnaire (see Additional file 1: Pre-study questionnaire) as part of a 30-min baseline interview, during which the baseline weight and blood glucose level were recorded and their recent test results (if any) were checked. Patients were also informed that they would be contacted again within a month to take a baseline HbA1c test and receive an instruction booklet on diabetes.

Interventions

The SMS message sending started on Febuary 1st 2022 for 7 consecutive weeks. Patients were greeted first with a welcome message that read "Welcome to the Center for diabetes awareness program! Please follow the instructions in order to keep your blood glucose levels normal". Seven SMS categories, comprised of 12 messages each, were prepared with the objective of sending one category message per week day. The categories included educational, interventional, and lifestyle messages and were extracted from a publication of the WHO EMR office on diabetes education.[18]

Sample size

The primary hypothesis of the study was that intervention patients receiving daily educational SMS messages would experience a reduction in their HbA1c levels compared to controls given only paper-based instructions.

Randomization and stratification

In order to prevent imbalance in prognostic factors, stratified randomization was implemented using the following stratification factors: age, sex, diabetes years, and SMS familiarity. Age and sex were considered of high importance in order to achieve balance within subgroups.

Ethics

There were no associated risks with our SMS intervention. The messages consisted of reminding patients to follow their doctors' instructions and did not interfere with their prescribed medications. For instance, sample messages included: *"Do not forget to take your medications at the preset times"* or "The medications will not be effective if not combined with regular exercise and healthy eating". The intervention aimed to provide an easier way to reach patients and educate them about their disease.

Processing and statistical analysis

Descriptive statistics were computed for baseline demographic and clinical characteristics; and reported as means and standard deviations for continuous variables, and frequency counts and percentages for categorical variables. SPSS (Statistical Package for Social Science) software version 26.0 was used for data entry and statistical analysis, and Excel 2013 for diagrams. The quantitative variables was expressed in the form of averages, plus or minus standard deviation or median with interquartile range, and the qualitative variables as for them, in the form of numbers and percentages. The student or Mac Neymar test was used to search for associations between the variables. Data was considered statistically significant for a p value < 0.05.

Results

Participant flow

Eighty five patients were assessed for eligibility during the recruitment (febuary 2022–June 2022) Fifteen were excluded at the beginning intervention as 10 did not know how to read their SMS,[20,21] four patients did not provided informed consent and one had type 1 diabetes. Through the end of the baseline study, we excluded more patients for changing their phone number and/or missing data and observed a series of dropouts that caused the loss of 10 patients (Figure 1,2).

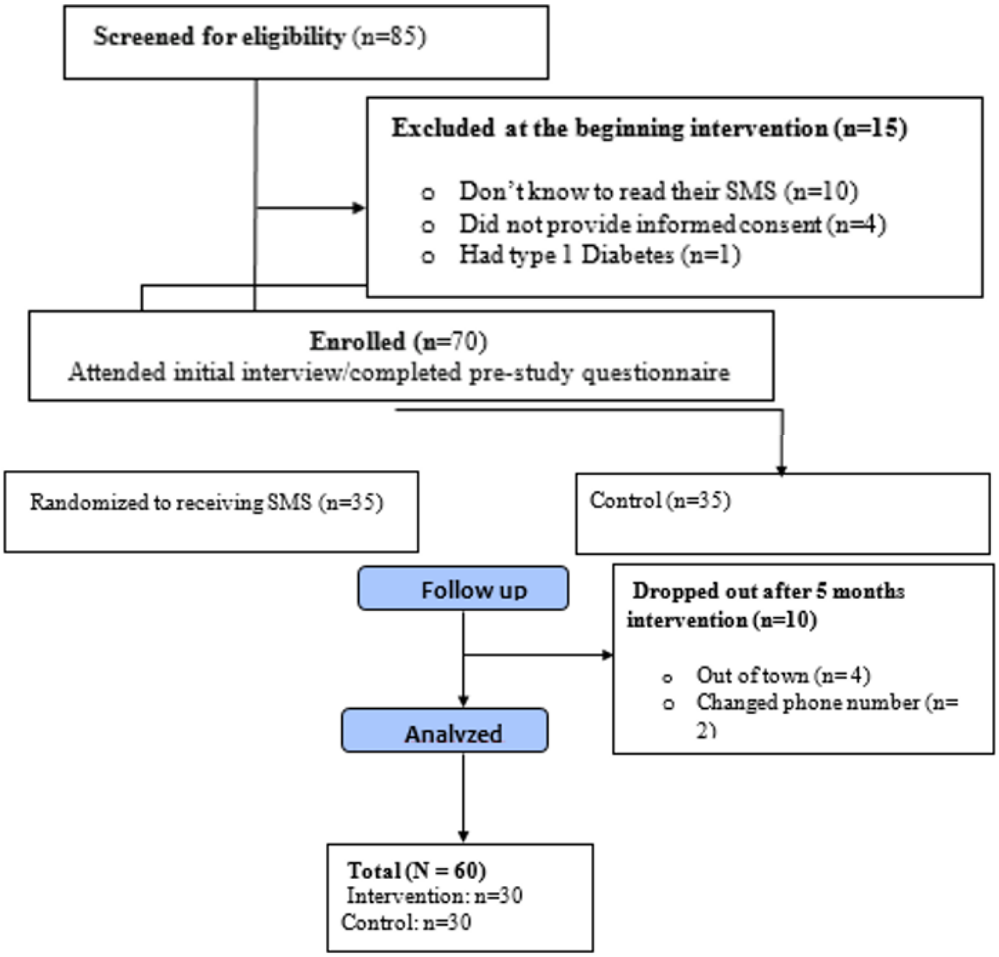

Figure 1 Recruitment Flowchart.

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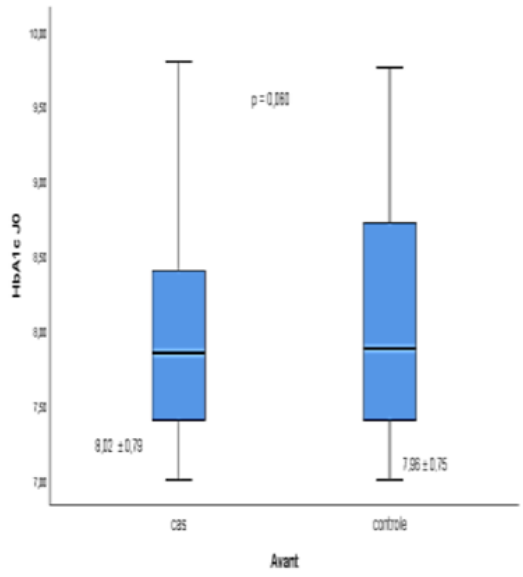

Figure 2A: Before intervention

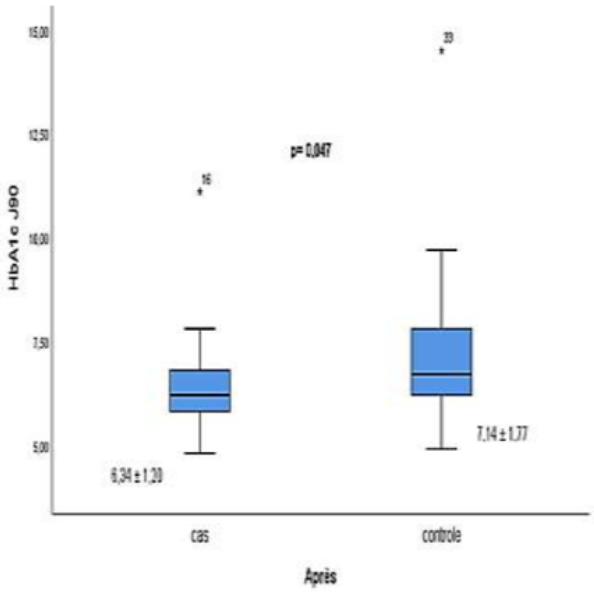

Figure 2B: After intervention

Figure 2 Distribution of the population according glycated haemoglobin (HbA1c**)** evolution.

There was a significant decrease in glycated haemoglobin in the 2 groups, greater in the intervention group than in the control group.

Participant characteristics

Baseline demographic and clinical characteristics of patients that completed the study and were included in the analysis (n = 60) are shown in Table 1. All participants were Type 2 diabetics and for both groups, most patients were in their 50s and slightly over 50% were female. On the social level, most group participants were married, employed, educated enough to read French and or English, could open and read SMS messages on their own.[23] Very few patients had received diabetes education as part of their nursing job in the hospital or at NCDH.[19] Concerning the medical history of diabetes, the majority of patients had had diabetes for more than a year, with an average of 7 years for both control and intervention patients. About 40% of both patients were on insulin treatment with improvement of Hypertension while the control group presented other chronic disease (13.3%); diabetic complications were slightly reduced in case groups compared to controls.[24]

Table 1 Participants' baseline socio-demographic and clinical characteristics (n = 60)

Variable	Case (%) N=30	Control (%) N= 30	p-value
Age (years)	56.9±7.88	55.6±6.94	
Sex			
Male	14 (46.7)	14 (46.7)	1
Feminine	16 (53.3)	16 (53.3)	
Region of origin			
West	12 (40)	17 (56.7)	0.174
Center	15 (50)	8 (26.7)	
Littoral	0 (0)	3 (10)	
North West	1(3.3)	1(3.3)	
South West	1(3.3)	0(0)	
South	1(0)	0(0)	
Foreigner	0 (0)	1(0)	
Marital status			
Married	21 (70)	21 (70)	0.779
widow/widower	3 (10)	3 (10)	
Divorcee)	1(3.3)	0(0)	
Single	5 (16.7)	6 (20)	
Residence			
Urban	4 (13.3)	4 (13.3)	1
Rural	26 (86.7)	26 (86.7)	

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Table 1 Continued...

Employed			
Public sector	30(100)	2(6.7)	
Private sector	30(100)	14 (47.6)	
No employment	3 (10)	7 (23,3)	
Retirement	30 (100)	7 (23,3)	
Education			
Primary	4 (13.3)	8 (26.7)	
Secondary	18 (60)	15 (50)	
University	8 (26.7)	7 (23.3)	
Medical history			
Diabetes years (≥1)	7	7.5	
On insulin	**12(40)**	**13(43,3)**	
Hypertensive			
SBP	139.20 ± 11.34	137.60 ± 20.23	
DBP	84.53 ± 9.46	84.33 ± 11.28	
Other chronic diseases	3(10)	00 (00)	
Suffer diabetes complications	24(80)	23(76.7)	
Lifestyle & Monitoring			
Smokers			
Average frequency of blood glucose measurement			
Less than once/week	12(40)	8(26,7)	
Once/week	11(36.7)	12(40)	
Two to three/week	7(23.3)	6(20)	
>4 glycemic check/week	0(0)	4(13.3)	
Average rate of physical activity	21(70)	24(80)	
Average rate of following a healthy diet			
Dietician consulting	30(100)	30(100)	
Proposal diet	30(100)	30(100)	
Clinical			
HbA1c (%)	7.14 ± 1.77	6.34 ± 1.20	**0.047**
Random blood glucose (mg/dl)	122.50± 2.00	110 ± 3.75	0,063
BMI	30.40 ± 4.29	30.19 ± 5.42	0,869

In the lifestyle and monitoring category, all control and 90% of intervention group were very similar in their average rates of lifestyle behaviours such as: Average, frequency of blood glucose measurement per week, rate of physical activity and rate of following a healthy diet. But the questionnaires showed patients' satisfaction with follow-up and communication with our program which was remarkable for both groups at 3 months, highly exceeding their satisfaction scores with their healthcare providers before the study. All participants indicated high level of satisfaction with the program, expressed interest to remain in the program should it continue to operate, said they would recommend it to others, and believed it could improve the hospital's reputation (Data not shown).

Clinical management showed that, SMS messages resulted in higher HbA1c reductions compared to controls, but the most sizeable improvements were observed in secondary outcomes (treatment and medication adherence, diabetes knowledge, etc.) and self-management behaviours.

Discussion

The work presented was a randomized clinical trial whose aim was to determine the effect of educational text messages on the metabolic balance of type 2 diabetics followed in 2 hospitals in Yaoundé. Due to the ubiquity of mobile phones in low- and middle-income countries, it is now possible to use digital tools to train people with diabetes to self-manage their disease. Therefore, text message-based interventions aim to help people with diabetes improve their self-management behaviour and achieve better glycaemic control.

We recruited 60 participants, 30 of whom constituted our intervention group and 30 our control group. More than half of our participants were in their 50s, just over 50% were women; this result is similar to that found by Huo et al.,[25] in china in 2019 where the average age of the population was 55.9%.[25] This could be explained by the age of onset of type 2 diabetes, generally after 40 years.[26] Most of the participants in both groups already had a number of diabetes complications such as diabetic neuropathy, diabetic retinopathy, diabetic nephropathy and erectile dysfunction; this could be explained by the fact that more than half of the participants in the 2 groups had been diabetic for more than 7 years. In addition, some chronic complications of T2D are present at diagnosis. This result is similar to that found by Abaza et *al* in Egypt where most participants had had diabetes for over a year, with an average of 5.63 – 7.99 years demonstrating the time complications take to develop. Hence the importance of therapeutic education by SMS in this target population.[4]

With regard to glycated haemoglobin, at the outset no significant difference was observed between the two groups. However, after 3 months of follow-up, the proportion of patients who achieved less than 7% was 80% in the intervention group and 56.7% in the control group, respectively. Significance, are similar to those encountered

in various studies regarding the effect of educational text messages on the metabolic balance of type 2 diabetics.[28] This is how Huo et al.,[25] in China in a study evaluating the effectiveness of a text messaging-based intervention, achieved a reduction in glycated haemoglobin of 1.11% in participants in the intervention group; moreover, a large proportion of patients had reached the set goals of less than 7% glycated haemoglobin thanks to these messages: 69.5% in the intervention group compared to 52.6% in the control group (p=0.004).[25] Also in New Zealand, Dobson et al.,[29] showed in their study that an automated message-based diabetes self-management and support program has potential to improve metabolic control in adults with poorly controlled diabetes.[29]

An association between the targeted 1% drop in glycated haemoglobin and membership in the intervention group was demonstrated in our study, as 25 patients in the intervention group (83.3%) achieved a targeted drop of 1 % HbA1c compared to 13 patients in the control group. A similar observation was made by Abaza et *al* in Egypt where in a population of 39 patients in each group, 16 patients in the intervention group against only 6 control patients had obtained a targeted reduction of 1% in glycated haemoglobin, thus demonstrating the effect beneficial educational text messages.[4]

In our study, the reduction in glycated haemoglobin at 3 months was significantly greater in the intervention group, i.e. 1.64% (P=0.047) than in the control group; i.e. 0.82%. This result is similar to that found by Abaza et *al* in Egypt who found a non-significant difference of 1.05% and 0.69% (P=0.406) respectively in the intervention and control group. This could be explained by the fact that the content of the messages sent to the participants in the study by Abaza et *al* was almost similar to the messages sent in our study.

In our study, we did not have a significant drop in fasting blood glucose in the intervention group despite the significant drop in glycated haemoglobin. This could be explained by the fact that glycaemic parameters depend on fasting glycemia and postprandial glycemia, which we did not assess in our study. So the decrease in glycated haemoglobin may be related to the unassessed postprandial glycaemia. However, the lack of improvement in blood sugar levels has been demonstrated by Farner et al.,[27] who found in their study that texting does not lead to improved blood sugar in low-resource settings.

In both groups, there was a nonsignificant drop in blood pressure, but in the studies in general, the drop in blood pressure was only significant in the intervention group. We had a drop of 5.7 mmHg identical to that found in the multicentre study by Farner et al.,[27] carried out in Cape Town in South Africa and Lilongwe in Malawi which found a significant difference between the groups in systolic blood pressure from baseline to arrival of 3.46mmhg (1.48 to 5.44; p=0.001) in favour of the intervention group.[27] This could be explained by the fact that the telephone messaging program generally acts on self-management behaviours such as the practice of a regular activity, a balanced diet, adherence to medication, smoking cessation, which constitute a subset of various self-management behaviours that can lead to lower systolic blood pressure.

Patient satisfaction with follow-up and communication with our program was outstanding for both groups. All participants indicated a high level of satisfaction with the program and expressed interest in staying with the program if it continued to work and also stated that they would recommend it to others. This is in line with Huo et *al* who demonstrated in their study that more than 80% of participants said they read the messages during the study period and about ¾ said they recorded the messages for learning more in-depth. Nearly 94% of participants said they would be willing to continue receiving text messages to improve their knowledge and support future disease management.[25]

Concluding remarks

The aim of this study was to evaluate the effect of educational text messages on the metabolic balance of type 2 diabetics followed in 2 hospitals in Yaoundé, we made the following findings: Regarding the socio-economic and clinical profile, the average age of patients was between 57.17-59.57 years with a female predominance (53.3%). Arterial hypertension was the main comorbidity found (76.7%-60%) respectively in the case and control groups. Educational text messages improved the metabolic balance of type 2 diabetics, as after 3 months of follow-up, there was a significant decrease in glycated haemoglobin of 1.64% in the intervention group compared to 0.82% in the control group (p=0.047). After 3 months of follow-up, we had had a significant improvement in the practice of physical activity (P = 0.021) and self-monitoring of blood sugar (P = 0.018) in favor of the intervention group. A knowledge assessment at the end of the study showed that knowledge was significantly higher in the intervention group than in the group (p<0.001).

SMS education appears to be a feasible and acceptable method for improving glycaemic control and self -management behaviours among Cameroonian diabetics.

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None.

Conflicts of interest

The authors declare that there are no conflicts of interest.

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