Short Message Service (SMS) and self-care promotion in type 2 DM: an integrative review

Short Message Service (SMS) e promoção do autocuidado em DM2: revisão integrativa

Short Message Service (SMS) y promoción del autocuidado en DM2: revisión integradora

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Abstract
Objective: To synthesize and analyze the available evidence in the scientific literature on use effects of Short Message Service (SMS) in self-care promotion in type 2 diabetes *mellitus*.
Methods: An integrative review of the literature was developed between 2007 and 2017, using the following databases to search for the studies: Cumulative Index to Nursing and Allied Health Literature, Cochrane Library, Scopus, Web of Science, Nursing database, Virtual Campus of Public Health, *Coleção Nacional das Fontes de Informação do Sistema Único de Saúde* (freely translated as Collection of Information Sources of the Brazilian Unified Health System), Regional Health Coordination South, *Índice Bibliográfico Español en Ciencias de la Salud* (IBECS), Latin American & Caribbean Literature in Health Sciences and PubMed. Descriptors such as text message, self-care, health education, health promotion and diabetes *mellitus*, as well as their descriptors in English and Spanish, and the associated Medical Subject Headings, were used. An initial sample of 739 articles was identified, of which 23 were classified as eligible to compose the final sample.
Results: In general, the work reported positive results. Among these, the following stand out: significant improvement in glycosylated hemoglobin levels, greater compliance with medications, improved self-care practices, increased knowledge about DM and better foot care.
Conclusion: Scientific evidence in the literature shows that the use of SMS as a methodological strategy may favor the improvement of self-care practices in type 2 DM.

Resumo
Objetivo: Sintetizar e analisar as evidências disponíveis na literatura científica sobre os efeitos do uso de *Short Message Service* (SMS) na promoção do autocuidado em diabetes *mellitus* tipo 2.
Métodos: Foi desenvolvida uma revisão integrativa da literatura, no período de 2007 a 2017, utilizando para a busca dos estudos as seguintes bases de dados: *Cumulative Index to Nursing and Allied Health Literature, Cochrane Library, Scopus, Web of Science,* Base de dados de enfermagem, Campus Virtual de Saúde Pública, Coleção Nacional das Fontes de Informação do Sistema Único de Saúde, Coordenadoria Regional de Saúde Sul, *Índice Bibliográfico Español en Ciencias de la Salud (IBECS),* Literatura Latino-Americana e do Caribe em Ciências da Saúde *e PubMed*. Para isso, utilizou-se descritores como: mensagem de texto, autocuidado, educação em saúde, promoção em saúde e diabetes *mellitus*, bem como os respectivos descritores em inglês e espanhol, e os *Medical Subject Headings* associados. Foi identificada uma amostra inicial de 739 artigos, dos quais 23 foram classificados como elegíveis para compor a amostra final.
Resultados: Em geral, os trabalhos reportaram resultados positivos. Dentre estes, destacam-se: melhora significativa dos níveis de hemoglobina glicada, maior adesão aos medicamentos, melhora das práticas de autocuidado, aumento do conhecimento acerca do diabetes e melhor cuidado com os pés.
Conclusão: Evidências científicas na literatura mostram que o uso de SMS como estratégia metodológica pode favorecer a melhora das práticas de autocuidado em diabetes tipo 2.

Resumen
Objetivo: Sintetizar y analizar las pruebas disponibles en la literatura científica sobre los efectos del uso de Short Message Service (SMS) para la promoción del autocuidado en diabetes *mellitus* tipo 2.
Métodos: Se realizó una revisión integradora de la literatura del período de 2007 a 2017 y se utilizaron las siguientes bases de datos para la búsqueda de los estudios: *Cumulative Index to Nursing and Allied Health Literature, Cochrane Library, Scopus, Web of Science,* Base de datos de enfermería, *Campus Virtual de Saúde* Pública, *Coleção Nacional das Fontes de Informação do Sistema Único de Saúde, Coordenadoria Regional de Saúde Sul,* Índice Bibliográfico Español en Ciencias de la Salud (IBECS), Literatura latinoamericana y del Caribe en Ciencias de la Salud *y PubMed*. Para ello, se utilizaron descriptores como: mensaje de texto, autocuidado, educación en salud, promoción de la salud y diabetes *mellitus*, así como los respectivos descriptores en inglés y español, y los *Medical Subject Headings* asociados. Fue identificada una muestra inicial de 739 artículos, de los cuales 23 fueron clasificados como elegibles para formar parte de la muestra final.
Resultados: En general, los trabajaos aportaron resultados positivos. Entre ellos pueden destacarse: mejora significativa de los niveles de hemoglobina glicosilada, mayor adhesión a los medicamentos, mejora de las prácticas de autocuidado, aumento del conocimiento sobre la diabetes y mejor cuidado de los pies.
Conclusión: Evidencias científicas en la literatura demuestran que el uso de SMS como estrategia metodológica puede favorecer la mejora de las prácticas de autocuidado en diabetes tipo 2.

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Conflicts of interest: nothing to declare.

Introduction

Type 2 diabetes *mellitus* (type 2 DM) is a chronic condition resulting from altered production of insulin by the pancreas and/or inability to properly exercise its function in the body. Inadequate management of the condition can result in immediate complications, such as hyperglycemia and long-term complications such as macro and microvascular complications.[1]

The Regional Centre for Studies for the Development of the Information Society (*Centro Regional de Estudos para o Desenvolvimento da Sociedade da Informação*) in 2016 revealed that the part of Brazilians between 45 and 59 years old who had mobile devices was 85%. Among individuals 60 years of age or older, 67% reported having the device. Considering that the prevalence of type 2 DM in Brazil is higher among individuals over 45 years of age, the present data show that the Short Message Service (SMS) presents a high potential to be an alternative form of health education for self-care in diabetes. This is a fact that is consolidated by the high accessibility and low cost of the resource.[2,3]

Currently, the frequent use of Information and Communication Technologies (ICTs) presents a great capacity for promoting self-care in diabetes. One of the reasons for this is that mobile equipment, such as mobile phones, offers the use of SMS. This service provides that the health provider constantly reminds the individual about self-care practices. Thus, there is a growing interest in the use of SMS as an educational methodological strategy to improve self-care through ease of communication and to reach individuals from different ethnic groups and socioeconomic levels.[4–7]

Sending text messages has shown to be a motivation for the proper management of diabetes by encouraging the recipients and making the assimilation of information easier. This is due to constant warnings about the importance of daily practices for health, which provides an increase in the link between the patient and his health center and promotes an improvement in the condition's clinical evolution. These results reveal the potential of using this methodological strategy to improve self-care.[8]

Studies carried out in the United States, India and Egypt showed that interventions that adopted SMS in their methodological strategy to promote self-care obtained positive results. Among them, the following are highlighted: reduced glycosylated hemoglobin (HbA1c) levels, greater compliance with medication use, better control of diabetes, decreased plasma lipid levels, increased physical activity and improved eating habits.[5,9–12]

Thus, the present integrative review study aims to synthesize and analyze the available evidence in the scientific literature on the effects of the use of SMS in self-care promotion in type 2 DM.

Methods

The integrative review was segmented into six stages, being: 1) elaboration of the guiding question; 2) carrying out the search in the literature; 3) categorization of studies; 4) evaluation of studies included in the work; 5) interpretation of results; 6) synthesis of the review developed.[13–15]

The guiding question of the study is: is there evidence in the literature that sending SMS to patients with type 2 DM promotes changes in self-care practices?[14]

From this, the searches were carried out in the following databases: Cumulative Index to Nursing and Allied Health Literature, Cochrane Library, Scopus, Web of Science, Nursing database, Virtual Campus of Public Health, *Coleção Nacional das Fontes de Informação do Sistema Único de Saúde* (freely translated as Collection of Information Sources of the Brazilian Unified Health System), Regional Health Coordination South, *Índice Bibliográfico Español en Ciencias de la Salud* (IBECS), Latin American & Caribbean Literature in Health Sciences and PubMed, where the last seven were indexed to the Virtual Health Library (VHL).

The PICO (Patient, Intervention, Comparison and Outcomes) strategy was used to determine the search strategies in all the databases. In the

databases indexed to the VHL, from the descriptors in Health Science (DeCS), the following search strategy was elaborated: Diabetes AND ("Mobile Applications" OR "*Aplicaciones Móviles*" OR "*Aplicativos Móveis*" OR "*Aplicativos em Dispositivos Móveis*" OR "*Aplicativos para Dispositivos Móveis*" OR "*Apps Móveis*" OR "Social Media" OR "*Medios de Comunicación Sociales*" OR "*Mídias Sociais*" OR "*Meios de Comunicação Sociais*" OR "Text Messaging" OR "*Mensaje de Texto*" OR "*Mensagem de Texto*" OR "SMS") AND ("*Self-Care*" OR "*Autocuidado"* OR "*Health Promotion*" OR "*Promoción de la Salud*" OR "*Promoção da Saúde*" OR "*Promoção em Saúde*" OR "*Programas de Bem-Estar*" OR "*Campanhas de Saúde*" OR "Health Education" OR "*Educación en Salud*" OR "*Educação em Saúde*").[14] All the controlled and uncontrolled descriptors were investigated in Portuguese, English and Spanish. The term "SMS" was an exception because it is an acronym that calls a synonym for "text message".

In the remaining databases, successive searches were carried out with different combinations of Medical Subject Headings (MeSH) that were closer to the DeCS employees. This process was necessary, since, probably due to the high amount of terms used initially, there was a great restriction on the results obtained, finding no studies. Therefore, the strategy most similar to DeCS and that was able to obtain results was "diabetes *mellitus*" AND "text messaging" AND "mobile application" AND "self-care".

The search identified 739 papers. Since not all the results met the proposed theme, it was necessary to stipulate exclusion criteria. In this way, publications that were review articles were excluded; did not adopt type 2 DM patients as a target group; did not use SMS as a methodological strategy; were electronically unavailable for reading; were not identified in search languages; adopted in their sample individuals with other types of pathologies; or described a protocol not yet performed.

Thus, the publications included in this review had as main theme the use of text messages to promote self-care in DM and had as target individuals diagnosed with type 2 DM or with type 1 and type 2 DM, concomitantly.

659 papers that were not related to the topic were excluded by reading the title and abstract. Of the excluded articles, 29 were duplicates. Thus, 80 publications were selected and read in their entirety. Their eligibility was evaluated so that only articles that met the established criteria were part of the final sample. They were classified as ineligible: seven because they were not identified for reading or did not appear in one of the search languages; 22 for not adopting the use of text messages as a methodological strategy; 10 because they did not have patients with type 2 DM as the study subject; six for using individuals with other pathologies; and four because they are protocols not performed until the present moment. In addition, 8 papers were excluded because they were review articles. Thus, a final sample of 23 articles, of which none was duplicated, was delimited. All the search steps are summarized in the flowchart of Figure 1 for better visualization of the process.

Furthermore, it is important to emphasize that the search period used was from 2007 to 2017 (10 years). This was based on findings in the literature, since no published studies were found before or after this time interval. In addition, all articles identified were relevant and within the present time for the study development.

The results obtained were independently reviewed by two authors, so that the search and selection phases were redone. Each article was classified according to its scientific evidence level by using the Agency for Healthcare Research and Quality (AHRQ) categorization. This step was adopted in order to provide greater reliability to the results and conclusions presented here.[15,16]

With this, from the final sample, a compilation was made with the most relevant information about each article, such as: country of performance, methodological strategy, number of individuals allocated in the intervention group, length of the study, frequency of sending of the messages (number of messages sent per day or week), thematic approach and scientific evidence level of the papers.

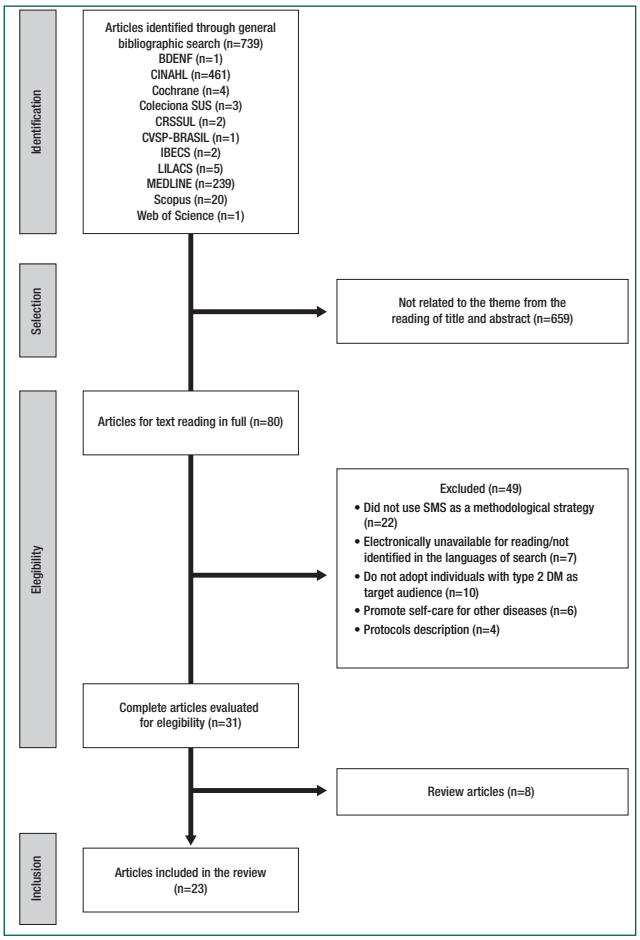

Figure 1. Flowchart with the steps followed to determine the final sample

Results

Characteristics of studies

The 23 articles found in the final sample have in common the SMS methodological strategy. However, part of the work also used other strategies, such as phone calls, motivational interviews and goal setting, as described in chart 1.

As to the place of study, articles were found with works developed in Iraq, South Korea, Iran, Jordan, India, the Netherlands, Egypt and the United States of America, most of which occurred in the latter (n=14). The studies were conducted with intervention groups ranging from 18 to 240 individuals, with different length times (5 days to 24 months). There was also a large difference in the frequency of sending text messages, since 7 studies chose to send weekly and 16 studies, daily. Part of the studies stipulated as the maximum number of characters for the content of the messages the maximum amount supported within an SMS.[4,9,23,29]

About 21 topics were dealt with in the content of sent text messages. The most frequently mentioned topics were: medications (n=15); self-monitoring of glucose levels (n=9); motivation (n=9); education (n=7); diet (n=7); physical exercise (n=6); and foot care (n=3).

Evaluation of methodological quality

The scientific evidence level of all the articles selected was presented as two, fitting as an individual study with experimental outlining (Chart 1).[16]

In the evaluation of the results, there was a great variety of methods applied. One of these was the control of medications (n=2). This strategy consists of monitoring the acquisition and reacquisition of medication for diabetes by the user. Thus, if there is adequate use, the repurchase period occurs within the expected period, if not, it occurs late and it is observed the low compliance with its use.[28,30] Another method applied was the step count (n=1), which monitors the movement of the individual by means of a device to evaluate changes in walking distances. Studies also opted for reports from the intervention group (n=5), which are based on an interview with the individual about their experience receiving SMS by the study. In addition to these methods, biochemical tests (n=14) and questionnaires (n=9).

Another factor to be addressed is the omission of important data. Part of the studies do not describe the exact number of messages each individual received per day or week, examples of the messages sent and the developer of the content of those messages. It was also not described by a significant number of papers as the basis used to determine the theme used and the number of characters used. This information becomes essential for the full understanding of the creation and implementation of interventions.

Chart 2 summarizes information regarding the content of text messages, method of evaluation of interventions and results of the studies analyzed here.

Chart 1. Characteristics of the studies included in the integrative review (n=23)

Author/ Year/ Country	Intervention group (n)	Sending frequency	Length (months)	Methodological strategy	Theme	Level of Evidence
Haddad et al. (2014) Iraq[6]	50	Once a week	7.25	SMS	Diet; treatment; complications; self-monitoring of blood glucose levels; and clinical care.	Individual study with experimental outlining Level II
Kim HS (2007) South Korea[17]	25	Weekly	12	SMS	Diet; physical exercise; medications; and self-monitoring of blood glucose levels.	Individual study with experimental outlining Level II
Yoon KH, Kim HS (2008) South Korea[18]	25	Weekly	12	SMS	Diet, physical exercise, dosage adjustment of medications, self-monitoring of blood glucose levels.	Individual study with experimental outlining Level II
Hanauer DA et al. (2009) United States[19]	22	Daily	3	SMS	Curiosities about the nutrition of patients with type 2 DM; trivial curiosities; and reminders for self-monitoring of blood glucose levels.	Individual study with experimental outlining Level II
Horner GN et al (2017) United States[20]	31	2 times a day	6	SMS	Health; reminders; and motivation.	Individual study with experimental outlining Level II
Nundy S et al. (2013) United States[21]	18	Daily	1	SMS and phone calls	Medications; foot care; clinical care; and self-monitoring of blood glucose levels.	Individual study with experimental outlining Level II
Osborn CY, Mulvaney SA (2013) United States[22]	20	Daily	0.5	SMS, motivational interviews and goal setting by phone.	Medications; side effects of medications; fear of being judged; motivation; support; and symptoms related to the disease.	Individual study with experimental outlining Level II
Nelson LA. et al. (2016) United States[23]	36	Daily	0.5	SMS	Healthy eating; physical activity; self-monitoring of blood glucose levels; and motivation.	Individual study with experimental outlining Level II
Fortmann AL et al. (2017) United States[4]	53	3 times a day	6	SMS	Motivation, education and attention calls.	Individual study with experimental outlining Level II
Peimani M et al. (2016) Iran[24]	50	Daily	3	SMS	Diet; physical exercise; medications; and self-monitoring of blood glucose levels.	Individual study with experimental outlining Level II
Dick JJ et al. (2011) United States[25]	18	Daily	1	SMS	Medications reminders; foot care; and self-monitoring of blood glucose levels.	Individual study with experimental outlining Level II
Capozza K et al. (2015) United States[26]	58	Daily	6	SMS	Education and motivation; medicines; self-monitoring of blood glucose levels; Weight; and physical exercises.	Individual study with experimental outlining Level II
Arora S et al. (2012) United States[12]	23	Daily	0.75	SMS	Education and motivation; medication reminders; healthy life challenges; curiosities about DM; and links to free disease management tools.	Individual study with experimental outlining Level II
Hassan ZM (2017) Jordan[27]	28	Four times a week	3	SMS	Foot care.	Individual study with experimental outlining Level II
Burner ER et al. (2014) United States[11]	24	Weekly	6	SMS	Education and motivation; medication reminders; and healthy life challenges.	Individual study with experimental outlining Level II
Shetty AS et al. (2011) India[10]	110	Twice a week	12	SMS	Diet; physical activities; and medications.	Individual study with experimental outlining Level II
Vervloet M et al. (2014) Netherlands[28]	56	Daily	24	SMS	Medications reminders.	Individual study with experimental outlining Level II
Abaza H, Marschollek M (2017) Egypt[5]	34	Daily	3	SMS	Reminders and education.	Individual study with experimental outlining Level II
Agboola S et al. (2016) United States[29]	64	Daily	6	SMS	Support; education; motivation; and healthy behaviors.	Individual study with experimental outlining Level II
Gatwood J et al. (2016) United States[30]	24	Daily	3	SMS	Medications.	Individual study with experimental outlining Level II
Nelson LA et al. (2016) United States[31]	80	Daily	3	SMS	Medications.	Individual study with experimental outlining Level II
Arora S et al. (2014) United States[9]	64	Daily	6	SMS	Education and motivation; medication reminders; challenges of healthy living; and curiosities associated with the disease.	Individual study with experimental outlining Level II
Celik S et al. (2015) Turkey[32]	221	Twice a week	12	Interview and SMS	Insulin administration.	Individual study with experimental outlining Level II

Chart 2. Content of text messages, method of evaluation of interventions and results obtained by each study (n=23)

Author/ Year	Messages example	M. Ev.	Results
Haddad NS., et al (2014)[6]	"Honey and dates cannot be consumed freely as they may disrupt diabetes control"; "If you forget to take your medication and remember 1 or 2 hours later, take it. If it takes longer, take your next tablet at the usual time"; "Take care of your feet. Foot problems can occur if you have diabetes; however, yours is being treated"; "Check your blood sugar four hours after meals and not immediately after eating"; "Visit us at the Diabetes Center to check your hemoglobin A1c"	BT and Q.	Improvement of HbA1c levels and knowledge about the disease.
Kim HS (2007)[17]	"Please decrease long-acting insulin in two units"; "Please add one sulphonylurea tablet at night"; "Please note the amount you are eating"; "Lack of exercise may be the cause of high glucose level"; "Your glucose control seems to be good";	BT.	Reduction of HbA1c levels comparing the intervention group with itself but there was no improvement comparing this to the control group.
Yoon KH, Kim HS (2008)[18]	"Please decrease long-acting insulin in two units"; "Please add one sulphonylurea tablet at night"; "Please note the amount you are eating"; "Lack of exercise may be the cause of high glucose level"; "Your glucose control seems to be good";	BT.	Reduction of HbA1c levels comparing the intervention group with itself but there was no improvement comparing this to the control group.
Hanauer DA., et al (2009)[19]	"Did you know? 250 ml of soda has 10 teaspoons of sugar"; "Butterflies feel the taste with their feet"; "If you missed the first reminder, it's time to check your blood sugar level"; "Just a reminder to check your blood sugar"; "Blood sugar was received. Stay up the good work!";	BT.	There was no difference in HbA1c levels between groups.
Horner GN., et al (2017)[20]	-	GR	Increasing the individual's connection with his health center, creating a sense of responsibility in the participants
Nundy S., et al (2013)[21]	"Check your feet today"; "It's time to take your medications for diabetes"; "How many days did you take your medications?"; "How many times have you checked your feet this week?";	GR	Improvement in the disease acceptance and reinforcement of the idea of the importance of self-care practices.
Osborn CY, Mulvaney SA (2013)[22]	"If you have difficulty going to the pharmacy, ask the doctor to prescribe 90 days of supply of your medications"; " If you are tired of taking medications for diabetes, talk to someone you trust and also has diabetes"; "It is important that you take your medications for diabetes even when you are feeling well. This will help keep your blood sugar under control"; "Everyone needs someone to talk about their diabetes. Do you know anyone who has diabetes?"; "If you have any side effects from your medications for diabetes, ask your doctor if you can take a different medication that does not have this side effect";	GR	Change of habits regarding medications and greater awareness about the importance of taking care of the disease.
Nelson LA., et al (2016)[23]	"Taking your diabetes medications will help you stay healthy for all the important things in your life"; "It may be difficult to reconcile time for physical exercise with your busy schedule. Try to determine small goals and build your success"; "Try baking, cooking or grilling your food. Use small portions of good oils such as canola and olive oil instead of the fat ones"; "Monitoring your blood sugar levels at different times of the day can give you an idea of different things that affect these";	GR.	Participants found the messages useful and reported that they did not feel more alone in caring for the disease, and more motivated to practice self-care.
Fortmann AL., et al (2017)[4]	"Use small plates! Portions will look larger and you may feel more satisfied after eating"; "It takes a team! Get the support you need with your family, friends, and support groups that can help you succeed"; "Tick, tock. Take your medications on the same time every day!"; "Time to check your blood sugar. Please send back your results";	BT	HbA1c levels were reduced in the intervention group.
Peimani M et al (2016)[24]	-	BT and Q.	Reduced fasting blood sugar levels; reduction of disease barriers; and increased self-care. In contrast, there was an increase in BMI and absence of significant changes in HbA1c and in the lipid profile.
Dick JJ., et al (2011)[25]	"Have you taken your medications for diabetes today?"; "How many times have you checked your feet this week?";	Q	Improvement of individuals' confidence regarding self-care and lower rates of forgetting medication.
Capozza K., et al (2015)[26]	"Have you had your blood test in the last 6 months? An A1C test accurately measures blood glucose, but you need to do this in your doctor's office"; "How are you? Feeling stressed with diabetes is normal. Getting support will help you feel better and control your glucose. Ask for help when you need it."	BT	There were no differences in HbA1c between the control group and the intervention group.
Arora S., et al (2012)[12]	"Having diabetes can lead to a heart attack or stroke, but can be prevented"; "Controlling blood glucose, blood pressure and cholesterol can mean a longer and healthier life"; "Eat more fruits, vegetables, beans, whole grains and less salt and fat"; "Medications reminder! Do not leave home without your medications "; "Challenge! Do not drink soda or juice today. Drink only water or milk"; "Challenge! Eat a meal today that has just vegetables"; "Challenge! Look at the food labels and find a snack that has less than 100 calories"; "What is a normal blood sugar level?";	BT and Q.	Improved intake of fruits and vegetables daily; increased physical activity practice; improvement in foot care; and greater compliance with medications. However, there were no significant changes in HbA1c and in knowledge about the disease.
Hassan ZM (2017)[27]	"Please dry between your toes"; "Look every day for cuts, sores, blisters, redness, calluses, or other problems"; "Checking your feet every day is even more important if you have nerve damage or poor blood flow"; "If you cannot see well, have someone check your feet";	Q	Increased knowledge about foot care and increased care practices with the feet.
Burner ER., et al (2014)[11]	-	GR	Improved diabetes control.
Shetty AS., et al (2011)[10]	-	BT and Q.	Improved of HbA1c and plasma lipids levels. There were no significant differences between the intervention group and the control group regarding compliance with the diet and greater practice of physical activity.
Vervloet M., et al (2014)[28]	"Have you been taking your mediation? Please take your medication as prescribed by your healthcare provider";	CM	Compliance with the use of medications, with similar efficacy results in the short (1 year) and long term (2 years).
Abaza H, Marschollek M (2017)[5]	"Do not forget to check your blood glucose and weight levels tomorrow, and record the result on your monitoring desk";	BT and Q.	Reduced HbA1C levels, greater compliance with medications and higher scores of knowledge about the disease and considerable improvements in the treatment of this.
Agboola S., et al (2016)[29]	"What are some of the benefits of becoming more physically active?"; "What are the benefits of staying the same?"; "How can you add other steps to your regular physical activity? Could you climb the stairs instead of using the elevator?"; "How would you rate your stress level in the last few weeks?";	BT and SC.	Increased physical movement of users and reduction of HbA1c.
Gatwood J., et al (2016)[30]	-	CM	There were no changes between the control and intervention groups regarding compliance with medications, and health beliefs and attitudes.

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Nelson LA., et al (2016)[31]	"It is important that you take your medications for diabetes as prescribed. Doing this can help you live longer"; "If you have trouble remembering to take your medications for diabetes, try linking them to other activities you do every day"; "Everyone needs someone to talk about their diabetes. How can your family or friends help you with your diabetes? Let them know";	BT	Responding to text messages was marginally related to better compliance with the program. There were no significant differences between HbA1C from the control and intervention groups.
Arora S., et al (2014)[9]	"Having diabetes can lead to a heart attack or stroke, but can be prevented"; "Controlling blood glucose, blood pressure and cholesterol can mean a longer and healthier life"; "Eat more fruits, vegetables, beans, whole grains and less salt and fat"; "Medications reminder! Do not leave home without your medications "; "Challenge! Do not drink soda or juice today. Drink only water or milk"; "Challenge! Eat a meal today that has just vegetables"; "Challenge! Look at the food labels and find a snack that has less than 100 calories"; "Curiosities: eating too much sugar and other sweet foods causes diabetes. A. True; B. False";	BT and Q.	Reduced HbA1C levels, increased compliance with medications and reduced use of emergency services.
Celik S., et al (2015)[32]	"Use the insulin pen needle only once for safe and pain-free use."; "For insulin injection, lift a skin fold with 2 or 3 fingers. Make sure you use the correct type of insulin at the right time"; " After injecting insulin, slowly count to 10 before removing the needle"; "Store unopened insulin vials in the refrigerator at 2-8 ° C"; "In case of swelling, redness, sore or infection at the injection site, contact your nurse"; "Use a different site for each injection, at least 1 to 2 cm away from the previous site";	BT and Q.	There was an improvement in insulin injection techniques and in the rotation of insulin injection sites, in addition to an improvement in HbA1c levels.

BT - Biochemical tests; Q - Questionnaires; GR - intervention group report; CM - Control of the length of medications; SC - Step count.

Thus, it was observed that the majority of the interventions obtained positive results with a significant improvement of the HbA1c (n=8) levels, greater compliance with medications (n=5), increased self-care practices (n=4), increased knowledge about the disease (n=2), and improved foot care (n=2). In contrast, part of the studies did not observe a statistically significant improvement in HbA1c levels (n=5) and in compliance with medications (n=2).

Discussion

Mobile technologies have been indicated to meet the needs of guidelines for self-care in diabetes. Remote communication ensures that health professionals can intervene at a distance through the use of SMS as an educational methodological strategy, achieving success in promoting self-care in diabetes with diet-related topics; physical exercise; medications; monitoring of glucose levels and motivational support.

Intervention time is an important variable for compliance with self-care practices. Shetty AS et al.[10] state that during the 12-month follow-up period the intervention group showed significant improvements in plasma lipid and Hb1Ac levels. While the study by Peimani M et al.[24] with a three-month intervention period and similar self-care themes did not identify statistically relevant results regarding plasma glycemic and lipid levels. Another 24-month study using a sample of 56 individuals showed that the improvement in medication compliance remained unchanged after 12 months of intervention.[28]

Moreover, it is observed that the time length variable of the interventions was related to the statistically significant results in HbA1c levels. Studies that obtained better results lasted, on average, eight months. Research that registered unsatisfactory results adopted in its intervention a period with a mean of three months.[4–6,9,10,12,17–19,24,26,29,31,32] This is probably due to the short interval between measurements and the delay in compliance with self-care practices.[33] Thus, in order to obtain expressive results, it is possible to estimate as the ideal time interval for the performance of the SMS interventions of eight to 12 months.

The theme of the messages adopted was also important for the positive results found. Interventions conducted in the United States and Egypt with educational issues that encouraged empowerment for self-care practices obtained significant results. These themes provided motivational support and knowledge about diabetes, resulting in the following outcomes: increased proximity to the individual with his health center, acceptance of his condition and regression regarding the feeling of loneliness regarding diabetes management. These factors were present at the end of the interventions, mainly because the user expresses an affective bond by receiving the messages and adopting the knowledge as part of their routine. It could also be observed that a higher frequency of sending personalized messages and individual sending to each user contributed to the achievement of significant results.[5,9,20,22]

Another important factor is the variety of the themes applied in the intervention. The studies that used messages with a low variety of themes or diverse themes on the same subject obtained results, although significant, related only to the issues addressed in the messages.[27,28,30,31] On the other hand, studies that used a wide range of thematic studies have obtained significant improvements in different diabetes issues such as diet, compliance with medications and improvement of HbA1c levels.[6,9,12]

Two studies sought to strengthen communication between the individual and the health center. The first, conducted in the United States, offered the possibility that respondents could respond to messages sent with their information. In this case, the individual could respond daily whether he had already taken his medications or not. The use of this response option was statistically correlated with a greater compliance with self-care.[31] The intervention done by Nelson LA. et al.[23] offered an option beyond that cited in the previous study where, in the event that the individual responded that he had not taken his daily medications another message, questioning him about the reasons, it was sent.

Another strategy of sending messages was the possibility of the individual personalizing the messages received. In this context, the individual, besides receiving the messages established as standards, could choose other subjects of his preference. This choice was made from previously presented options, where the user could choose the theme that best suited his needs to complement the general content. Accordingly, since each individual has different barriers to health condition management, this strategy may increase the chances of a successful intervention.[21,25,26]

In addition to these strategies, a resource called "administrative message" was created. What made it possible for individuals to report problems with receiving the usual messages or if they would like to cease receiving them.[25,26] This type of message is important to increase the proximity of the individual to the study, increasing the chances of compliance and also guaranteeing autonomy to the user regarding the program's withdrawal. In addition, one study reported sending a welcome message at the beginning of the intervention, which may also increase the provider-user link.[23]

The studies reported here are susceptible to bias. The main bias relates to the relationship between the length of the intervention and the results obtained. Interventions with short periods (less than three months) do not present significant changes in glycosylated hemoglobin (HbA1c). Thus, studies with short length, even using robust methodological strategies tend not to be successful in biochemical control. The application of questionnaires and intervention group reports also tend to present biases. In these cases, the individual may be induced by the interviewer to skew his response, which he thinks is the best or the most correct.

Another limitation identified was not to inform which professionals were responsible for formulating the content of messages. If the content of the messages has not been developed by a qualified professional, the desired effect in the intervention group may not be achieved. Therefore, it is extremely important that this content is developed by a healthcare professional who is familiar with the subject matter.

In this integrative review of the literature, text messages via SMS have proved to be important tools for self-care promotion, as well as being a methodological strategy that can be implemented for Brazilian patients with type 2 DM. However, we stress here the need for the text messages treated in the present study to be adapted for use in new communication applications for mobile devices. In this sense, WhatsApp allows provider-user interaction through different multimedia mechanisms such as texts, audios and images, besides being free.

Conclusion

Scientific evidence in the literature shows the efficacy of SMS as a methodological strategy for improving self-care practices in type 2 DM. In the present study, the main results identified in this type of intervention are: greater compliance with medications, reduced glycosylated hemoglobin (HbA1c) and plasma lipid levels, improved eating habits and increased physical activity.

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