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Educational games in the health promotion of adolescents with obesity: integrative review

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ABSTRACT

Objectives: to analyze the use of educational digital games to promote health in adolescents with obesity. **Methods:** an integrative literature review was conducted in the MedLine, LILACS CINAHL and Scopus databases. **Results:** of the 1,337 studies identified, 15 were included for analysis. The most prevalent outcomes in the studies were physical activity and healthy eating. Most digital games are active video games with graphic designs that encourage body movement to promote physical activity, some of which are represented by avatars. In this format, adolescents are encouraged to engage in real-life behaviors, such as healthy eating and physical activity. **Conclusion:** digital games represent an educational technology with potential use in healthcare, as they promote the development of health knowledge, attitudes toward physical exercise, and healthy eating habits in adolescents.

Descriptors: Exergaming; Adolescent; Obesity; Health Promotion.

INTRODUCTION

Adolescent obesity is a growing and alarming problem. Many young people face serious health risks with the increased consumption of ultra-processed foods and a sedentary lifestyle, combined with the impact of social media on body image.

For several decades, overweight and obesity in childhood and adolescence have been a worrying phenomenon in several countries[1,2], including Brazil[3], and their biopsychosocial repercussions can impact adulthood[4].

In this context, researchers have been seeking solutions that spark the interest of the affected population. Studies on the use of active video games (AVG) as a technology for health promotion emerged over twenty years ago[5,6].

Games offer much more than mere entertainment[6]. These devices promote greater player engagement by sparking their curiosity and expand learning opportunities[7,8]. They display the properties of an educational tool through the mobilization of information and development of positive attitudes[9].

For health promotion targeting eating behaviors and obesity, the use of digital games can be an opportune means of promoting health education activities in the prevention, management and confrontation of obesity[8,9]. The playful environment fostered by digital games stimulates users' learning through challenges and tests that mobilize cognitive and perceptive resources in the search for problem solutions and encourage the creation of coping mechanisms.

Digital games enable adolescents to spontaneously and enjoyably engage with contexts, situations and phenomena that foster meaningful behaviors and the acquisition of new knowledge[9]. Incorporating games into educational practices reinforces knowledge exploration and construction, establishing them as a crucial tool.

Their use has significant repercussions for users' quality of life, fostering shifts toward healthier attitudes and behaviors[10,11].

Although the use of digital games is well established worldwide, especially for adolescents, the scientific evidence supporting their use as an effective health education tool for the prevention, management, and confrontation of obesity is still unclear.

More research is needed to fully understand the scope of the use of these technologies as educational tools, as their implementation could reduce health problems and improve the quality of life for this population.

The objective of this study was to analyze the use of educational digital games for health promotion in adolescents with obesity.

METHODS

This integrative review was developed in five stages: development of the research question (problem identification), literature search, study evaluation, data analysis, and presentation of the review[12].

The PICO strategy was used to develop the question, in which "P" refers to the population, patient, or problem (overweight or obese adolescents); "I" to the intervention or area of interest (use of digital educational games); and "O" to the results/outcomes (elements associated with obesity management, prevention, and/or control)[13]. Although "C" refers to the comparison between the intervention and control group, it was not used since it is not applicable to this type of review.

Therefore, the guiding research question was "What is the scientific evidence on the use of educational games for obesity management in adolescents?". In this study, the age range considered for adolescence was 10-19 years, according to the period of adolescence established by the World Health Organization (WHO)[13].

The search for studies was conducted between May and June 2023 in the Medical Literature Analysis and Retrieval System Online (MEDLINE) databases via the National Library of Medicine, National Institutes of Health, Latin American and Caribbean Health Sciences Literature (LILACS), Cumulative Index to Nursing and Allied Health Literature (CINAHL), and Scopus, using controlled descriptors and keywords (Table 1) based on the Medical Subject Headings (MeSH), CINAHL Headings, and Health Sciences Descriptors (DeCS), combined by the Boolean operators AND and OR.

The search phrases used in each database are presented in Table 2.

Studies addressing the development of computer-designed educational digital games for adolescents aimed at managing obesity, published in any language without a timeline were selected. Narrative reviews, literature reviews, editorials, response letters, monographs, dissertations, theses, experience reports, and opinion pieces were excluded.

The EndNote™ software (free online version 21.0 EndNote® Basic, Clarivate, USA) was used to manage, process, and edit bibliographic references.

The search, analysis and synthesis of the studies were conducted by two independent researchers, one a master's student and the other a doctoral student. A consensus meeting was held to solve any cases of disagreements, when the studies were reread in full by the researchers and their eligibility/exclusion was debated. Then, the results were consolidated descriptively into two summary tables.

Table 1 - Controlled descriptors and keywords retrieved from the Medical Subject Headings (MeSH), CINAHL Headings, and Health Sciences Descriptors (DeCS), 2023

Controlled descriptors	Keywords
"adolescent"	*"Adolescence"*
"Female Adolescent"	*"Male Adolescents"*
"Female Adolescents"	*"Male Female Adolescent"*
"Male Adolescent"	*"Teen"*
"Teenager"	*"Teenagers"*
"Teens"	*"Youth"*
"Youths AND video game"	*"Computer Game"*
"Computer Games"	*"Video AND obesity"*
"Obesity Management"	*"Management Obesity"*
"Management System"	*"Obesity Management System"*

Table 2 - Search phrases by database, 2023

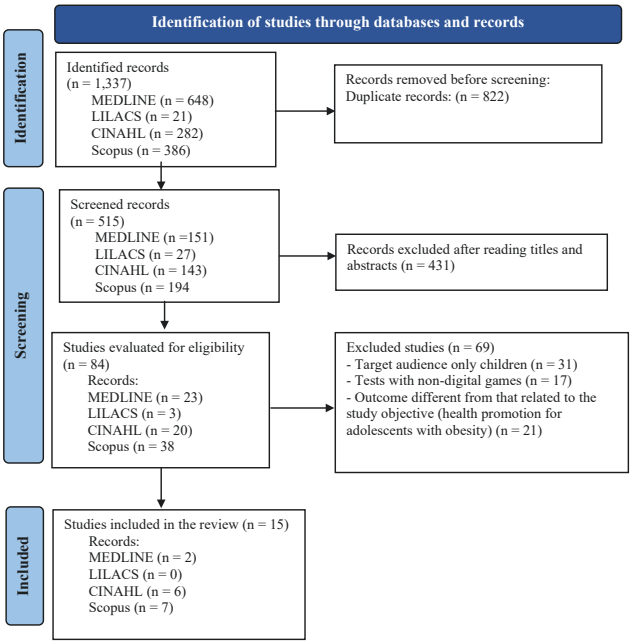
Database	Search phrases
Medical Literature Analysis and Retrieval System Online (MEDLINE)	*((adolescent OR adolescence OR "Female Adolescent" OR "Male Adolescents" OR adolescents OR "Male Female Adolescent" OR Teen OR Teenager OR Teenagers OR Teens OR Youth OR Youths) AND ("video game" OR "Computer Game" OR "Computer Games" OR Video)) AND (obesity OR "Obesity Management" OR "Management System" OR "Obesity Management" OR "Management Obesity" OR "Obesity Management System" OR "Obesity Management Systems" OR "Obesity Managements System"))*
Latin American and Caribbean Health Sciences Literature (LILACS)	*((adolescente OR adolescência OR adolescentes OR jovens OU juventude OU Juventudes) AND ("videogame" OR "Jogo de computador" OR "Jogos de computador" OR Vídeo)) AND (obesidade OR "Gerenciamento da obesidade" OR "Sistema de gerenciamento" OR "Gerenciamento do sobrepeso" OR "Sistema de gerenciamento da obesidade" OR "Sistemas de gerenciamento da obesidade" OR "Sistemas de gerenciamento do sobrepeso"))*
Cumulative Index to Nursing and Allied Health Literature (CINAHL)	*(("adolescent health" OR adolescent OR adolescents OR teen OR teenager) AND "video game" OR "computer game" OR "computer games" OR computer) AND (obesity OR "Obesity Management" OR "Obesity Management" OR "Management Obesity" OR "Obesity Management System" OR "Obesity Management Systems"))*
Scopus	*((adolescent OR adolescence OR adolescents OR Teen OR Teenager OR Teenagers OR Teens) AND ("video game" OR "Computer Game" OR "Computer Games")) AND (obesity OR "Obesity Management" OR "Management System" OR "Management Obesity" OR "Obesity Management System" OR "Obesity Management Systems" OR "Obesity Managements System"))*

RESULTS

A total of 1,337 studies were found, of which 84 remained after applying the inclusion and exclusion criteria. After reading the remaining articles in full, 15 studies comprised the sample (Figure 1)[14].

The fifteen studies[5-11,15-22] selected for the Integrative Review (IR) were published between 2006 and 2021. Regarding the country of origin, more than half (53.4%; n = 8) were developed in North America (United States and Canada), six in Europe (Germany, France, Netherlands, United Kingdom), and one in Oceania (New Zealand) (Table 3). Table 4 presents the objectives, methods, main results, and conclusions of the interventions of selected studies[5-11,15-22].

Figure 1 - Study selection process flowchart, 2023



Note: MEDLINE: National Library of Medicine National Institutes of Health; LILACS: Latin American and Caribbean Health Sciences Literature; CINAHL: Cumulative Index to Nursing and Allied Health Literature. Flowchart adapted and translated from Preferred Reporting Items for Systematic Review and Meta-Analyses (PRISMA) 2020[14].

DISCUSSION

The use of digital games as educational tools has shown predominantly positive results in promoting knowledge about obesity in adolescents, including prevention, monitoring, management, and related factors (healthy eating, physical activity, anthropometry, among others).

Among the existing digital game formats, the AVG, or even Exergame, were observed. In this emerging technology, interactive games are used to increase exercise performance by allowing users to physically interact with avatars on the screen through various body movements that stimulate physical activity[19].

In eight out of the 15 studies analyzed, AVG was applied to adolescents with the aim to encourage physical activity through the body movement required to play the game[8-11]. These studies converge on positive results related to the reduction in sedentary lifestyles compared to non-active, so-called conventional video games, which do not involve body movement. In addition to this type of stimulation in AVG games, there are notable improvements in lifestyle, which becomes healthier, in physiological aspects and physical development[11,16,18,23].

No major physiological changes were observed with the use of AVG in a short period of time, and the frequency and intensity of use were decisive factors in the success of results[18,20]. Researchers in

Table 3 - Bibliographic characterization of the studies according to database, journal, and year of publication, 2023

Nº	Reference	Database	Journal	Year	Country of origin
1	Unnithan et al.[5]	CINAHL	International Journal of Sports Medicine	2006	United States
2	Adamo et al.[8]	CINAHL	Applied Physiology, Nutrition & Metabolism	2010	Canada
3	Radon et al.[9]	CINAHL	Journal of Science and Medicine in Sport	2011	Germany
4	Maddison et al.[15]	CINAHL	American Journal of Clinical Nutrition	2011	New Zealand
5	Majumdar et al.[16]	Scopus	Games for Health Journal	2013	United States
6	Staian e Calvert[17]	MEDLINE	Cyberpsychology	2013	United States
7	Simons et al.[10]	Scopus	BMC Public Health	2014	Netherlands
8	Simons et al.[11]	Scopus	PLoS One	2015	United States
9	Simons et al.[18]	Scopus	International Journal of Behavioral Nutrition and Physical Activity	2015	Netherlands
10	Gribbon et al.[6]	CINAHL	The American Journal of Clinical Nutrition	2015	Canada
11	LeRouge et al.[7]	Scopus	Journal of the American Medical Informatics Association	2016	United States
12	Chaput et al.[19]	Scopus	British Journal of Nutrition	2016	France
13	Poppelaars et al.[20]	CINAHL	Appetite	2018	Netherlands
14	Ruggiero et al.[21]	MEDLINE	Games for Health Journal	2020	United States
15	Farič et al.[22]	Scopus	Journal of Medical Internet Research	2021	United Kingdom

Note: MEDLINE: Medical Literature Analysis and Retrieval System Online; LILACS: Latin American and Caribbean Health Sciences Literature; CINAHL: Cumulative Index to Nursing and Allied Health Literature.

Table 4 - Summary of information from selected articles (n = 15) on the use of educational digital games in obesity management among adolescents, by title, objective, method, main results, and conclusion, 2023

Continue...

Nº	Reference	Objective	Method	Main Results	Conclusion
1	Unnithan et al.[5]	To determine if there was any difference in submaximal energy cost of movement between overweight and non-overweight children while playing a dance simulation video game; and to determine if cardiorespiratory measurements obtained during play meet the American College of Sports Medicine recommendations for the development and maintenance of cardiorespiratory fitness.	A controlled clinical trial was conducted with 22 children and adolescents (10 overweigh; 12 non-overweight). Cardiorespiratory measurements were taken during a maximal treadmill walking test and during a 12-minute dance protocol.	The absolute mean (overweight: 17.7 ± 5.1 vs. non-overweight: 590.6 ± 147.9 Milliliters per minute^{-1}) sustained throughout the dance protocol was significantly higher in the overweight group compared to the non-overweight group. There was no significant difference in the mean energy cost of movement when Oxygen volume was normalized for fat-free mass (overweight: 17.7 ± 5.1 vs. non-overweight: 17.3 ± 3.9 milliliters kg fat free mass $^{-1}$min^{-1}).	The study demonstrated no differences in energy expenditure between overweight and non-overweight children while playing the dance video game, when expressed as a percentage of peak heart maximum heart rate obtained on the treadmill test. However, overweight children had higher energy expenditure while dancing in the video game compared to non-overweight children.
2	Adamo et al.[8]	To examine the effectiveness of stationary cycling with an interactive video game (GameBike) compared to stationary cycling with music on adherence, measures of energy expenditure, submaximal aerobic fitness, body composition, and cardiovascular disease risk markers in overweight and obese adolescents.	Randomized clinical trial with 30 adolescents (with at least one metabolic complication) or obese adolescents aged 12-17 years.	Both groups showed improvements in submaximal aerobic effort indicators measured during a progressive exercise stress test on an ergocycle. When considering the groups together, the training modalities resulted in a decrease in body fat percentage and total cholesterol.	Training on a bike with music is as effective as training while playing a video game at the same time when it comes to improving fitness, body composition, and skills.
3	Radon et al.[9]	To evaluate if active video games can have an effect on physical activity in obese adolescents in a clinical setting.	Activity-promoting video games were offered to all 84 inpatients (aged 13–28) enrolled in a long-term rehabilitation program on a voluntary basis.	The average heart rate during sessions (mean 115 heart beats per minute; 95% confidence interval 108–122 heart beats per minute) was similar to the heart rate during strength training (106 heart beats per minute; 101–112 heart beats per minute).	The results indicate that video games can have an impact on the physical activity of obese adolescents and young adults. However, because interest in the devices appears to be very low, their suitability for weight loss programs in young people cannot be guaranteed.
4	Maddison et al.[15]	To evaluate the effect of active video games on weight, body composition, physical activity and fitness for a six-month period.	Two-year parallel randomized controlled clinical trials. A total of 322 overweight and obese children and adolescents, aged 10-14 years, current sedentary video game users, were randomly assigned to use conventional video games or active video games.	There was evidence of a reduction in body fat in the intervention group (-0.83%; 95% Confidence Interval: -1.54%, -0.12%; p = 0.02). The change in daily time spent playing active video games at 24 weeks increased significantly.	An active video game intervention has a small effect on body mass index (BMI) and body composition in overweight and obese children and adolescents. It can be used as an adjunct strategy, but not as the primary target of intervention to reduce body mass index and improve body composition.
5	Majumdar et al.[16]	To evaluate the effectiveness of playing a serious game, "Creature-101" (developed by Teachers College, Columbia University [New York, NY] and Stottler Henke Inc. [San Mateo, CA]), in promoting energy-balance-related behaviors, such as increased fruit and vegetable intake, water intake, and physical activity, and reduced intake of processed snacks and sugary drinks and recreational screen time.	Pre-post intervention-control study (n = 590) conducted in low-income public schools. Students received guidance on scientific evidence that promotes energy balance through mini-games, educational videos, and slideshows and were motivated with interactive dialogues with game characters.	Intervention students reported significant decrease in the frequency and quantity of sugary drinks and processed snacks consumption compared to controls. No changes were observed for other behaviors.	"'Creature-101" has shown to be effective in reducing the consumption of sugary drinks and processed snacks, which are linked to obesity risks, indicating that the game holds promise in promoting healthy behaviors.
6	Staiano e Calvert[17]	To compare the energy expenditure of a group of adolescents at high risk of obesity when hitting a tennis ball in a simulated class compared to an exergame tennis match (social or solitary) or sedentary computer activity.	Intervention study with 74 African-American adolescents aged 12 to 18 years.	Energy expenditure was significantly greater in adolescents who played the social game against a peer than those who played alone. Energy expenditure was greater in both exergame groups compared to the control group.	Exergames appear to be an interesting tool for increasing physical activity, especially if they replace sedentary computer activity indoors.

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Continue...

Nº	Reference	Objective	Method	Main Results	Conclusion
7	Simons et al.[10]	To evaluate the effects of an intervention incorporating motivational elements for adherence included in a long-term intervention and a behavioral process assessment.	A randomized clinical trial was conducted with inactive adolescent gamers, aged 12-16 years, and their families. Families were randomly assigned to intervention and control groups, which were assessed by researchers or research assistants (anthropometric measurements and interviews) at T0 (baseline), T1 (1 month), T2 (4 months), and T3 (10 months). The intervention group was exposed to an active game, and the control group was encouraged to continue their normal gaming activities for 10 months. At the end of the study, the active game was also offered to the control group.	There was a reduction in the mean standard deviation score, waist circumference, hip circumference, and sum of skinfold thicknesses. There was also a reduction in adolescents' self-reported time spent in inactive games, other sedentary activities, and consumption of sugary drinks.	The strengths of the study included the incorporation of motivational elements into active play and a comprehensive process assessment. The trial provided evidence for the potential contribution of active game to preventing excessive weight gain in adolescents
8	Simons et al.[11]	To evaluate the effects and adherence of an active videogame promoting intervention on anthropometry, sedentary screen time, and consumption of sugar-sweetened beverages and snacks among mostly healthy-weight adolescents who do not regularly play active video games.	Two hundred seventy adolescent gamers (≥2 hours/week of non-active video game time) were randomly assigned to an intervention group (n = 140) (receiving active video games and encouragement to play) or a waitlist control group (n = 130). Sedentary screen time, physical activity, consumption of sugar-sweetened beverages, and snacks were assessed at T0 (baseline), T1 (1 month), T2 (4 months), and T3 (10 months).	The intervention group decreased significantly more in the mean (standard deviation) Body Mass Index score (β = 0.074, 95% CI: 0.008; 0.14) and in the sum of skinfold thicknesses (β = 3.22, 95% CI: 0.27; 6.17) compared to the control group. The intervention group had a significantly greater reduction in self-reported non-active video game time (β = -1.76, 95% CI: -3.20; -0.32) and total sedentary screen time (Exp - β = 0.81, 95% CI: 0.74; 0.88) compared to the control group.	The active videogame intervention did not result in lower anthropometric analysis values in a group of non-active "excessive" videogame players, mostly healthy weighted, compared to a control group over a 10-month period. Some unexpected effects were found in the control group, with lower mean values for Body Mass Index and skinfold thickness compared to the intervention group. The intervention resulted in less self-reported screen sedentary time, although these results were likely influenced by social desirability bias.
9	Simons et al.[18]	To examine the association between active video game play and other energy-balance-related behaviors	Adolescents aged 12 to 16 years with access to active video games and who reported spending at least one hour per week on active videogames were invited to participate. Participants completed 24-hour electronic diaries on five randomly assigned weekdays and two weekend days over a one-month period, reporting time spent playing active and non-active video games, and other energy-balance-related behaviors.	The results indicated that adolescents who reported active video game play on the days assessed also reported spending more time playing non-active video games, compared to adolescents who did not report active video game play on the days assessed.	The results suggested it is unlikely that time spent by adolescents on active video game play will replace time spent on other physically active behaviors or sedentary activities. Spending more time playing active video games appears to be associated with a small but significant increase in snack intake. This suggests that interventions aimed at increasing time spent playing active video games may have unexpected side effects, thus warranting caution.
10	Gribbon et al.[6]	To examine the acute effects of active video game play on energy intake and expenditure.	Using a randomized crossover design, 26 male adolescents (mean age 14.5 ± Standard Deviation 1.4) completed three one-hour experimental conditions: resting control, seated video game play (Xbox 360; Microsoft), and game play (Kinect Adventures on Xbox 360), followed by an ad libitum lunch.	Energy expenditure was significantly higher during active video game play than during the resting control and seated video game conditions, although no significant differences were observed in 24-hour energy expenditure.	The increase in energy expenditure promoted by a single session of active Kinect video game play is not associated with increased food intake, but is offset after the intervention, resulting in no measurable change in energy balance after 24 hours.
11	LeRouge et al.[7]	To evaluate the potential capacity of animated avatars (a digital representation of the user) and virtual agents (a digital representation of a coach, friend, or teacher) to deliver computer-based interventions for chronic weight management in adolescents.	Community-based participatory research to explore design and human-computer interaction. This approach focuses on users, tasks, social context, and their support systems; empirical usage measures; and interactive designs, through which the product is designed, evaluated, and modified with the real user and their support network in brief and repeated interactions.	Data indicate strong interest in including avatars and virtual agents, supporting self-management efforts and making self-management more "joyful", "fun" and motivating.	This study provides evidence supporting the inclusion of the use of avatars and virtual agents designed using participatory approaches in the continuum of care. It increases the likelihood of long-term engagement and retention of overweight and obese adolescent users and suggests expanding the current model of chronic care toward broader technical and social representations.

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Conclusion.

Nº	Reference	Objective	Method	Main Results	Conclusion
12	Chaput et al.[19]	To examine the influence of weight status (obese vs. lean) on nutritional responses (food preferences and appetite sensations) to passive video games, active video games, and physical exercise in male adolescents.	Twelve lean and 12 obese adolescent boys (aged 12–15 years) completed four one-hour sessions in a crossover study: control (a quiet sitting session), passive video game (PVG; boxing game on Xbox 360), active video game (AVG; boxing game on Xbox Kinect 360), and exercise (Ex. cycling).	Obese participants ate significantly more than lean participants in all four conditions. Macronutrient intake did not differ significantly between groups or conditions. Hunger was significantly higher and satiety was lower in obese participants, although no effect of condition was observed.	Moderate-intensity exercise provides a better effect on energy balance than an isoenergetic hour of active video game playing in lean adolescent boys, impacting both energy intake and energy expenditure.
13	Poppelaars et al.[20]	To examine the effectiveness of Hit n Run, a video game based on the principles of Go/No-Go inhibition training in young adults who reported disinhibited eating.	Adolescents and adults (aged 18 to 30) were randomly assigned to play Hit n Run or received an informational brochure. Before and immediately after the intervention week, general and food-specific inhibitory control, caloric intake, and the perceived attractiveness of food images were assessed.	The results revealed no improvements in food-specific inhibitory control or caloric intake in either intervention group. Similar improvements in general inhibitory control and similar decreases in the perceived attractiveness of food-related stimuli were observed for Hit n Run.	The authors suggest that future research should aim to clarify how video game design can implement mechanisms of cognitive training tasks to facilitate the development of effective game-based interventions.
14	Ruggiero et al.[21]	To develop a digital game that could be used as a standalone game, ultimately playable anywhere, and could also be used to complement educational nutrition and physical activity curricula for youth.	Two phases and several pilot groups of youngsters aged 7-13 years attending nutrition education programs (N = 48) were conducted using single-group pre-post designs. The first phase (n = 21) examined individual and team gameplay, and the second phase (n = 27) focused solely on team gameplay.	The survey administered after the conclusion of games indicated that 70% of the children and adolescents learned new information about healthy eating and 70% also learned new information about physical activity. Youngsters across all pilots showed an average increase of 11.8% in knowledge. Knowledge scores in the game, in the individual gameplay group, also showed a 12.5% increase in knowledge score. A post-game behavioral intention assessment found strong intentions to eat more fruits and vegetables and engage in more physical activity. Most youngsters reported that the game was very fun.	Preliminary results showed improvements in knowledge, and most youth expressed behavioral intentions to make changes in physical activity and fruit and vegetable intake. The formative work and initial evaluation of MyPlate Picks (MPP) showed promising results for knowledge and behavioral intentions. Youngsters reported that playing in teams was more fun. Future evaluation of the game in large groups and for use with other implementation approaches is needed.
15	Farič et al.[22]	To develop a physical activity intervention for adolescents using VR (Virtual Reality) exergaming.	Formative development was guided by the Medical Research Council framework and included recruiting a group of adolescent users to provide iterative feedback, a literature review, a quantitative survey of adolescents, and qualitative interviews with adolescents and parents.	VR exergaming proved appealing to adolescents and acceptable to parents. Behavior changing techniques that users could engage with and features that should be incorporated into a virtual reality game were identified, including realistic body movements, accurate graphics, scalable gameplay difficulty levels, novel challenges, in-game rewards, multiplayer options, and the potential for linking with real-world features such as physical activity trackers. Some potential barriers to use were identified, including cost, perceived discomfort of VR headsets, and concerns about motion sickness. A prototype of the game was developed and user-tested with generally positive feedback.	This is the first attempt to build an exergame designed to engage adolescents in physical activity within a public health intervention development framework. The formative work suggests this is a very promising path.

Canada[8] showed that the playing time is crucial, and after 24 hours of use, no significant difference was observed between the groups of adolescents who played the video game and those who did not. However, there is a significant energy expenditure among players, which indicates a benefit from AVG use that can be extended with the habit of this activity, constituting a possible positive factor for adolescent health.

In a study conducted in the Netherlands[10], excellent results were obtained using AVG aimed not only at adolescents but also at the entire family. There were significant reductions in participants' waist circumference, hip circumference, and skinfold thickness, as well as a reduction in the time spent playing inactive video games, engaging in sedentary behaviors and consuming unhealthy foods. Thus, playing AVG shows promise for encour-

aging and developing healthy habits associated with physical activity and healthy nutrition.

Contrary to these findings, another study conducted in the United States[16] found no significant positive changes with AVG, and its use was accompanied by an increase in the consumption of unhealthy snacks. This requires considerable caution and close monitoring to avoid exposing adolescents to the risk of illness.

Furthermore, in addition to AVG, other types of digital games were also observed in the studies analyzed, such as the use of avatars. A game with participants represented by avatars was produced in a study conducted with adolescents[20]. Each participant had to go through a series of activities that forced the player to make choices within the game universe, which, in turn, generated results associated with their behaviors. The nature of the game is related to choosing healthy foods, practicing physical activities, among other elements that are part of a healthy lifestyle. The authors observed that the digital personification of users favored increased concern regarding their food choices in the "real world", leading to self-management of their behaviors.

Thus, games can aid in the learning process through experiential learning and the adopted didactic approach in relation to promoting a healthy lifestyle, preventing obesity and other long-term chronic diseases, and encouraging information about healthy foods and the practice of physical activity[17,21,22,24].

This phenomenon was observed in a study conducted with children that aimed to provide health education about physical activity practice and healthy food consumption[22] through educational games. The authors found that 70% of users of the educational digital game demonstrated higher knowledge about healthy eating and the benefits of physical activity, highlighting the important educational role of digital games when properly developed and validated as a health education tool.

Data found in this review suggest that digital games based on encouraging regular physical activity and educational games that stimulate knowledge acquisition can contribute to the prevention and management of obesity in adolescents. Health gains are driven by the game's components and the goals outlined in their usage diagrams.

These findings should be carefully considered, as long-term use of these games can encourage unhealthy practices, such as unhealthy snacks consumption[18] that negatively impacts adolescents' overall health.

Furthermore, during their gaming routine, it is recommended that users consider the informative elements present in the game's content, seeking to distinguish between what is imaginary and experienced in the games' cyberspace and what is part of their real-life everyday lives. This allows them to bring positive aspects into the existential world, such as the health-promoting practices and social relationships outlined in the communicational layout of digital games.

Educational games can be used as technologies to help encourage healthy eating and manage obesity in adolescents. Effective communication with adolescents requires resources that spark their interest, capture their attention, and provide enjoyment. From this perspective, digital games have proven to be useful tools and yield positive results in clinical/care management for this population.

A limitation of this review is the lack of a theoretical framework to assess the level of evidence of the designs found in the studies. The objective of this review was to analyze the use of educational technologies in the form of digital games for health promotion in adolescents with obesity, highlighting the main results achieved through the use of these games. These results do not dictate the final understanding of the positive effects of these educational technologies, but rather provide elements demonstrating their great potential for use in healthcare practice.

CONCLUSION

The use of AVG presents itself as a promising educational technology for knowledge acquisition and adoption of healthy habits (physical exercise and proper nutrition).

Digital games aimed at the health of obese adolescents offer technologies with the potential to promote the educational process by encouraging physical activity, knowledge development, and decision-making regarding diet and the execution of tasks within the game world that extend into the real world.

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RAMT: project administration; supervision; validation and writing – review & editing.

MVOQ: project administration; supervision; validation and writing – review & editing.

IGC: conceptualization; data curation; formal analysis; funding acquisition; investigation; methodology; resources; software; visualization and writing – original draft.

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Conflict of interest

None.

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