EFFECT OF EDUCATIONAL SOFTWARE ON ADOLESCENTS**EFEITO DE SOFTWARES EDUCATIVOS EM ADOLESCENTES****EFFECTO DE SOFTWARES EDUCATIVOS EN ADOLESCENTES**

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ABSTRACT

Objective: to demonstrate the effect of the use of educational applications / softwares on adolescents' knowledge / behavior about physical activity and healthy eating. **Method:** this is a descriptive, descriptive, integrative review, of studies published between 2013 and 2017 in the PUBMED / MEDLINE, LILACS and Cochrane central databases. The search was carried out in April and May 2017, using controlled descriptors included in DeCS, and the results presented in the form of figures, discussed with the literature. **Results:** it was noticed that there is no consensus in the literature about the effects of the use of applications / softwares in improving the knowledge and behavior of adolescents about physical activity and healthy eating. **Conclusion:** it is believed, therefore, to be of great importance to carry out further studies in the development of educational applications / software aimed at applying behavioral change techniques so that the use of the applications / softwares by the adolescents can present the improvement of knowledge and behavior about physical activity and healthy eating. **Descriptors:** Adolescent; Obesity; Software; Nutritional Status; Educational Technology; Mobile Applications.

RESUMO

Objetivo: evidenciar o efeito da utilização de aplicativos/software educativos no conhecimento/comportamento de adolescentes sobre a atividade física e a alimentação saudável. **Método:** trata-se de estudo bibliográfico, descritivo, tipo revisão integrativa, de estudos publicados entre 2013 e 2017, nas bases de dados PUBMED/MEDLINE, LILACS e Cochrane central. Realizou-se a busca nos meses de abril e maio de 2017, utilizando-se descritores controlados contemplados no DeCS, e os resultados apresentados em forma de figuras, discutidos com a literatura. **Resultados:** percebeu-se que não há um consenso na literatura sobre os efeitos da utilização de aplicativos/software na melhoria do conhecimento e do comportamento de adolescentes acerca da atividade física e da alimentação saudável. **Conclusão:** acredita-se, dessa forma, ser de suma importância a realização de mais estudos no desenvolvimento de aplicativos/software educativos que visem a aplicar técnicas de mudança comportamental a fim de que o uso dos aplicativos/software, pelos adolescentes, possa apresentar a melhoria do conhecimento e do comportamento acerca da atividade física e da alimentação saudável. **Descritores:** Adolescente; Obesidade; Software; Estado Nutricional; Tecnologia Educacional; Aplicativos Móveis.

RESUMEN

Objetivo: evidenciar el efecto del uso de aplicaciones / softwares educativos en el conocimiento / comportamiento de adolescentes sobre la actividad física y la alimentación sana. **Método:** se trata de un estudio bibliográfico, descriptivo, tipo revisión integrativa, de estudios publicados entre 2013 y 2017, en las bases de datos PUBMED / MEDLINE, LILACS y Cochrane central. Se realizó la búsqueda en los meses de abril y mayo de 2017, utilizando descriptores controlados contemplados en el DeCS, y los resultados presentados en forma de figuras, discutidos con la literatura. **Resultados:** se percibió que no hay consenso en la literatura sobre los efectos del uso de aplicaciones / softwares en la mejora del conocimiento y del comportamiento de adolescentes acerca de la actividad física y de la alimentación sana. **Conclusión:** se considera de suma importancia la realización de más estudios en el desarrollo de aplicaciones / softwares educativos que apunte a aplicar técnicas de cambio comportamental a fin de que el uso de las aplicaciones / softwares, por los adolescentes, pueda presentar la mejora del desempeño el conocimiento y el comportamiento acerca de la actividad física y de la alimentación sana. **Descriptor:** Adolescente; Obesidad; Programas Informáticos; Estado Nutricional; Tecnología Educacional; Aplicaciones Móviles.

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INTRODUCTION

Obesity and overweight are defined by the World Health Organization as an excess accumulation of body fat that can impair the well-being and health of individuals. Alarming data and increased prevalence, in an unbridled rhythm, is presented worldwide.¹

Obesity rates have dramatically increased over the past 30 years suggesting a global public health crisis. It is reported that by 2013, 42 million children and adolescents were overweight or obese, and worldwide, 70 million children will be overweight or obese by 2025 if current trends continue. It is shown that between 1978/79 and 2004, the combined prevalence of overweight and obesity among people aged two to 17 years increased from 15% to 26%. The rates of overweight and obesity, more than doubling for this age group, increased from 14 to 29 percent among young people aged 12 to 17 years.¹

It was revealed in a survey carried out by the IBGE that in 2015, 7.8% of students aged 13 to 17, from the 5th fundamental year to the 3rd year of high school, were obese. It is understood that the problem reaches one million adolescents, among them, male students, 8.3% were obese and, female, 7.3%, and were overweight 23.7% of the interviewees (including the obese) - or 3.1 million young people.²

The results of the study with 73,399 students show that 24.0% of Brazilian adolescents enrolled in schools in municipalities with more than 100 thousand inhabitants, are with high blood pressure (prehypertension or hypertension) and 25.0% are overweight.³

It is known that innumerable are the implications of obesity on adolescents' health and quality of life. The associated morbidities such as diabetes, dyslipidemias and the metabolic syndrome were highlight.⁴ Psychological and social issues are also relevant, such as the occurrence of bullying involving overweight among schoolchildren.⁵

Through the health policies of Brazil and the world, several interdisciplinary and multisectoral goals have been determined with the objective of promoting health and combating obesity.⁶ The educational practice should be carried out with joy, hope, conviction that change is possible, curiosity, commitment, decision making and availability to dialogue, knowing how to listen to the other and wanting the student well.⁷

Several processes can be used for good educational practice. It is shown that in the case of adolescents, digital games can be a good option, since they are already part of the daily life of most adolescents, be it on the smartphone or consoles. It is understood that with these new learning styles and the needs of the new generations, educational games and games-based learning are gaining more prominence because they are more aligned with the interests of young people. It is shown that the educational approach based on electronic games can be useful, with good receptivity, besides integrating playful characteristics with specific contents, thus motivating the learning process of children and young people.⁸

It is suggested by contemporary educational theories that learning is most effective when it is active, experiential, contextualized, problem-based, and provides immediate feedback. It is reported that the games offer activities that have all these characteristics.⁹ It is noticed that it is also necessary that the child and the adolescent with obesity perceive the necessities of change in their habits of life and food education from a context to promote health.¹⁰

The potential of these resources for the change in adolescent behavior is believed to be a social moment where technology is present for a large part of the population, particularly with regard to eating habits, helping to cope with obesity.

The development of a serious game as an educational proposal to combat childhood obesity is under investigation and the potential of the method as a pedagogical resource is highlighted.¹¹ It is shown that a study with children on obesity prevention used educational software for improvement of knowledge about the subject. It was evidenced by the authors that the students, after the intervention, correctly answered questions about the daily intake of healthy and unhealthy foods, as well as about the importance of physical activity.¹²

Due to the magnitude of the problem, it is imperative to seek current and effective strategies to prevent and combat obesity among adolescents and young people. It is argued that in this direction, the question of this study consists of: the use of applications/software promote the improvement in the knowledge / behavior of adolescents about physical activity and healthy eating?

OBJECTIVE

- To demonstrate the effect of using educational software / applications on adolescents' knowledge / behavior about physical activity and healthy eating.

METHOD

It is a descriptive, descriptive study, type integrative, of studies published between 2013 and 2017. The study was conducted by searching the following databases: Medical Literature Analysis and Retrieval System Online (PubMed / MEDLINE) Cochrane Central Register of Controlled Trials (Cochrane Central) and Latin American and Caribbean Literature in Health Sciences (LILACS). The search was carried out in April and May of 2017, using controlled descriptors contemplated in DeCS. For the presentation of this investigation, the guidelines of the PRISMA protocol.¹³

The PICO strategy was used for its realization. It is considered that the construction question of the research question is of paramount importance, since it is the

one that enhances and favors the achievement of the objectives of the study. The words Patient, Intervention, Comparison and Outcome (PICO) form the acronym PICO, a strategy that helped to construct the research question.¹⁴

It was allowed to generate, through the PICO strategy, the question analyzed in the study considering "P" (patient) as the adolescents from ten to 19, "I" (intervention) as the use of applications / softwares / educational games for the cell phone for the treatment or prevention of obesity, "C" (comparison) as verification of change in knowledge / behavior and "O" (outcome) as the improvement of behavior on physical activity and healthy eating.

For the definition of the terms of the research, the combination with all the descriptors defined in the PICO strategy was used. The descriptors were listed using the DeCS (Health Sciences Descriptors) and the Medical Subject Headings Section (MeSH) by selecting the corresponding item.

The search strategies were established according to each database (Figure 1).

Databases	Search strategies
PubMed/MEDLINE	((("adolescent"[MeSH Terms] OR "adolescent"[All Fields]) AND ("software"[MeSH Terms] OR "software"[All Fields]) AND ((("nutritional status"[MeSH Terms] OR ("nutritional"[All Fields] AND "status"[All Fields]) OR "nutritional status"[All Fields] OR "nutrition"[All Fields] OR "nutritional sciences"[MeSH Terms] OR ("nutritional"[All Fields] AND "sciences"[All Fields]) OR "nutritional sciences"[All Fields]) AND ("education"[Subheading] OR "education"[All Fields] OR "educational status"[MeSH Terms] OR ("educational"[All Fields] AND "status"[All Fields]) OR "educational status"[All Fields] OR "education"[All Fields] OR "education"[MeSH Terms]))) OR ((("adolescent"[MeSH Terms] OR "adolescent"[All Fields]) AND ((("nutritional status"[MeSH Terms] OR ("nutritional"[All Fields] AND "status"[All Fields]) OR "nutritional status"[All Fields] OR "nutrition"[All Fields] OR "nutritional sciences"[MeSH Terms] OR ("nutritional"[All Fields] AND "sciences"[All Fields]) OR "nutritional sciences"[All Fields]) AND ("education"[Subheading] OR "education"[All Fields] OR "educational status"[MeSH Terms] OR ("educational"[All Fields] AND "status"[All Fields]) OR "educational status"[All Fields] OR "education"[All Fields] OR "education"[MeSH Terms]))) AND ("mobile applications"[MeSH Terms] OR ("mobile"[All Fields] AND "applications"[All Fields]) OR "mobile applications"[All Fields] OR ("mobile"[All Fields] AND "application"[All Fields]) OR "mobile application"[All Fields])) OR ((("motor activity"[MeSH Terms] OR ("motor"[All Fields] AND "activity"[All Fields]) OR "motor activity"[All Fields]) AND ("adolescent"[MeSH Terms] OR "adolescent"[All Fields]) AND ("exercise"[MeSH Terms] OR "exercise"[All Fields]) AND ("software"[MeSH Terms] OR "software"[All Fields])) OR ((("adolescent"[MeSH Terms] OR "adolescent"[All Fields]) AND ("exercise"[MeSH Terms] OR "exercise"[All Fields]) AND ("mobile applications"[MeSH Terms] OR ("mobile"[All Fields] AND "applications"[All Fields]) OR "mobile applications"[All Fields] OR ("mobile"[All Fields] AND "application"[All Fields]) OR "mobile application"[All Fields]))
Cochrane Central	("adolescent" AND "software" AND "nutrition education") OR ("adolescent" AND "nutrition education" AND "mobile application") OR ("adolescent" AND "software" AND "motor activity") OR ("adolescent" AND "mobile application" AND "motor activity") OR ("adolescent" AND "exercise" AND "software") OR ("adolescent" AND "exercise" AND "mobile application") in Search All Text
LILACS	(tw:(adolescent)) AND (tw:(software)) AND (tw:(nutrition education)) OR (tw:(adolescent)) AND (tw:(nutrition education)) AND (tw:(mobile application)) OR (tw:(adolescent)) AND (tw:(software)) AND (tw:(motor activity)) OR (tw:(adolescent)) AND (tw:(mobile application)) AND (tw:(motor activity)) OR (tw:(adolescent)) AND (tw:(exercise)) AND (tw:(software)) OR (tw:(adolescent)) AND (tw:(exercise)) AND (tw:(mobile application))

Figure 1. Search strategies used in databases. Divinópolis (MG), Brazil, 2017.

The data were selected by two researchers and the following inclusion criteria were respected: age between ten and 19 years; a five-year timeframe for publication between the years 2013 and 2017; fully accessible surveys that specifically address the use of educational software / applications in obesity prevention.

830 studies were identified, 702 in PubMed / MEDLINE, 117 in Cochrane Central and 11 in LILACS. The abstracts were read by selecting the studies for reading in full.

Of the 830 studies, 823 were excluded because they presented the following characteristics: 706 did not deal with a study of behavioral change and / or knowledge using educational software, therefore, they did not answer the question of the study; 98 were repeated; eleven did not give full access to the article; two had more than five years of

publication and six did not fit within the ten to 19 age group.

Seven studies were selected for analysis and the entire data selection process can be seen in Figure 2.

Figure 2. Adapted flowchart of the PRISMA 2009 model used in the selection of the studies. Divinópolis (MG), Brazil, 2017.

The level of evidence of the articles was categorized by the Agency for Healthcare Research and Quality (AHRQ) categorization of 2016, which considers level 1 as the greatest strength of evidence, which includes the meta-analyzes of multiple controlled studies . Individual designs with experimental design,

such as randomized, level 2 clinical trials, are considered as randomized controlled trials. Case-control and quasi-experimental studies, such as non-randomized studies, are classified as level 3. Studies with a non-experimental design, such as the cross-sectional, receive the level of evidence 4. Case reports are

considered as level 5 and opinions of reputable authorities based on clinical competence or opinion from expert committees and interpretations of non-research based information are at level 6.¹⁵

RESULTS

It should be noted that all the selected studies are international, which shows the

lack of contribution of the Brazilian researchers on the subject, with 57.14% of them being carried out in the United States. Regarding the type of studies, the systematic review and the randomized clinical trial had the largest number of studies, totaling 71.43%.

Authors	Year	Location	n	Level evidence	of Effects
Hieftje K, Edelman EJ, Camenga DR, Fiellin LE. ¹⁶	2013	United States	19	Systematic review	Aiming at reviewing the studies that used educational software as an intervention to change behavior in youngsters, the study showed that, of the 19 studies, 17 showed a significant behavioral change in the adolescents submitted to the intervention.
Baños RM, Cebolla A, Oliver E, Alcañiz M, Botella C. ¹⁷	2013	Spain	228	Case-Control Study	With the focus on the knowledge change of the adolescents, the group submitted to the lecture presented almost the same evolution of the group that used the educational software, however, this last group obtained a greater increase in the scores of the Questionnaire of Nutritional Knowledge.
Dickinson WP, Glasgow RE, Fisher L, Dickinson LM, Christensen SM, Estabrooks PA, et al. ¹⁸	2013	United States	7706	Randomized Clinical Trial	Using two websites that had online action planning modules to assist patients in the implementation of activities, it was concluded that, after six months of intervention, it was possible to evidence a change in behavior in their diet and physical activities.
Turnin MC, Buisson JC, Ahluwalia N, Cazais L, Bolzonella-Pene C, Fouquet-Martineau C, et al. ¹⁹	2015	France	580	Almost Experimental Study	Using digital menu software installed in three schools, students were allowed to choose food from all their daily feeds. Information was presented through the software of each food chosen. It was verified that there was a change of behavior due to the Z-score of body mass decreased during the period.
Direito A, Jiang Y, Whittaker R, Maddison R. ²⁰	2015	New Zeland	51	Randomized Clinical Trial	Using two types of mobile applications to increase the frequency of physical activity and cardiorespiratory fitness in adolescents, it was concluded that the results presented by the use of the applications were not significant compared to the intervention without them. It is suggested to use applications in a multifaceted approach to increase fitness, promote increased physical activity frequency, and consequently reduce adverse health outcomes associated with insufficient activity.
Brannon EE, Cushing CC. ²¹	2015	United States	74	Systematic review	Mobile health applications were examined to determine which behavioral change techniques are most effective in modifying physical activity and feeding of children and adolescents. Most of the 235 applications reviewed targeted physical activity, specifically with only a minority of applications that directed dietary behavior or strategies for physical activity and diet.
Lee J, Piao M, Byun A, Kim J. ²²	2016	United States	42	Systematic review	It was concluded that mobile intervention had no significant effect on BMI. In addition, two studies were examined regarding the effect of daily exercise size and sugary drinks intake. Neither had any significant effect.

Figure 3. Description of articles inserted in the study. Divinópolis (MG), Brazil, 2017.

It is pointed out that in a review investigation, the type and quality of studies assessing the effects of electronic media-based interventions on behavior change in health and safety.¹⁶ In the 19 selected studies, of behavior by varying in target conditions, design and outcome measures. In summary, seven (37%) studied interventions aimed at improving physical activity and / or nutrition; six (32%), asthma or lung function; three (16%), the safety behaviors; two (11%), sexual risk behaviors and one (5%), diabetes. Clinical settings (n = 7), school (n = 7), home (n = 3) and other settings (n = 2) were included in the study settings. Seventeen studies (89%) reported the age range of individuals, ranging from three years to 18 years. The mean age of the subjects (m = 12.47 years, m = 13 years) was reported in two studies and the subjects in the studies were high school students. Results of behavioral changes related to nutrition and physical activity were evidenced in seven studies. A computer-based game was included in three (43%) studies; one (14%) used a video game console; one (14%) employed an internet-based program; one (14%) incorporated an Internet game and one (14%) integrated video clips as part of the intervention. Five studies included a control group. Included in the review results were studies⁹ related to physical activity, changes in sedentary behavior, physical activity, Body Mass Index (BMI), and systolic blood pressure. In two studies, participants increased their physical activity (p = 0.024, p = 0.011, respectively) and decreased their sedentary behaviors (TV / DVD watching, p = 0.024), (computer use, p = 0.002), (all sedentary behaviors, p = 0.051). Finally, in one study, a significant effect of treatment for the reduction of obesity in girls, evaluated by means of BMI (0.69 ± 0.04 in the control versus 0.62 ± 0.04 in the intervention), was reported, and one study reported a significant difference in subjects' systolic blood pressure (113.9 vs. 108.0 D Cohen = 0.578, p < 0.001) before and after intervention. It was concluded with the authors conclusion that, through interventions using educational software, it is possible to perform the behavioral change in adolescents in the scope of nutrition and physical activity.

The "ETIOBE Mates" website, which combines the Internet and computer games to convey nutritional and healthy lifestyle knowledge for the prevention and treatment of obesity in adolescents, has been developed.¹⁷ The information in the ETIOBE Mates covering the domains: nutritional terms (fibers, proteins); awareness of dietary

recommendations (such as five pieces of fruit per day); nutrients contained in food (potatoes have carbohydrates); (breakfast choices) and awareness of diet-related disease associations (a sedentary lifestyle increases the risk of cardiovascular disease). Participants were divided into two control and experimental groups: the control group received a pamphlet that provided the same nutritional content as the site, but in paper format. The experimental group was instructed to navigate to the ETIOBE Mates website and use the programs as much as they wanted for two weeks. It was determined that adolescents played ETIOBE games at home because schools did not offer the time, nor computers to do so in the school environment. The participants completed the "Game and Internet Habits Questionnaire" and the "Nutrition Knowledge Questionnaire" by the participants during the class. It was filled by the participants again, after two weeks, the "Nutritional Knowledge Questionnaire" during the class. By the results¹⁵ the participants were shown to increase their nutritional understanding, however, those in the group that used ETIOBE Mates acquired more knowledge compared to those who accessed the information in the leaflet. A significant time factor (F (1,226) = 18,319, P < 0.001; η^2 = 0.075) was indicated by the descriptive data on the Nutrition Knowledge Questionnaire for adolescents. This indicates that both groups increased their scores on the questionnaire after the two-week intervention period. It was observed that a group factor of significant effect (F (1,226) = 3,731, P = 0.06, η^2 = 0.01) was not shown by the results, however, the interaction between the group and time was statistically significant (F (1,226) = 4.388, P = 0.037, η^2 = 0.019). There was a greater increase in the questionnaire indices after the intervention, compared to the traditional group, by the ETIOBE group. The analysis was also repeated using age, sex, and z-score of BMI as covariables, but the results showed no effect for these variables (age, F = 0.001, sex, F = 2.262, BMI, F = 0.297). It was verified that the use of educational software was able to improve adolescents' knowledge about healthy eating, as well as traditional based intervention.

New functionality has been implemented and implemented on the Connection to Health (CTH) site.¹⁸ It is proposed to provide a health risk assessment with patient feedback by providing on-line action planning modules to assist patients in the planning and implementation of health behavior change activities. Patients from six primary care

practices were selected and randomized to a baseline site (including a health assessment with feedback on outcomes and educational materials on behavioral health change) or an improved site that included the resources of the basic site plus an action planning component as a method of this study. It was considered that of the 7706 participants, 169 (2.2%) recruitment targets used the site. It was contributed, through both web-based interventions, to patients to make positive changes in their behavior, especially in activity level and healthy diet. Patients were asked to return for follow-up evaluations three and six months after enrollment. The change in behavioral outcome measures was analyzed to investigate the impact of interventions. Healthy food scores were significantly improved, with a mean of 5.15 at baseline, 3.98 at three months and 3.96 at six months ($F(2163) = 15.87$; $p < .0001$). There was also significant improvement in physical activity levels ($F(2103) = 5.02$, $P = 0.0083$), but there were no significant effects between groups ($F(2103) = 0.34$, $P = 0.7137$). It was contributed, through web-based interventions, to the participants to make positive changes in their behavior, especially in activity level and healthy diet.

Nutri-Adrice software was developed with the aim of improving nutritional skills through food-based examples available in a cafeteria.¹⁹ Three high schools were selected that met the following criteria: they were located in the area of Toulouse; represented suburban (school A) and urban (schools B and C) and were equipped with a kitchen (ie cafeteria meals were cooked on the premises). Various teas for lunch were offered to teens. It was recorded that a total of 580 adolescents participated in the study: 154 at school A, 207 at school B and 219 at school C. The intervention period lasted six months. It was seen that children used the software freely once a day and there was no change in academic programs related to nutritional practices. It was considered that the total number of days that the Nutri-Advice kiosk was available during the intervention period was 72 at school A, 78 at school B and 67 at school C. The post-intervention anthropometric measures were completed each school. It was found that the mean age was 13.3 ± 1.0 years (range, 11.5-16.4 years) and the schools did not differ in age profiles. The mean number of sessions per child was 26 (range, 1-67) over the six-month period and significantly higher in school C compared to schools A and B ($P < 0.001$). The overall prevalence of obesity was 11.6%, with no

significant difference between boys and girls (12.8% and 10.4%, respectively; $P = .38$). The prevalence of obesity was significantly different between the three schools: 3.9%, 10.1% and 18.4% in schools A and C, respectively; ($P < 0.001$). It was verified that the mean Z score of BMI was 0.50 ± 1.1 and differs between schools ($P < 0.009$). It was seen that the IMC z-score at school A was significantly lower than at school C. It was reported by most children that their level of physical activity was moderate, however, children at school C were more active than of school A ($P = 0.001$). The overall BMI z score and the prevalence of obesity were significantly reduced during the intervention period. It was found that the change in BMI z score was significant in two of the three schools, and the change in obesity was significant in one of the three schools. It was concluded that the children presented a behavior change because they chose fewer cheeses and sweets or desserts and more foods rich in starch and dairy products and tended to choose fruits and vegetables more frequently. It was found that the z-index of body mass index decreased significantly during the period.

The use of two smartphone applications used to improve cardiorespiratory fitness in sedentary youth was evaluated.²⁰ It was a randomized controlled trial using a total of 51 young people aged 14 to 17 years randomized to one of the three conditions: 1) use of an immersive smartphone application (occupies the whole screen of the device); 2) use of a non-immersive application or 3) normal behavior (control). They consist of the applications in an eight-week training program designed to improve physical fitness. Evaluations were performed at the beginning and after eight weeks of training. Participants were assessed individually. A CRF (one mile walk / test) field test was completed at both times, and their height and weight measured, self-referenced their physical activity and related psychological variables, were given a Actigraph accelerometer to use for seven days and filled out a booklet detailing the use of the accelerometer. It was verified that the mean age of the participants was 15.7 (SD 1.2) years; the participants were mostly New Zealanders (61%, 31/51) and 57% (29/51) female. The overall retention rate was found to be 96% (49/51). There was no significant intervention effect on the primary outcome using any of the applications. It should be pointed out that compared to the control, the time to complete the aptitude test was 28.4 seconds shorter (95% CI -66.5 to 9.82, $P =$

0.20) for the immersive application group and - 24.7 seconds (95% CI -63.5 to 14.2, $P = .32$) for the group of non-immersive applications. It was concluded, through the study, that the use of the applications did not present behavioral change in relation to the frequency of physical activity in adolescents.

A review of the current state of translational science in child and adolescent behavioral change was examined by empirically assessing whether behavioral change techniques have a greater impact on health behavior change, specifically physical activity and diet (fitness, step counts, fruit and vegetable consumption, among others).²¹ Applications available to the general public were included in the interventions identified in the study. It was seen that most of the 235 applications targeted physical activity specifically and a minority addressed dietary behavior or strategies for physical activity and diet. Approximately 20% of the applications were provided with only self-monitoring metrics such as weight, calories or physical activity, and the additional 35% included videos or instructions (modeling) for exercise or physical activity routines. In only two applications were health promotion messages or weight maintenance included in the descriptions. The study concludes that there is a shortage of applications that promote behavioral change in children and adolescents, as well as the use of behavioral change techniques in the construction of health-related applications.

The Population, Intervention, Comparison and Results (PICO) criteria were used in their review to assess whether mobile technology is effective for weight or behavior change among children.²² It was seen that of the three studies systematic review selected, this was the only one to use the PICO strategy for data selection. It was verified that a total of 193 articles (of an initial 276) remained after the elimination of duplicates. Titles and abstracts were independently reviewed by two researchers. We selected studies by inclusion criteria and submitted 42 articles to the full text review. There was no significant effect on BMI by the mobile intervention (Hedges' g : -0.073, 95% CI: -0.031 to 0.185). Two studies were also carried out on the effect of daily exercise and on the intake of sugary drinks, but neither showed a significant effect (Hedges' g : 0.189, 95% CI: - 0.355 to 0.733; 0.316, 95% CI: -0.764 to 0.131). Abandon rates were considered as potential mediators of the intervention outcome, however, the effects of mobile technology on the management of pediatric obesity were

positively evaluated. The attrition rates in the intervention group were found to be twice as low as the control group rates in the studies. For the same studies, positive results, although not significant, were obtained for self-monitoring, screen time, sugary drinks intake, weight maintenance and negative mood control. For this study, the mobile intervention did not have a significant effect on the behavioral change and on the BMI of the participants.

DISCUSSION

The question of the study was answered: does the use of applications / software promote the improvement in the knowledge / behavior of adolescents about physical activity and healthy eating? It was evidenced in this research that there is no consensus in the literature about the effects of the use of applications / software in improving the knowledge and behavior of adolescents about physical activity and healthy eating. It was seen that there are variations of intervention methods, studies that worked with control group and experimental group^{17,20} and studies that applied the applications / software throughout the sample.¹⁸⁻⁹ It was observed that the intervention time was also not a consensus between studies where there was a change from two weeks to six months. It was observed that in relation to the evaluation of the results, when a change in knowledge was involved, a questionnaire of nutritional knowledge applied before and after the intervention was used. Changes in choice of diet and / or increase in physical activity were considered as results in the studies that proposed behavior change, although this result was not evident in all studies.

The quality of the studies present in this research is emphasized. A systematic review in most of the studies (3 = 42.86%) was chosen, considered as level 1 of evidence, and randomized clinical trial (2 = 28.57%), characterized by level 2 of evidence. The quality of the papers used to discuss the proposed problem regarding the levels of evidence of the studies selected for this research was evidenced.

It presents, even with all the difficulty around the scenario, some result in the prevention of obesity and in the change of behavior of adolescents by educational software. It is emphasized that while electronic media-based interventions have the potential to promote youth health and safety behaviors, there may be some potential limitations to accessing these types of out-of-school interventions.¹⁵

It is inferred that the available studies that quantify the effect of smartphone applications on weight loss are increasing. It has been observed that there is a great diversity in the applications used, obtaining different results in the improvement of the lifestyle. It has been shown that these mobile health interventions have small to moderate effects on physical activity and sedentary behavior.²³

It was found that, even with the good results using mobile health applications, not all studies were able to stimulate behavior change in the participants and, perhaps, the failure of educational software to promote change in behavior is not using behavioral change techniques. For this reason, it is suggested that there is insufficient behavior change strategies in applications to manipulate these variables, or that the use of the application was not intensive enough to evoke changes.¹⁰ This is considered worrying because it is relatively clear that demand for health-related mobile applications is high, with 19% of smartphone users downloading at least one health application.²¹

It is cautioned that changing health and behavior is a complex proposition that becomes increasingly difficult at the time demands are placed on primary care services. It is noted that despite the critical importance and recent attention given to health and behavior change, there are no easy answers on how to deal with this problem.¹⁸

Other elements are associated with behavior change such as the behavioral readiness stage (EPMC) and socioeconomic issues. The EPMC has been used in the evaluation and / or intervention of risk behaviors since the 1980s, mainly in the fight against smoking, in inappropriate eating habits and in sedentary lifestyle. The classification proposed by the model allows us to verify those who are willing to change and those who are resistant to changing their lifestyle.²⁴ For example, in the consumption of fruits and vegetables, the adolescents who were in the more advanced stages of behavior change presented higher consumption and represented different eating behaviors than those who were in the early stages.²⁵ It is important to note that none of the articles identified evaluated the EPMC, highlighting a possible gap in the studies.

The shortage of national articles on the subject was observed. The research is justified to discuss the association of the use of educational software in the change of behavior about a healthier life with young Brazilians with the smartphone increasingly present in the life of the adolescents.²⁶ It is

emphasized that the development and the evaluation of new techniques and technologies for health, especially when it comes to digital education, in order to be a differential in the acquisition of the attention of adolescents, known as digital generation, which is present in this technological world and that shows preference by new technologies when compared to a traditional strategy for education and health promotion.¹¹

It is added that educational games are considered instruments that provide fun, but also a tool capable of facilitating and assuring learning, with the potential to facilitate behavior changes by promoting a rearrangement of educational contingencies.²⁷

CONCLUSION

It is concluded, after the analysis of the studies, that the use of educational software for the promotion of health is a reality and is well seen by adolescents. It is worth noting that more studies aimed at educational games using the Internet as a source of data and experiments to use the smartphone as a classroom resource through the assessment of the behavior change readiness stage as a result are examples of investigations which could contribute to the promotion of knowledge / behavior change towards the prevention and fight against obesity among young people.

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