https://doi.org/10.1590/1678-9865202235e210186

ORIGINAL

Memorization of messages, satisfaction, and feasibility of a nutritional intervention using a mobile text messaging app among adolescents

Memorização de mensagens, satisfação e usabilidade de intervenção nutricional via aplicativo de envio de mensagens entre adolescentes

Alice Barreto de MENESES[1] 0000-0003-3780-6131
Giselle Rhaisa do Amaral e MELO[1] 0000-0003-4918-8377
Stefany Côrrea LIMA[1] 0000-0002-7230-1051
Natacha TORAL[2] 0000-0003-0297-2340

ABSTRACT

Objective

This study aimed to evaluate the memorization of messages that promote healthy eating, as well as satisfaction and feasibility of a nutritional intervention using a mobile text messaging app aimed at adolescents from public schools in the Federal District, Brazil.

[1] Universidade de Brasília, Faculdade de Ciências da Saúde, Departamento de Nutrição. Brasília, DF, Brasil.
[2] Universidade de Brasília, Faculdade de Ciências da Saúde, Programa de Pós-Graduação em Nutrição Humana. *Campus* Universitário Darcy Ribeiro, Asa Norte, 70910-900, Brasília, DF, Brasil. Correspondence to: N TORAL. E-mail: <natachatoral@unb.br>.

Article based on the master's dissertation of GRA MELO, entitled "*Intervenção nutricional direcionada aos estágios de mudança via* WhatsApp *entre adolescentes de escolas públicas do Distrito Federal*". Universidade de Brasília, 2020.

How to cite this article

Meneses AB, Melo GRA, Lima SC, Toral N. Memorization of messages, satisfaction, and feasibility of a nutritional intervention using a mobile text messaging app among adolescents. Rev Nutr. 2022;35:e210186. https://doi.org/10.1590/1678-9865202235e210186

Methods

The messages sent addressed aspects of healthy eating based on the Dietary Guidelines for the Brazilian Population. A self-reported questionnaire was applied with 94 students to assess the memorization of the messages received during the nutritional intervention, the level of satisfaction with the intervention, whether the messages were read and shared, the frequency of reading, and what was learned from the intervention. The association of memorization with satisfaction and with the frequency of reading the messages was also investigated.

Results

About 48% of participants reported remembering at least one message; 77.7% showed high ranges of satisfaction; 54.3% always read the messages; 66.0% did not share messages with other people. Most of the students reported positive learning or good impressions about the intervention. An association was found between memorization and satisfaction with the intervention (p=0.002), as well as between reading and memorization (p=0.005).

Conclusion

Although the memorization of the healthy eating messages sent in the nutritional intervention was less than expected, a great satisfaction and high frequency of reading the messages were reported by adolescents. Future studies should investigate the permanence of the results of long-term nutrition intervention, the main influencers of memorization, and how to improve it.

Keywords: Adolescent. Food and nutrition education. Memory. Text messaging.

RESUMO

Objetivo

Este estudo teve como objetivo avaliar a memorização de mensagens de promoção de alimentação adequada e saudável, a satisfação e a usabilidade de uma intervenção nutricional via aplicativo direcionada para adolescentes de escolas públicas do Distrito Federal.

Métodos

As mensagens enviadas abordavam aspectos sobre alimentação adequada e saudável com base no Guia Alimentar para a População Brasileira. Foi aplicado um questionário de autopreenchimento a 94 estudantes para avaliar a memorização das mensagens recebidas durante a intervenção nutricional, o nível de satisfação com a intervenção, se as mensagens eram lidas e compartilhadas, a frequência de leitura e quais foram os aprendizados decorrentes da intervenção. Investigou-se ainda a associação entre a memorização, a satisfação e a frequência de leitura das mensagens.

Resultados

Cerca de 48% dos participantes referiram lembrar de pelo menos uma mensagem da intervenção; 77,7% se mostraram satisfeitos com o estudo; 54,3% sempre liam as mensagens que recebiam e 66% não compartilhava as mensagens com outras pessoas. A maioria relatou aprendizados ou impressões positivas sobre a intervenção. Foi encontrada uma associação entre a memorização das mensagens e a satisfação com o estudo (p=0,002), bem como entre a leitura e a memorização das mensagens (p=0,005).

Conclusão

Apesar de a memorização das mensagens enviadas na intervenção nutricional ter sido aquém do esperado, foi referida grande satisfação e alta frequência de leitura pelos adolescentes. Futuros estudos devem investigar a permanência dos resultados de intervenções nutricionais a longo prazo, os principais influenciadores da memorização e como melhorá-la.

Palavras-chave: *Adolescente. Educação alimentar e nutricional. Memória. Envio de mensagens de texto.*

INTRODUCTION

Obesity is an important public health problem worldwide. In Brazil, obesity is estimated to affect 3.4 million adolescents and 9.7 million are overweight [1]. A high prevalence of risk factors for other chronic noncommunicable diseases at this stage of life in seen the country, resulting mostly from the high frequency of consuming ultra-processed foods and physical inactivity [2]. Adolescence is a critical phase of life in which

habits are formed and consolidated [3,4], highlighting the need to promote adequate and healthy eating practices.

Food and nutrition education actions must be contextualized within the reality of adolescents and be implemented in an attractive way, such as through mobile health. In 2020, 97% of Brazilian adolescents lived in homes with a cell phone; 94% had access to the internet; and 86% used WhatsApp [5]. The smartphone is considered the preferred communication channel of adolescents. This allows this public to be reached in a direct, accessible, and inexpensive way, to improve different health behaviors, including nutrition [6].

In addition to conducting educational actions, evaluating the strategies applied in a given nutritional intervention is essential to identify the most effective method to reach each audience. Knowledge is important about whether individuals were able to understand and retain the information presented by memorizing its contents, assuming that this would be a starting point for a possible modification of future eating practices. This assessment – and the factors involved – provides knowledge about the effects and results of nutritional intervention [7,8].

In addition to memorization, other indicators should be investigated to assess the results of a nutritional intervention, such as the participants' level of satisfaction with the proposal and the usability of the action. These aspects allow understanding of whether what was learned is considered useful and viable for practical application and the participants' opinions about the intervention [9,10].

The present study aimed to evaluate the memorization of messages that promoted adequate and healthy eating, as well as the satisfaction and the usability of a nutritional intervention conducted using a text messaging application among adolescents from public schools in the Federal District.

METHODS

A nutritional intervention was carried out with adolescents (10–19 years old) in the third year of high school in the Federal District, in which the participants in the intervention group received messages promoting adequate and healthy eating through the text messaging application WhatsApp. The messages were sent at lunchtime to the smartphones of 290 adolescents participating in the nutritional intervention group, from 5 schools, for 42 days, with one message per day. These messages addressed aspects of adequate and healthy eating according to the Dietary Guidelines for the Brazilian Population [11]. In the control group, 57 students from 2 schools received 42 messages on another topic unrelated to food (prevention of dating violence), with the same duration and frequency. Further details of the nutritional intervention can be found in Melo *et al.* [12].

Subsequently, the memorization of messages sent related to food and nutrition, as well as the satisfaction and usability of the nutritional intervention, were evaluated one month after its completion. For this, only the total number of students who participated in the nutritional intervention was considered, not those in the control group. Data was collected to evaluate the memorization of messages in three of the five schools in the group, because in two of them, due to scheduling conflicts with curricular activities, it was not possible to apply the questionnaire during the period.

In these schools, 151 students participated in the nutritional intervention, and all were invited to participate in this step. For the sample calculation of the present study, a homogeneous distribution of the population was considered, with a sampling error of 5% and a confidence level of 95%, obtaining a minimum sample of 94 participants.

Data were collected in November 2019, through a self-administered questionnaire, based on the Memory Assessment Questionnaire adopted by Micali, distributed in printed form to participants in each of the schools [8]. To evaluate memorization, the adolescents were first asked to free recall three messages that they remembered from the intervention promoting adequate and healthy eating. Responses were grouped into the following categories: recalled 3 messages; recalled 1 or 2 messages; and did not recall any messages and left this question blank. In the next question, five messages from the nutritional intervention were presented (Chart 1) to all participants, and the adolescents were asked if they remembered the messages. Responses were recorded using a 5-point Likert-type scale, with 1 – "I don't remember anything about this message" and 5 – "I remember this message well".

Chart 1 – Messages from the nutritional intervention that were presented to adolescents to investigate memorization. Federal District, Brazil, 2019.

Messages
1 – Did you know that the Ministry of Health adopted a new classification of foods? Now, they can be called "whole foods", "minimally processed foods", "culinary ingredients", "processed foods", and "ultra-processed foods."
2 – "Whole foods" are obtained from plants or animals and do not have any modification by humans. The so-called "minimally processed foods" undergo processes such as cleaning, freezing, or cutting, but do not receive the addition of salt, sugar, oils, fats, or other ingredients.
3 – The "minimally processed foods" and the preparations made with these foods must be present in all your meals and snacks! Create new combinations with cereals, beans, vegetables, and fruits. The more colorful, the better!
4 – "Processed foods" are whole foods that receive salt, sugar, vinegar, or oil to last longer. Examples: cheeses, canned or candied fruit, canned corn and peas, tomato paste, canned sardines and tuna, dried meat, and bacon.
5 – "Ultra-processed foods" contain large amounts of sugar, salt, saturated fats, and chemical additives. Examples: packaged snacks, filled cookies or crackers, soda, powdered juice, ice cream, sausage. Avoid them!

To assess satisfaction with the nutritional intervention, students were asked whether they enjoyed participating in the study, with responses ranging, on a 5-point Likert-type scale, from 1 – "I didn't like it at all" to 5 – "I loved it." The next questions verified the usability of the intervention, the frequency with which they read the messages, and whether they shared the information they received with other people. For reading frequency, 4 categories were presented: "never", "almost never", "sometimes", and "always read". For sharing, 5 categories were adopted: "I shared it with my school friends", "I shared it with my family", "I shared it with my friends outside of school", "I shared it with other people", and "I did not share the messages".

Finally, we asked, through an open question, what the participants learned in the intervention to assess whether they read the messages carefully and whether the knowledge presented was useful. The responses were read and grouped according to the analysis of their content into 4 categories: positive response, with personal changes; positive response in general; blank; and nothing new was learned/I already knew the content.

Information was collected on the gender and age of the participants during the nutritional intervention. Data were entered into electronic spreadsheets for further statistical analysis. To verify the hypothesis of normality of the data, the Kolmogorov-Smirnov test was adopted. Descriptive analyzes were carried out and the Mann Whitney U test was used to analyze the association between the memorization variables, both in satisfaction with the study and in the frequency of reading the messages. The analyzes were conducted using the SPSS software version 23.3, adopting a significance level of 5%.

The study was approved by the Research Ethics Committee, *Faculdade de Ciências da Saúde, da Universidade de Brasília* (Opinion nº 2839,510). Participants were asked to sign the Consent Form and their

parents or legal guardians signed the Free and Informed Consent Form to participate in the intervention using the title of the initial project, so that the students did not know that memorization would be evaluated.

RESULTS

A total of 94 students participated in this study, 77.7% of whom were female, with a mean age of 17.9 (±0.71) years. About 48% of the students freely recalled at least one message remembered from the intervention (Table 1). The evaluation of whether the adolescents remembered specific messages found that most of the evaluated participants remembered well all the messages presented, with an average of 10.8% and 31.4% of the participants who marked, respectively, the fourth and fifth point of the scale (Table 2).

Table 1 – Distribution of the number and percentage of students for the free recall of the nutritional intervention messages, satisfaction with the nutritional intervention, frequency of reading the messages and sharing the messages. Federal District, Brazil, 2019.

Variables	n (%)
Free recall of the intervention messages	
3 messages	24 (25.5)
1 or 2 messages	21 (22.3)
No message	49 (52.1)
Satisfaction with the intervention	
Did not like at all	1 (1.1)
Did not like very much	2 (2.1)
Indifferent	18 (19.1)
Liked	37 (39.4)
Loved	36 (38.3)
Frequency of reading the messages	
Never	2 (2.1)
Almost never	7 (7.4)
Sometimes	34 (36.2)
Always	51 (54.3)
Sharing the messages	
Yes, peers at school	2 (2.1)
Yes, family	19 (20.2)
Yes, friends outside of school	1 (1.1)
Yes, others	10 (10.6)
No	62 (66.0)

Table 2 – Distribution of the number and percentage of students who remembered the nutritional intervention messages. Federal District, Brazil, 2019.

Message recall scale	n (%)				
	1 – Did not recall	2	3	4	5 – recalled well
Message 1*	29 (31.2)	4 (4.3)	17 (18.3)	12 (12.9)	31 (33.3)
Message 2*	28 (30.1)	14 (15.1)	15 (16.1)	8 (8.6)	28 (30.1)
Message 3*	26 (28.0)	11 (11.8)	15 (16.1)	13 (14.0)	28 (30.1)
Message 4*	40 (43.0)	17 (18.3)	7 (7.5)	9 (9.7)	20 (21.5)
Message 5*	25 (26.6)	11 (11.8)	10 (10.8)	8 (8.6)	39 (41.9)

Note: *The content of the messages is shown in Chart 1.

Regarding the satisfaction of the participants, 77.7% of the individuals reported having liked or loved participating in the study (Table 1). Participants who remembered a message when asked for free recall reported greater satisfaction with the intervention (p=0.002). More than half (55.6%) of the participants who remembered a message reported that they loved participating in the study, compared to only 22.4% of the participants who did not remember any message.

Most of the adolescents (54.3%) reported that they always read the messages that they received (Table 1). The students who said that they read the messages memorization them better (p=0.005), and 68.9% of those who always read the messages were able to record their memory of at least one message. Most of those evaluated (66.0%) did not share the messages with anyone, but when they did, the messages were shared mainly with family members (20.2%) (Table 1).

About a fifth of the students (19.1%) reported that they learned something important for themselves and that it generated benefits. More than half (51.1%) wrote a positive impression about the project, but did not comment on what was learned, while 26.6% did not respond, and 3.2% responded that they did not learn new information or that they already knew the information presented.

DISCUSSION

The fact that less than half of the participants in the present study remembered at least one healthy eating message from the nutritional intervention can be considered an unsatisfactory effect, considering that 42 messages were sent and only one month had elapsed since it ended. However, memorization is a process that involves the acquisition and storage of information; therefore, one of the possibilities for poor recall of messages is that the entire learning process necessary to ensure effective memorization throughout the nutritional intervention was not followed [13]. Furthermore, when the intention is to present information that is meant to be presented to other people, the association of text messages with images helps to increase attention and understanding, especially the memorization of information [14]. This did not occur in the intervention, as the messages consisted solely of text.

Another possible justification for the lack of free recall of messages is that adolescents may not have had the interest or patience to correctly complete the questionnaire, leaving the answers blank. This phase of life represents a time of many transformations and the development of one's own identity, which, together with the excess of information adolescents must deal with daily, can cause impatience with certain activities [4,15]. Evidence that this may have happened at this stage of the research is the fact that, in a second part of the questionnaire, when the messages were presented already written to the students, most of the participants stated that they remembered all of them.

In addition to what has already been presented, another aspect also related to memorization is the personal relevance of the messages to the participants. Davis, Morgan, and Mobley showed that individuals who participated in an intervention involving the memorization of messages about healthy eating were more likely to remember messages when they were sent in specific contexts, such as when dealing with topics with personal relevance to their lives; when the information included the use of attractive language, such as association with colors – in this case, not necessarily involving the use of images, but mental associations – or when it was combined with cooking workshops [7]. Thus, the relevance of the messages to the context of the adolescent's life is another factor that may have influenced their memorization of them.

The data from the memorization of specific messages may reflect how much participants read the messages, since although many did not necessarily internalize and learn the content, they remembered that they had already seen that information, showing that they read the content they received. Therefore,

filling in the questionnaire itself can be seen as a positive point, as it allowed some information to be reinforced. This was observed in a review study by van der Heijden, Feskens, and Janse, who observed that postintervention follow-up can contribute to greater retention of what was learned and maintenance of results [16].

An indicator that was significantly associated with memorization was the level of student satisfaction, as more students who remembered the messages liked the study compared to those who did not. Most of the students were satisfied with the study, which indicates that interventions that use smartphones and the social networks accessed most by young people may be attractive options for this audience. This can also be evidenced by the frequency of reading, as most adolescents reported that they always read the messages sent in the nutritional intervention. In addition, they do not involve cost for the participant, a factor that also contributes to satisfaction. The results of this study are consistent with other findings in the literature, which observed high satisfaction of participants in studies that used text messages related to health promotion [9,10,17,18].

As expected, the students who read the messages distributed during the nutritional intervention remembered them more. Other studies have also shown the advantages and good receptivity to text messages as a method to promote healthy habits [10,19]. The time of sending messages – lunchtime – is also a factor that may have contributed to the good frequency of reading, since during this period, teenagers are probably less busy. The timing can also help to improve the effectiveness and usability of messages, since sending them close to mealtime can help the guidelines be remembered when choosing food [19].

The sharing of messages with family members, done by about a fifth of the participants, may also be related to satisfaction with the nutritional intervention, considering that the adolescent possibly shared messages with trusted people when the content would be relevant to them. It is also valuable to record positive impressions in the learning reported. How much adolescents learned from nutritional intervention, from their perception, is important information to help develop future strategies that are more effective for this audience, considering that memorization is related to learning, which in turn influences behavior change and the construction of new habits [20].

The potential of this study is that it is the first analysis of content memorization presented in a nutritional intervention using an application with adolescents in Brazil, with an innovative proposal to also evaluate the influence of other indicators, such as satisfaction and usability, in this recall. As it was carried out remotely, the intervention allows the participation of more individuals simultaneously, an important feature, especially in the current context of a global pandemic. The nutritional intervention used technologies common to adolescents' habits, such as smartphones and WhatsApp, and the messages were based on the current official document that addresses the principles and recommendations of an adequate and healthy diet, which is the Dietary Guidelines for the Brazilian Population.

A limitation of the study that it was not possible to include a sample of all schools involved in the nutritional intervention. However, a representative sample was obtained among the participants of the remaining schools. The application of a questionnaire about satisfaction with the intervention may have generated overestimated data; nevertheless, the participants were invited to participate in a step of the study on memorization, whose form included, among other aspects, questions about satisfaction, as a way to minimize the emphasis on this investigation.

CONCLUSION

The memorization of the healthy eating messages sent in the nutritional intervention was less than expected. However, the adolescents reported great satisfaction and a high frequency of reading the

messages. An association was found between satisfaction and memorization, inferring that the more students like the intervention and the greater their interest in what is being communicated, the greater the chances of more effective learning and consequently better memorization.

Although mediation employing communication technologies appears to be more attractive to the adolescent public, better understanding is necessary about how to further increase interest and involvement in educational actions to promote healthy eating. Future studies should investigate the maintenance of the long-term results of nutritional interventions; the main influences on memorization and how to improve it; and ways to increase the frequency of reading the contents conveyed in educational actions. It is also suggested that future interventions that incorporate text messaging in the intervention should combine this strategy with other types of resources, providing active participation of adolescents.

CONTRIBUTORS

N TORAL contributed to the project design and coordination. AB MENESES, GRA MELO, and SC LIMA were responsible for the collection, analysis, and interpretation of data. All authors contributed to the article writing and approval of the final version.

REFERENCES

1. Ministério da Saúde (Brasil). Instrutivo para o cuidado da criança e do adolescente com sobrepeso e obesidade no âmbito da Atenção Primária à Saúde. Brasília: Ministério; 2020.
2. Instituto Brasileiro de Geografia e Estatística. Pesquisa Nacional de Saúde do Escolar: 2019. Rio de Janeiro: Instituto; 2021 [cited 2019 Nov 03]. Available from: https://biblioteca.ibge.gov.br/visualizacao/livros/liv101852.pdf
3. Ministério da Saúde (Brasil). Proteger e cuidar da saúde de adolescentes na educação básica. 2nd ed. Brasília: Ministério; 2018 [cited 2019 Oct 11]. Available from: https://pesquisa.bvsalud.org/bvsms/resource/pt/mis-39790
4 World Health Organization. Global Accelerated Action for the Health of Adolescents (AA-HA!): guidance to support country implementation. Geneve: Organization; 2017 [cited 2019 Sep 20]. Available from: https://apps.who.int/iris/bitstream/handle/10665/255415/9789241512343-eng.pdf;jsessionid=B518B98EA1E557BB16CFADF91A614E3F?sequence=1
5. Brazilian Network Information Center. Executive summary: ICT kids online Brazil – Survey 2020. São Paulo: NIC.br; 2021 [cited 2022 Jan 24]. Available from: https://cetic.br/media/docs/publicacoes/2/20211124200038/executive_summary_ict_kids_online_2020.pdf
6. Loescher LJ, Rains SA, Kramer SS, Akers C, Moussa RA. Systematic review of interventions to enhance healthy lifestyle behaviors in adolescents delivered via mobile phone text messaging. Am J Health Promot. 2018;32(4):865-79.
7. Davis LA, Morgan SE, Mobley AR. The utility of the memorable messages framework as an intermediary evaluation tool for fruit and vegetable consumption in a nutrition education program. Health Educ Behav. 2016;43(3):321-27.
8. Micali, FG. Construir e avaliar um instrumento imagético para orientação alimentar [dissertation]. São Paulo: Faculdade de Medicina de Ribeirão Preto; 2013 [cited 2019 Oct 11]. Available from: https://teses.usp.br/teses/disponiveis/17/17138/tde-13022014-101433/publico/dissertacaoFlavia.pdf
9. Hickman NE, Schaar G. Impact of an educational text message intervention on adolescents' knowledge and high-risk behaviors, comprehensive child and adolescent. Nursing. 2018;41(1):71-82.
10. Saez L, Legrand K, Alleyrat C, Ramisasoa, S, Langlois J, Muller L, *et al.* Using facilitator–receiver peer dyads matched according to socioeconomic status to promote behaviour change in overweight adolescents: a feasibility study. BMJ Open. 2018;8(6):e019731.
11. Ministério da Saúde (Brasil). Guia Alimentar para a População Brasileira. 2nd ed. Brasília: Ministério; 2014 [cited 2019 Sep 20]. Available from: https://bvsms.saude.gov.br/bvs/publicacoes/guia_alimentar_populacao_brasileira_2ed.pdf
12. Melo GR, Lima SC, Chagas CM, Nakano EY, Toral N. Tailored smartphone intervention to promote healthy eating among Brazilian adolescents: a randomised controlled trial protocol. BMJ Open. 2020;10(10):e038896.

13. Baird T, Maskill L. Memory. In: Maskill L, Tempest S, editors. Neuropsychology for Occupational Therapists: cognition in occupational performance. Hoboken: John Wiley & Sons Inc.; 2017. https://doi.org/10.1002/9781119557036.ch8

14. Said NA, Al-Said KM. The effect of visual and informational complexity of news website designs on comprehension and memorization among undergraduate students. AI Soc. 2021;37:401-09. https://doi.org/10.1007/s00146-021-01164-6

15. Mihajlov M, Vejmelka L. Internet addiction: a review of the first twenty years. Psychiatr Danub. 2017;29(3):260-72.

16. Van der Heijden LB., Feskens EJM., Janse AJ. Maintenance interventions for overweight or obesity in children: a systematic review and meta-analysis. Obes Rev. 2018;19(6):798-809.

17. Whitley MD, Payán DD, Flórez KR, Williams MV, Wong EC, Branch CA, *et al.* Feasibility and acceptability of a mobile messaging program within a church-based healthy living intervention for African Americans and Latinos. Health Informatics J. 2020;26(2):880-96. https://doi.org/10.1177/1460458219853408

18. Bailey J, Davies C, McCrossin T, Kiernan M, Skinner R, Steinbeck K, *et al.* Fit4YAMs: structuring a lifestyle intervention for rural overweight and obese young adult males using participatory design. J Adolesc Health. 2018;62(3S):S65-S71. https://doi.org/10.1016/j.jadohealth.2017.06.019

19. König, L.M., Renner, B. Boosting healthy food choices by meal colour variety: results from two experiments and a just-in-time Ecological Momentary Intervention. BMC Public Health. 2019;19(975):1-15. https://doi.org/10.1186/s12889-019-7306-z

20. Lin X-F, Deng C, Hu Q, Tsai C-C. Chinese undergraduate students' perceptions of mobile learning: Conceptions, learning profiles, and approaches. J Comput Assist Learn. 2019;35(3):317-33. https://doi.org/10.1111/jcal.12333

Received: August 27, 2021
Final version: April 4, 2022
Approved: June 1, 2022