



Revisión

Online platforms to teach Nutrition Education to children: a non-systematic review *Plataformas online para enseñar Educación Nutricional a niños: una revisión no sistemática*

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Abstract

Introduction: Childhood obesity is now considered a worldwide problem. Nutrition Education (NE) has been identified as a key factor in preventing overweight and obesity in children. In recent years, there has been an increase in the interest in innovative ways to teach this knowledge to children, mainly through the use of the Internet.

Objective: Review and analyze the available evidence about programs focused on NE for children through the use of the Internet.

Results: Three different ways were found to deliver NE over the Internet to children: platforms designed to communicate with other peers or professionals; platforms designed to provide NE through the contents included in the web tool; and platforms designed to provide NE through the contents included in the web tool and automated feedback. Most of these programs were effective in achieving the objectives established.

Conclusion: Although the use of Internet platforms to teach NE to children has been shown to be effective, the amount of evidence is still scarce. Some of the main advantages the Internet provides are: the opportunity to put the children in contact with education and health professionals; children can keep a record of the food consumed; and it is a more attractive and interesting way for children to learn NE, compared to traditional methods.

Key words:

Nutrition education.
Children. Web
platforms.
Intervention.

Resumen

Introducción: la obesidad infantil es actualmente considerada un problema a nivel global. La educación nutricional (EN) ha sido identificada como un factor para prevenir el sobrepeso y la obesidad en los niños. Durante los últimos años se ha incrementado el interés en métodos novedosos para enseñar este conocimiento a los niños, especialmente a través del uso de Internet.

Objetivo: revisar y analizar la evidencia disponible con respecto a los programas de EN dirigidos a niños a través del uso de Internet.

Resultados: se identificaron 3 formatos para transferir EN a niños a través del uso de Internet: plataformas diseñadas para comunicarse con otros niños o con profesionales, plataformas diseñadas para ofrecer EN a través de los contenidos incluidos en la herramienta web, plataformas diseñadas para proveer EN a través de los contenidos incluidos en la herramienta web y además retroalimentación automatizada. La mayoría de estos programas fueron efectivos para conseguir los objetivos establecidos.

Conclusión: aunque el uso de plataformas de Internet para enseñar EN han demostrado su efectividad, la cantidad de evidencia es todavía escasa. Entre las principales ventajas que ofrece Internet, se encuentran la oportunidad de poner en contacto a los niños con profesionales de la salud, llevar a cabo un registro de los alimentos consumidos, y también es una forma más atractiva e interesante para que los niños aprendan EN, en comparación con métodos tradicionales.

Palabras clave:

Educación nutricional.
Niños. Plataformas
web. Intervención.

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INTRODUCTION

Balanced nutrition is essential for healthy growth and plays an important role in our health and in the prevention and management of many chronic conditions, such as overweight and obesity, cardiovascular disease, or cancer (1). The unprecedented increase in diet-related diseases has been linked to poor eating habits and diminishing knowledge and skills related to foods and their use (2-5). Moreover, the number of children with overweight or obesity has increased considerably in recent years, with a total of 42 million registered in 2013 (6).

In Europe, the majority of the risks of premature death are related to harmful eating habits and obesity (7). The consumption of fiber-rich foods has declined, whereas the intake of high-fat and refined carbohydrate foods has increased (8). For example, in Spain, where 30% of the children suffer from overweight (9), over 80% of children from 6 to 7 years old consume bakery products (biscuits, buns, etc.), sweetened beverages, and yogurt with added sugar, on a daily basis (10).

Empirical evidence indicates that dietary habits acquired during childhood persist throughout adulthood (11), and the middle school years constitute a period when it is possible to positively influence students' behaviors related to nutrition and Physical Activity (PA) (12). Both reasons highlight the importance of early prevention strategies in improving eating habits. One of the main tools to fight against the impoverishment of healthy diets in children is to increase the knowledge about food and nutrition, that is, NE. Some data point out that children do not know the most basic concepts of nutrition, and some of them even think that sweets and pasta are needed by the body to survive (13). NE provides children with dietary recommendations in order to improve the knowledge and skills needed to acquire healthy habits and prevent health-related diseases (14), and it also helps children to understand messages that can help them to make more informed choices (15). NE encompasses "any combination of educational strategies, accompanied by environmental supports, designed to facilitate voluntary adoption of food choices and nutrition behaviors conducive to health and well-being" (16) (p. 176). According to Contento (17), NE involves more than just nutritional literacy; thus, it has to address food preferences, sensory-affective, personal (perceptions, beliefs, attitudes, meanings) and environmental factors, and social norms (18).

COMPONENTS OF NUTRITION EDUCATION INTERVENTIONS

The main concepts usually included in NE programs for children are: basic nutritional knowledge about food (food groups, what calories are, etc.), the importance of balanced eating, and how food helps or affects our body (19). Although these concepts are usually considered fundamental, some programs include or emphasize other contents as well, such as the planning of different meals, how many foods they should consume per day, or how to plant and consume some vegetables (20,21). In addition, activ-

ities focused on food manipulation and meal preparation are also considered good strategies to provide NE (22-23).

According to Contento (17), the activities designed to achieve the targeted behaviors in an NE program should be divided into three components:

- *The motivational component* helps the children to carry out the practices of an NE intervention. The goal is to increase awareness and enhance motivation by addressing beliefs and attitudes through effective communication strategies. This component can be approached in two ways, by recognizing the positive outcomes of healthy eating (benefits), or by highlighting the potential health risks of a bad diet (consequences).
- *The action component* is aimed to facilitate children's ability to take action through goal setting and cognitive self-regulation skills. This component refers to a goal-setting process, where participants should make specific action plans for specific behaviors or food choices.
- *The environmental component* includes the nutrition educators to work in combination with policymakers and others to promote healthy-eating environmental supports for action.

Contento's model provides basic elements to consider in developing an NE program focused on changing children's eating behaviors.

DELIVERING NUTRITION EDUCATION PROGRAMS

NE for children is usually designed to be delivered in two main contexts, schools and clinics/hospitals. In schools, the professionals in charge of providing this knowledge are teachers, and in hospitals this task is performed by nutritionists and doctors. In addition, NE has usually been delivered using different tools such as brochures and printed books (24) or practical materials such as printed sheets to teach children how to prepare certain recipes for healthy foods (25). In other approaches, fruits and vegetables (F&V) are provided in the classroom to introduce the children to eating these foods and help them with the experience of eating them (26,27).

DELIVERING NUTRITION EDUCATION PROGRAMS THROUGH ONLINE PLATFORMS

The Internet is widely frequented by children and adolescents in their daily lives, for example, to watch videos, play games, search for information, do their homework, or socialize with other children (28). In recent years, there has also been an increasing use of the Internet to deliver NE programs (29). According to the United States Department of Agriculture (30), there is a moderate amount of evidence indicating that NE delivered via Internet-based programs may be effective in improving dietary intake-related behaviors among children and adolescents. However, there is a need to increase the quality of Internet-based interventions to teach NE to children. Some of the main advantages of using online

systems are that the messages contained in the interventions can be adjusted to each individual according to his/her needs (31), and the contents can be presented to the children through a dynamic and attractive format, as in the case of animations, videos, comics, among others (32). Moreover, one of the main characteristics of the online systems is the option to communicate with others, such as a health professional to receive or request support when needed (33).

OBJECTIVES

So far, a few nonsystematic and systematic reviews and meta-analyses have specifically analyzed the effectiveness of NE programs, mainly focusing on the prevention or treatment of obesity. Reviews generally focus on the combination of PA and NE. Among the main reviews focused only on NE, we can find the one by Lyttle (15), where 17 articles published between 1980 and 1994 were analyzed. The main results were that NE can have an impact on the children's knowledge, and that behavioral change (eating healthier) is possible using these contents. Another NE review was carried out by Contento et al. (34), who analyzed 217 NE intervention studies. The authors concluded that these programs "generally work" and the most effective ones are behaviorally-focused and based on appropriate theory and prior research. Another review was conducted by Pérez-Rodrigo & Aranceta (35), who analyzed the main results of 10 studies. They concluded that, at that time, growing evidence supported the effectiveness of programs focused on health promotion with an emphasis on healthy eating. More recently, Hingle, Macias-Navarro, Rezaimalek, and Scott (36) reviewed programs focused on teaching NE and/or PA, using technological tools. These authors identified 22 studies, most of them using the Internet to deliver the programs, but only 3 were focused on teaching NE as the only component. Of these 3 interventions, 2 were focused on adolescents from 12 to 15 years old (37,38), and only one was carried out with younger children (39). To our knowledge, there are no reviews specifically focused on online NE interventions for children. Therefore, the objective of this paper is to perform a non-systematic review of studies that have tested an online program for teaching NE to children.

METHOD

A nonsystematic review was conducted by searching the following databases: PubMed/Medline, CENTRAL-Cochrane, SCOPUS, Google Scholar, PsycINFO, and grey literature. The keywords were: Nutrition Education AND Children AND Intervention AND Internet OR Web platform OR Technology in the title/abstract. The inclusion criteria for the articles were: a) the intervention should be designed to teach NE as the main objective, or it had to include an NE component, but not as a secondary objective of the study; b) it should be addressed to children from 5 to 13 years old; c) it should include a description of the program; d) it should clearly

specify the methodological procedures (sample, experimental design, measurements, etc.); and e) it had to be published between 2000 and 2014. Finally, studies that used only Serious Games were excluded.

RESULTS

Finally, 9 studies matched the inclusion criteria. Figure 1 shows the selection process, along with all the articles rejected and the reason for their rejection. The general description of these 9 studies is included in table I.

Regarding the country where the research was carried out, most of the studies were conducted in the United States (6 studies), 1 in Austria, 1 in the Netherlands, and one large-scale study was carried out in Norway, the Netherlands, and Spain.

Most of these studies were implemented in primary school contexts (6 studies), 1 was conducted at home, 1 combined home and school, and 1 was carried out during a summer camp and at home.

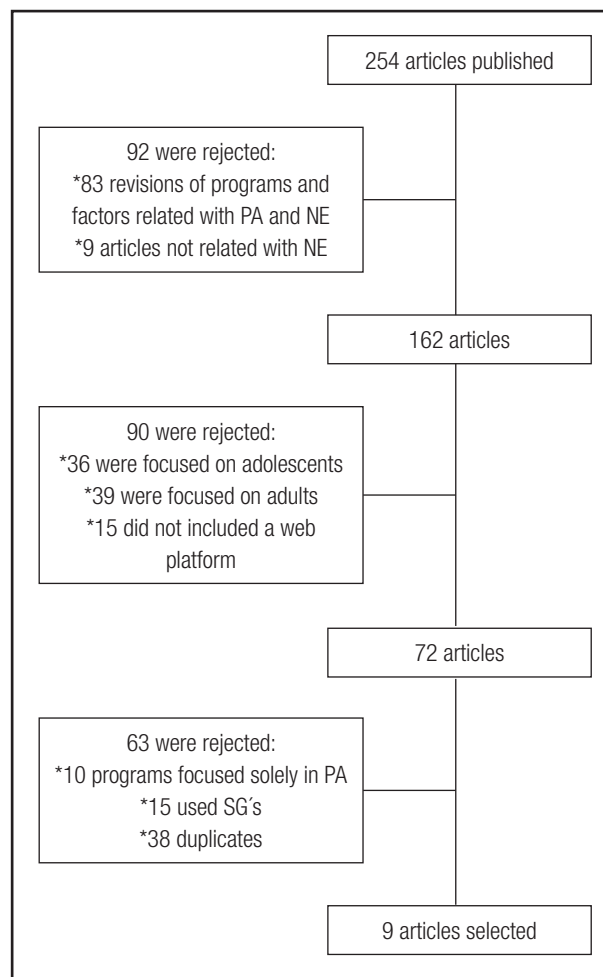


Figure 1.

Flowchart search and results.

Table I. General description of the studies

Program name, main author, year & country	Aims and Objectives	Tools	Components & duration	Target population	Contexts
<p>"The 5 A Day Virtual Classroom" DiSogra, 2000 (47) United States</p>	<p>Increase F&V consumption</p>	<p>Web platform Computer with internet access</p>	<p>The intervention was delivered during 2 weeks. It offered the students the opportunity to advise the U.S. president on how to motivate children to eat five servings of F&V per day. This activity aimed to evoke discussions in class and homework to broaden ideas about the influences on health, leading them to make more informed decisions</p>	<p>5 to 11 years old</p>	<p>Primary schools</p>
<p>"The Food, Fun and Fitness Project" Baranowski, 2003 (43) United States</p>	<p>To motivate the performance of PA at home, increase the consumption of fruits and juices, and encourage drinking more water and eating 5 meals daily</p>	<p>Web platform</p>	<p>Four weeks at summer camp, followed by 8 weeks of intervention via the Internet, held in their homes with specific web pages for children and parents</p>	<p>8-year-old African-American girls. Parents</p>	<p>Summer day camp and homes</p>
<p>"The Cool Food Planet KIDZ" Kreisel, 2003 (40) Austria</p>	<p>To increase nutritional knowledge</p>	<p>Web platform Computers with Internet access CD-ROM</p>	<p>A program consisting of 2 weeks of NE, provided by a CD-ROM, that used computers as a tool for applied learning in children. Seeking to develop challenging and attractive teaching tools for students, various methods of communication, such as text, sound, images and animation, were applied through the computer</p>	<p>8 to 11 years old</p>	<p>Primary schools</p>
<p>The name of the program is not presented. Frenn, 2005 (45) United States</p>	<p>To promote the consumption of healthy foods and the practice of PA</p>	<p>Web platform including videos Computer laboratory Internet</p>	<p>The intervention was implemented in 8 sessions and consisted of watching videos lasting 2-3 minutes and Internet-based programs on awareness of the need and access to healthy foods and PA as well as the benefit of better nutrition and exercise. Individualized feedback was generated and sent via email to the participants after sending the first daily dietary recall, and followed up in the following 4 sessions</p>	<p>Children aged 11-12 years</p>	<p>Primary schools</p>
<p>"Girl-scout NE program" Rydell, 2005 (44) United States</p>	<p>To promote bone health among preadolescent girls using a web-based component of a nutritional and PA behavioral intervention</p>	<p>Web platform Computers with internet access</p>	<p>In 30 sessions, contents related to strengthening the bones were provided to the girls through a web-based platform. The web site included a news section with updated information about how to strengthen the bones. Another section was called "Puzzled Patty", where the girls had to provide a solution to a series of problems related to a fictional character. The webpage also included an e-mail account for each girl, a bulletin board, a calendar of events, calcium-rich recipes, suggested bone building activities, and links to other study-related web sites</p>	<p>Girls aged 10-12 years old</p>	<p>Summer school Homes</p>

(Continuation in the next page)

Table I (Cont.). General description of the studies

Program name, main author, year & country	Aims and Objectives	Tools	Components & duration	Target population	Contexts
The name of the program is not presented <i>Mangunkusumo, 2006 (42)</i> United States	To promote the consumption of F&V	Web platform Internet	The time it took to deliver the intervention was not reported in the article. Educational program through the use of Internet-tailored nutrition advice for the children, followed by Internet-supported brief dietary information, combined with face-to-face counseling by a nurse -in the presence of at least one parent, to increase the intake levels of these foods	9-12 years old	Primary schools
<i>"Pro Children Study"</i> <i>Te Velde, 2007 (41)</i> Norway, Netherlands and Spain	Provide information on actual consumption level of vegetables and fruits with children from schools in Europe, and their parents	Web-based computer-tailored feedback tool. Parent version of the web-based computer tool. Both interventions can be found at this link: http://www.prochildren.org/navigator.htm Worksheets with guided activities for the classroom and outside the classroom	Approximately 7 months. The Pro Children intervention consisted of different components: a classroom component, a school component, a family component and one optional component, which differed by intervention site	Children 11 to 13 years old and their parents	Primary schools and homes
<i>"Louisiana (LA) health program"</i> <i>Williamson, 2008 (33)</i> United States	To test the efficacy of the two intervention arms for prevention of weight gain through changes in food selection and food intake, and changes in PA of the students	Classroom curriculum classes Web platform Internet counseling by experts in nutrition	For 3 years Classroom curriculum classes are given to a group and a combination of these classroom curriculum classes and a web platform with Internet counseling and education containing lessons and quizzes	9 to 12 years old.	Primary schools
<i>"FATaintPHAT"</i> <i>Ezendam, 2012 (46)</i> Netherlands	Promote healthy nutrition, increase PA, and reduce sedentary behavior	Web platform Internet	The intervention was implemented in 8 sessions, during which the children received information related to weight management and energy balance-related behaviors. Also, in each session, they received tailored feedback and health links	Students from 12 to 13 years old	Primary schools

Although all these interventions were directed toward children, some of them included other users, such as the parents or teachers, in order to increase the effectiveness of the intervention (40,41).

Regarding age, only 2 were focused on children from 9 to 12 years old (42,43), and the rest of the interventions were for children ranging from 5 to 13 years old.

The duration of the interventions ranged from 2 weeks (40,47) to 7 months (41). Results did not show a relationship between duration and effectiveness, as similar findings were found after 12 weeks (43) and after 7 months (41).

As for the increase in F&V consumption, 2 studies reported measuring this aspect. Te Velde et al. (41) reported an increase of 56.9 grams per day in the intervention group, but for some participants

this consumption even increased to 91.5 grams per day in the follow-ups (1 and 2 years after the intervention ended). In the study by Baranowski et al. (43), the treatment group consumed more F&V than the control condition (4.9 vs. 4.1 servings over 2 days).

Considering the use of the Internet, three different ways were identified: a) contents delivered through the web tool; b) NE contents delivered through the web tool plus automated feedback; and c) the Internet to allow communication with peers or professionals. Next, we describe the results obtained in each of these ways/categories.

PLATFORMS FOCUSED ON PROVIDING NUTRITION EDUCATION THROUGH AN ONLINE PROGRAM

In this category, we found 4 programs. These interventions used platforms to teach NE directly to the children, and in some cases they also used complementary tools such as worksheets or books.

Baranowski et al. (43) designed a platform that provided contents for the children related to selecting F&V as a snack and drinking more water instead of soft drinks, among others. For the parents, the platform provided suggestions about how to increase the availability of F&V and about eating them with their children. Kreisel et al. (40) implemented a platform called "Cool Food planet" to increase the nutritional knowledge of the children, in combination with traditional teaching classes and materials (worksheets with exercises, board games, etc.). Rydell et al. (43) implemented a web platform along with summer camps, focused on increasing nutritional knowledge, eating behavior and PA. Te Velde et al. (41) implemented an NE platform combined with worksheets and class exercises, along with a web platform to reinforce the knowledge gained in school.

Regarding results about efficacy, Baranowski, et al. (43) compared an intervention group consisting of a 4-week summer camp program with activities focused on healthy eating and 8 weeks of online intervention designed to reinforce the contents learned in the summer camp. The intervention group was compared to a control group that received the 4-week summer camp, but with the usual activities, and the participants were asked to login once a month to a platform that contained links to other general health and homework websites that the researchers thought 8-year-old girls would find interesting. The intervention group decreased their consumption of sweetened beverages by 20%, they increased their water consumption by 40%, and they consumed 1.2 times more F&V. However there were no significant differences in BMI between the control and intervention groups after the intervention.

Kreisel (40) compared an intervention that consisted of learning NE directly from a platform that included contents about basic concepts such as preparing healthy food, food from farms, which foods are made of what animals or vegetables, (e.g. Sausages), among others. The participants in the control group learned these concepts, but through traditional teaching materials such as worksheets and board and card games designed specifically for this study. Nutritional knowledge increased in both groups, and this

significant effect was maintained after 3 months. This study also found that younger children (8-9 years old) showed a greater increase in knowledge acquisition than older students.

The study by Rydell et al. (44) also analyzed adherence, and they found that, although all the participants used the platform frequently at the beginning of the study, this use decreased with time, as is usually found in adults. Regarding recommendations, Rydell et al. (44) suggested the importance of the age-appropriateness of the nutrition information.

The intervention by Te Velde et al. (41) implemented an NE platform with worksheets and class exercises, along with a web platform to reinforce the knowledge gained in school. The study also had a control group, but the article did not clarify what contents were provided to this group, or if there were any contents at all. The participants in the intervention group increased their consumption of F&V by 56.9 grams per day. However, in the follow-up, the effects remained for only some of the participants, those who received the intervention in Norway, where even at the follow up the consumption of F&V increased to 91.5 grams per day.

PLATFORMS FOCUSED ON PROVIDING NUTRITION EDUCATION THROUGH AN ONLINE PROGRAM PLUS AUTOMATED FEEDBACK

In this category, we can find two studies. These platforms provide NE contents, ask about diet, F&V consumption, or other unhealthy behaviors, and then provide warnings and reinforcement for healthy diet choices.

Frenn et al. (45) designed a platform focused on providing NE and recommendations about eating F&V and junk food. This system provided tailored feedback with recommendations or reinforcements depending on the child's performance. Results showed that participants who completed more than half of the sessions significantly decreased their percentage of dietary fat, and they increased their moderate and vigorous exercise by an average of 22 minutes.

Ezendam, Brug and Oenema (46) implemented a platform at schools that included contents about weight management, energy balance-related behaviors, and PA components. The system also provided tailored feedback to the children and helped them to establish goals for their feeding choices and behavior. They compared an intervention group with a no-intervention control group, but it was not clear whether or not they received any content. The results showed that the children in the intervention group were less likely to report drinking more than 400 ml of sugar sweetened beverages, they decreased their snack consumption, and they increased their F&V consumption.

PLATFORMS INCLUDING COMMUNICATION WITH PEERS OR PROFESSIONALS

Three studies were identified in this category. These types of platforms promote communication among the students in order to

create a “virtual community” where children can exchange ideas and opinions about their eating and suggestions to improve it. Furthermore, they create a space where children are able to communicate in private with health professionals (e.g., nutritionist, nurse or doctor), in order to obtain advice and information related to NE, or to follow up on their diet.

DiSogra and Glanz (47) designed an intervention where primary school children were asked to make suggestions about how other children could eat more F&V and make recommendations for the president of the United States about how to implement effective NE programs. These opinions were discussed with their classmates and teachers, and these suggestions were then added to a platform where other children in other schools in the country did the same task. Results showed no differences in the opinions about how to eat better in children from different schools. Older children were more likely to suggest improving access to F&V. The main suggestions for the president were to reward the kids for eating F&V and use print media to communicate the benefits of eating healthy.

Williamson, et al. (33) designed a program for primary school students focused on modifying the environmental cues, social support, and promotion of self-efficacy through classroom curriculum classes. It also included the possibility of communicating with a counselor through online chats and asynchronous emails. Although the design and method of the intervention were published, the results still have not been published.

Mangunkusumo et al. (42) designed an intervention where children received NE through a platform and had to record their F&V and junk food consumption. A nurse reviewed these data, and if there were unhealthy eating behaviors, a counseling session with the child and parents was planned to offer information and recommendations. The study compared an intervention group to a control group. The participants in the no-intervention condition completed online questionnaires about their consumption of F&V and periodic health examinations, but only the children in the intervention group received feedback about their answers and dietary counseling from a nurse. The results showed that children in the intervention group were almost three times more likely to be aware of their inadequate fruit consumption level and the recommended vegetable intake levels.

CONCLUSIONS

The objective of this paper was to carry out a non-systematic review of NE programs supported by web platforms, and 9 studies were identified between 2000 and 2014. In general, the objectives of the interventions focused on: increasing the nutritional knowledge of the children (40,41), increasing the F&V consumption (42,43,47), promoting healthy nutrition in the children (45,46), preventing weight gain (33), and promoting bone health (44). Overall, almost all the interventions were effective in achieving their specific goals.

Regarding the length of the interventions, a wide range was observed, with studies lasting from two weeks (40,47) to

7 months (41). Although it would be logical to imagine that longer interventions would be the most effective ones, this relationship was not observed because similar results were found in medium length interventions, such as the one by Baranowski et al. (43), which lasted 12 weeks, and the intervention by Te Velde et al. (41), which lasted more than twice as long as Baranowski's. More research is needed to determine the influence of the length on the effectiveness of the interventions.

The use of the Internet to deliver NE programs has several advantages. One of the main advantages is that these systems offer an economical and extensive medium to deliver contents to a large number of people in different parts of the world at the same time (48,49).

The Internet has the potential to reach a large audience easily, and it could increase adherence in children and youth due to their familiarity with computers and the Internet (44,50). It is also possible to upgrade and update the contents without much cost, as occurs when reprinting books, and to provide more interaction between user and technology, which could increase the use of these methods. The use of computers and the Internet also acquires added value because technologies are considered more pleasant, fun and comfortable by children (40). In addition, these systems have the potential to deliver nutritional messages adapted to individual needs and beliefs about the individual's behavior (42,50). Finally, they can promote behavioral changes through feedback and an individualized monitoring tool, as well as offering the possibility of exchanges between users and rewards for their efforts.

There is an urgent need to analyze more in-depth the effectiveness of programs solely focused on NE directed to children. As observed in this study, only 3 reviews were found (15,34,35), and two of them are more than 20 years old (15,34).

Evidence about the effectiveness of NE online programs is still limited, and it is necessary to analyze other factors and moderators of these programs, such as the length of the intervention, or the role of other agents involved in the intervention (family, school, etc.).

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