Nutritional interventions for adolescents using information and communication technologies (ICT): a systematic review

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Brasília - DF
2016
ABSTRACT

INTRODUCTION: Adolescence is considered a nutritional risk period associated with a high prevalence of inadequate dietetic habits, that if not treated, can lead to obesity and non-communicable diseases. Once the majority of adolescents in the USA have access to Internet and electronic devices, an interactive and low-cost way of promoting healthy nutrition behaviors is by using information and communication technologies (ICT) in interventional programs. Therefore, the OBJECTIVE of this systematic reviews is to identify the different technologies and likewise its main characteristics that have been used for nutritional interventions in adolescents as well as evaluate the quality and effectiveness of these studies.

METHODS: This study followed PRISMA’s guidelines and had its protocol published on PROSPERO (#CRD42016035882). Five databases (PubMed/MEDLINE, Scielo.ORG, Web of Science, PsycINFO, and Scopus) were searched to find articles written in English, Portuguese or Spanish describing nutritional interventions programs designed mainly for healthy adolescents that used ICT. MeSH terms representing ICT, nutrition, intervention, and adolescents had to be in the title or abstract. Randomized controlled trials, quasi-experimental, and observational studies, full papers, and original articles, published between January 2005 and January 2016 were included. Hand searches from reference lists were also performed. Study quality was assessed by the Effective Public Health Practice Project Quality Assessment Tool. Data was synthesized in a table. RESULTS: the search yielded 559 titles and abstracts. 44 studies went further analyses and 11 were included in this review. Participants were mostly recruited from school settings (10 of 11 studies), age varied from 9-17yo. 5 studies targeted specific populations. Study follow-up varied from 2 weeks to 2 years. 4 interventions were based on the Social Cognitive Theory. Interventions strategy included computer games, programs generating tailored feedback, text messages and interactive CD-ROM. 9 studies used computer-mediated ICT. 5 studies focused on multiple behaviors simultaneously. Participants were exposed to intervention once, daily, weekly or according to pre-determined number of lessons. 5 studies had significant outcomes. CONCLUSION: Nutritional interventions for adolescents using ICT shows to be more attractive. New technologies have emerged in the health care scenario. It is not simple to state the most effective interventions due to heterogeneity of studies. However, it can be suggested long-term interventions with more frequent exposure to technology resources that also have a theoretical component targeted to a single health behavior change.

INTRODUCTION

Adolescence is considered a nutritional risk period marked by psychological, physiological, and social changes. In this age group, the literature shows a prevalence of inadequate dietetic habits, such as high intake of sugary and processed foods, long spacing between meals, and low consumption of fruit and vegetables. The long-term effects of this consumption pattern can result in overweight issues as well as micronutrient deficiencies and non-communicable diseases (NCD), that if not treated, it can be track into adulthood \(^{(1)}\).

Nutrition interventions are a cost effective way to promote health behaviors in order to reduce obesity and NCD in the teen population \(^{(1)}\).

The internet and technology resources are increasingly growing among the population. Especially in adolescents, as reported by the Pew Research Center, in 2015, 92% of the American adolescents ages 13-17yo indicated to go online at least once a day. Furthermore, 88% and 87% mentioned to have access to a mobile phone and desktops, laptops or a computer daily, respectively \(^{(2)}\).

A number of interventions, including those related to health promotion, have been delivered using Information and communication technologies (ICT), such as e-mails, websites, computer programs, smartphones, text messages, and games \(^{(3)}\). Thereby, the use of web-based resources in the health care scenario has allowed a more innovative and interactive way to promote behavior change, and ultimately improve positive health outcomes \(^{(4)}\).

Consequently, this systematic review aimed to identify the different technologies that have been used for nutritional interventions in adolescents, likewise its main characteristics. An additional objective was to evaluate the quality and effectiveness of these studies.
METHODS

The fully protocol is available on PROSPERO Website (#CRD42016035882). The intervention followed the PRISMA’s (Preferred Reporting Items for Systematic Reviews and Meta-Analyses) guidelines (5).

Data sources and search strategy

Five databases (PubMed/MEDLINE, Scielo.ORG, Web of Science, PsycINFO, and Scopus) were searched in order to find articles written in English, Portuguese or Spanish, that promoted valuable information about nutrition education interventions that used ICT in adolescents. Several MeSH terms were applied to represent ICT, nutrition, intervention, and adolescents. Table 1 represents the initial search designed for PubMed/MEDLINE. The search strategy was adapted to other databases.

Selection criteria

Only randomized controlled trials, quasi-experimental, and observational studies, full papers, and original articles, published between January 2005 and January 2016, were considered. The MeSH terms needed to be identify in the title or abstract. Description of the technology and/or intervention had to be available in the full papers. Participants were required to be healthy, but not necessarily eutrophic. Studies that included children above 8 years old or young adults could still be selected as long as they focused on adolescents (mean age between 10-19yo).

Selection process

The list of title and abstracts were downloaded and organized via the program Mendeley©. Duplicates were removed and the remaining studies were analyzed for eligibility by two reviewers (1R and 2R). The full articles selected were retrieved, subsequently. Disagreements
were resolved by discussion, in the presence of the Expert (E). Hand searches from reference lists of all included articles were performed.

Quality and risk of bias assessment

Study quality and risk of bias were assessed on study design, target population, confounders, data collection methods, dropouts, intervention integrity, and final analyses using the Effective Public Health Practice Project (EPHPP) Quality Assessment Tool, by 1R and independently. Based on final score, articles were considered weak, moderate or strong. Those considered weak were not removed, but the risk of bias of their evidence was highlighted. An expert (E) adjudicated unresolved discrepancies.

Data collection process and synthesis

Reviewers 1R and 2R developed a data collection form based on the Centre for Reviews and Dissemination guidance for undertaking reviews in health care (6). Independently, they extracted the data on type of publication, country, financial sources, main purpose, study design, inclusion/exclusion criteria, recruitment procedures, unit of allocation, participant characteristics (age, gender, ethnicity, social economic status/education, weight status and comorbidities), intervention characteristics (type, frequency/duration of exposure and theoretical basis), and outcomes (follow-up, dropout rate, type of analysis, main and additional outcomes). Due to the lack of homogeneity of the included studies, a meta-analysis could not be performed. Data was then synthesized in a summarization table.

Table 1: Search strategy designed for PubMed/MEDLINE

<table>
<thead>
<tr>
<th>DATABASE</th>
<th>PubMed/MEDLINE</th>
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<tbody>
<tr>
<td>DATE</td>
<td>02/01/2016</td>
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<tr>
<td>STRATEGY</td>
<td>#1 AND #2 AND #3 AND #4</td>
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<td>--------------------------</td>
</tr>
<tr>
<td>#1</td>
<td>(adolescent OR adolescents OR adolescence OR teen OR teens OR teenager OR teenagers OR youth OR youths [MeSH Major Topic])</td>
</tr>
<tr>
<td>#2</td>
<td>telecommunications OR “electronic Mail” OR email OR E-mail OR telemedicine OR “mobile health” OR mhealth OR mhealths OR telehealth OR ehealth OR telephone OR telephones OR “cell phones” OR “cellular phone” OR “cellular phones” OR smartphone OR smartphones OR “smart phones” OR “mobile phone” OR “mobile phones” OR “text messaging” OR “texting” OR “short message service” OR “text messages” OR “text message” OR television OR “videodisc recording” OR videoconferencing OR videoconference OR videoconferences OR “webcast as topic” OR “streaming video as topic” OR “podcasts as topic” OR “podcasts as topics” OR “wireless technology” OR “wireless technologies” OR computer OR “digital computer” OR “digital computers” OR minicomputer OR “computer communication networks” OR “computer communication network” OR “distributed database” OR “distributed databases” OR “telecommunication networks” OR “telecommunication network” OR internet OR internets OR “world wide web”</td>
</tr>
</tbody>
</table>
OR “twitter messaging” OR blogging OR blog
OR blogs OR “social media” OR “social
medium” OR “social mediums” OR “web 2.0”
OR “local area networks” OR lan OR “satellite
communications” OR “satellite communication”
OR “satellite telecommunication” OR
multimedia OR “handheld computer” OR
“handheld computers” OR “pocket pc” OR
“pocket pcs” OR “palmtop computer” OR
“palmtop computers” OR “palm-top computer”
OR “palm-top computers” OR “personal digital
assistant” OR “pda computer” OR “pda
computers” [MeSH Major Topic])

#3
(“intervention studies” OR “ intervention study”
OR education OR workshops OR workshop OR
“training program” OR “training programs” OR
“educational activities” OR “health education”
[MeSH Terms])

#4
(diet OR diets OR food OR “food consumption”
OR “food habit” OR “food habits” OR "feeding
behavior" OR "feeding behaviors" OR "feeding
behaviour” OR "feeding behaviours" OR
"dietary pattern" OR "dietary patterns" OR “diet
pattern” OR “diet patterns” OR "eating pattern"
OR "eating patterns" OR "dietary behavior" OR
"dietary behaviors” OR "dietary behaviour" OR
"dietary behaviours" OR "feeding pattern" OR
"feeding patterns" OR "eating behavior" OR "eating behaviours" OR "eating behaviour" OR "eating behaviours" OR “nutritional status” OR “nutritional sciences” OR dietetics [MeSH Major Topic])

RESULTS

The search yielded 559 titles and abstracts. Once they were screened, 44 studies went under further analyses. Eleven studies fully met the inclusion criteria as well as one additional study that was found by hand searches from the reference lists. Figure 1 describes in details the selection process of included studies. The quality assessment revealed three strong studies (9,10,12), five considered moderate (11,13,14,15,16), and also three rated as weak (7,8,17). The studies which had a negative EPHPP tool’s evaluation were due to a non-representativeness of the sample and usage of a non-validated questionnaire.
Population

Participants were mostly recruited from school settings (7,8,9,10,11,12,13,14,16,17), with the exception of one study that recruited boy scout troops (15). Age range varied from 9 to 17 years, with four studies focusing on 12 to 14 years old (8,9,10,11), four including older ones (15 to 17 years old) (12,13,16,17), and three had younger ones (7,14,15). Five interventions targeted specific populations such as low-income groups, ethnic minorities, and minority females or males (11,13,14,15,17).

Study design
Sample sizes ranged from 87 to 1298 participants, and three studies had over 800 adolescents (9,12,13). Of the eleven interventions, two were randomized controlled trials (8,11), five were cluster randomized controlled trials (10,12,14,16,17), and four used a quasi-experimental design (7,9,13,15).

**Follow-up and study duration**

The majority of studies had one follow-up after baseline assessment (7,8,10,11,13,14,17), but four had two follow-up measurements (9,12,15,16). Study duration (last follow-up assessment) varied from 2 to 8 weeks (7,14,17), 3 to 4 months (8,10,12,13), 6 months and 1 to 2 years (9,11). Seventy-five percent of studies that had a follow up over six months did not have results maintained later (9,15,16).

**Theoretical basis**

Four interventions used the Social Cognitive Theory as theoretical basis, either used it alone (11,15) or in a combination with the Theory of Reasoned Action (14) or the Theory of Planned Behavior (10). Two studies based its interventions on principles from the Social learning theory, which supports the role of social and affective elements in behavior change, including the adoption of healthy behaviors (16,17).

**Intervention strategies and variables measured**

Four interventions included computer games (7,14,15,17), four were computer programs that generated tailored feedback/advice (9,12,13,16), two used text messages (8,11) and one used an interactive CD-ROM (10). Altogether, nine of eleven studies used a computer-mediated intervention, either a program, website, game or an email tailored feedback (7,9,10,12,13,14,15,16,17). Merely, two studies dealt with smartphone (8,11); however, only one of them used exclusively this type of technology (11). Six of the eleven interventions investigated dietary intakes of multiple food groups and nutrients simultaneously (9,12,13,14,16,17), whereas two focused only on
fruits and vegetables\(^{(8,15)}\), and the remaining evaluated either just dietary fat intake\(^{(10)}\), total calories per day\(^{(11)}\) or nutritional knowledge\(^{(7)}\). Components such as physical activity\(^{(11,12,14)}\), psychological variables\(^{(13)}\) and psychosocial factors\(^{(14,15)}\) were also incorporated or evaluated in some of the interventions.

**Intervention duration and frequency of exposure**

Duration and frequency of exposure to intervention varied widely. In two studies participants were exposed to intervention once\(^{(10,13)}\), whereas other programs had daily\(^{(8)}\) or weekly activities\(^{(7,11,14,15,17)}\), and some did not have a specific time of exposure to intervention but established a number of lessons to be done within one to three months.\(^{(9,12,16)}\)

**Main outcomes**

Five interventions had positive effects on diet that were statistically different from baseline measurements and/or comparison group\(^{(9,14,15,16,17)}\). Ezendam et al. (2012) found an increased intake of vegetables and a decrease in snack and sugar sweetened beverages after 4 months, but these findings were not maintained after 2 years. A lower sugar consumption was also shown by Sharma et al. (2015) and Whittemore et al (2012), whose intervention also resulted in a decrease in junk food intake associated with an increase in vegetable and fruit consumption. Thompson et al. (2009) found that boy scout troops had significant increases in fruit juice consumption and home availability immediately after intervention, but this was not maintained later. Bech-Larsen & Gronhoj (2013) also found a significant increase in fruit and vegetable consumption, but only for students who had a low intake of these food groups at baseline. Ress et al. (2010) did not show statistically positive effects of the intervention for fruits and vegetables, but did show an increase of brown bread servings in the experimental group. Yang et al. (2015) who evaluated the effects of a team-based approach, showed significant positive improvements in dietary behaviors of most food groups (dairy, meats, fruits
and vegetables), as well as an increase in the consumption of fiber, calcium and vitamin C and B2, not only compared to baseline measurements, but also in comparison to the other experimental group who had a more individualized intervention rather than a group interaction. 

*Haerens et al. (2007)* did not detect effects of the intervention for its study whole sample, although a decrease in fat consumption was observed in girls from technical-vocational schools and in both girls and boys from general schools. *Maes et al. (2011)* reported an increase in fat intake over time in the control group; however, fat intake in the intervention group remained stable. Related to nutritional knowledge, *Banos et al. (2012)* found a significant increase for both groups, although a higher score was observed for the intervention students.

**Table 2: Main characteristics of included studies**

<table>
<thead>
<tr>
<th>Study</th>
<th>Objectives of the study</th>
<th>Study design</th>
<th>Participants characteristics</th>
<th>Interventionx Control</th>
<th>Variables measured</th>
<th>Duration, frequency of exposure and follow-up</th>
<th>Theoretical basis</th>
<th>Main results</th>
</tr>
</thead>
<tbody>
<tr>
<td>Baños et al., 2012 (7)</td>
<td>Efficacy for improving nutritional information and evaluate acceptability and playability of the games.</td>
<td>Quasi-experimental design</td>
<td>Number: 228 Age: 10-13 Gender: Boys and girls</td>
<td>Intervention: ETIOBE mates, educational website including games Control: Paper-pencil intervention</td>
<td>Nutritional knowledge</td>
<td>Duration: 2 weeks Frequency: &quot;as much as they wanted&quot; Follow-up: after 2 weeks</td>
<td>Not informed</td>
<td>Improved nutritional knowledge for both groups. Scores were greater in the intervention group.</td>
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<td>Bech-Larsen &amp; Grønhøj, 2013 (8)</td>
<td>Increase the consumption of fruits and vegetables</td>
<td>Randomized controlled trial</td>
<td>Number: 256 Age: 12 Gender: Boys and girls</td>
<td>Intervention: SMS-based diary and feedback system plus nutrition education Control: Nutrition education only</td>
<td>Achievement of consumption goals for fruits and vegetables</td>
<td>Duration: 4 weeks Frequency: daily messages Follow-up: after 15 weeks</td>
<td>Not informed</td>
<td>Increased frequency of fruits and vegetables consumption only for those with a low pre-intervention intake.</td>
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<tr>
<td>Ezendam et al., 2012 (9)</td>
<td>Help prevent weight gain in girls by</td>
<td>Cluster randomized</td>
<td>Number: 883 Age: 12-13</td>
<td>Intervention: FATaintPH AT; web-Consumption of SSB, snacks, fruits, and vegetables</td>
<td>Duration: 10 weeks</td>
<td>Theory of Planned Behavior</td>
<td>Higher vegetables intake and lower snack</td>
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<tr>
<td>Study</td>
<td>Design</td>
<td>Sample</td>
<td>Intervention</td>
<td>Control</td>
<td>Duration</td>
<td>Frequency</td>
<td>Follow-up</td>
<td>Outcomes</td>
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<td>Haerens et al., 2007 (10)</td>
<td>Randomized controlled trial</td>
<td>Number: 333 Age: 12-14 Gender: Boys and girls</td>
<td>Intervention: Computer-tailed dietary fat intake intervention, provided as an interactive CD-ROM. Control: No intervention control group</td>
<td>Dietary fat intake</td>
<td>Duration: 50 minutes Frequency: 1 session Follow-up: after 3 months</td>
<td>Social Cognitive theory, Theory of Planned behavior, and transtheoretic model</td>
<td>Decreased dietary fat intake in girls enrolled in technical-vocational schools; and those in general education who reported reading intervention messages.</td>
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<td>Lubans et al., 2012 (11)</td>
<td>Cluster randomized controlled trial</td>
<td>Number: 357 Age: 12-14 Gender: Girls only</td>
<td>Intervention: NEAT Girls, multi-component school-based intervention program, including text messages, nutrition workshops, interactive seminars, handbooks, and sports sessions. Control: No intervention control group</td>
<td>BMI, BF%, dietary intake (kcal/day)</td>
<td>Duration: 12 months Frequency: weekly messages Follow-up: after 12 months</td>
<td>Social Cognitive Theory</td>
<td>Body composition changes were higher in the intervention group, but not statistically significant.</td>
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<td>Maes et al., 2011 (12)</td>
<td>Quasi-experimental design</td>
<td>Number: 1298 Age: 12-17 Gender: Boys and girls</td>
<td>Intervention: Food-O-Meter, composed of a FFQ, food composition database, and a decision tree for generating individuals</td>
<td>Dietary intake of fiber, vitamin C, calcium, iron, fat, and beverages</td>
<td>Duration: During school hours Frequency: 3 sessions Follow-up: after 1 and 3 months</td>
<td>Not informed</td>
<td>No significant changes in fat intake for the intervention group</td>
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<td>Study</td>
<td>Research Question</td>
<td>Design</td>
<td>Study Population</td>
<td>Intervention</td>
<td>Control</td>
<td>Outcome</td>
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<td>Rees et al., 2010 (13)</td>
<td>Evaluate the effectiveness of a computer-generated tailored intervention versus a generic leaflet to increase intakes of brown bread, wholegrain cereal, fruits and vegetables</td>
<td>Cluster randomized controlled trial</td>
<td>Number: 823 Age: 12-16 Gender: Girls only</td>
<td>Intervention: Computer-tailored intervention, based on individual’s self-reported intake of target foods and psychological questionnaire</td>
<td>Control: Generic leaflet based on National Guidelines (not tailored)</td>
<td>Dietary intakes of brown bread, whole grain cereal, fruits, and vegetables</td>
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<td>Frequency: 1 session Follow-up: after 3 months</td>
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<td>Sharma et al., 2015 (14)</td>
<td>Evaluate the feasibility, acceptability, and effects of a computer game on dietary behaviors, physical activity behaviors, and psychosocial factors</td>
<td>Quasi-experimental design</td>
<td>Number: 107 Age: 9-11 Gender: Boys and girls from public schools</td>
<td>Intervention: Quest to Lava Mountain (QTLM), a game in which players must create an avatar and make it eat healthy and stay active; and complete a series of progressive</td>
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<td>Dietary intake of fruits, vegetables, fiber, fat, and sugars.</td>
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<td>Duration: 6 weeks Follow-up: after 6 weeks</td>
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<td>Social Cognitive Theory and the Theory of Reasoned Action</td>
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<td>The tailored intervention leaflet had a significant effect on whole bread intake, but there were no significant effects for other foods.</td>
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<td>Study</td>
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<td>Thompson et al., 2009 (15)</td>
<td>Evaluate the effects of a Boy Scout Five-A-Day Badge program on fruit juice (FJ) and low-fat vegetable (LV) consumption</td>
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<td>Cluster randomized controlled trial</td>
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|                       | Number: 473  
|                       | Age: 10-14  
|                       | Gender: Boys only               |
|                       | **Intervention**: Troop and internet (website) intervention to increase fruit juice (FJ) and low-fat vegetable (LV) consumption — online activities (knowledge games, web recipes, goal setting, problem solving) |
|                       | **Control**: Mirror-image intervention to increase physical activity |
|                       | Fruit juice (FJ) and low-fat vegetable (LV) consumption                   |
|                       | **Duration**: 9 weeks  
|                       | **Frequency**: 55 minutes per week  
|                       | **Follow-up**: after 9 weeks and 6 months |
|                       | Social Cognitive Theory                                                                 |
|                       | Significant increases in FJ consumption, FJ home availability, and LV self-efficacy in the intervention group immediately following the intervention but were not maintained 6 months later. |

<table>
<thead>
<tr>
<th>Whittemore et al., 2012 (16)</th>
<th>Compare the effectiveness of two school-based internet obesity prevention programs</th>
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<tbody>
<tr>
<td></td>
<td>Cluster randomized controlled trial</td>
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</table>
|                            | Number: 604  
|                            | Age: 14-16  
|                            | Gender: Boys and girls                                                  |
|                            | **Intervention**: Two experiment al groups: (1) Health-e-Teen, program including lessons (nutrition, physical activity, metabolism and portion control), self-monitoring, health coaching, and social networking. (2) Health-e-Teen + coping skills training (addition of 4 lessons on BMI; frequency of eating fruits and vegetables, breakfast, sugar drinks, fast food, junk food) |
|                            | **Frequenc y**: 8 or 12 lessons  
|                            | **Follow-up**: after 3 and 6 months                                         |
|                            | **Social Learning Theory**: Both groups significantly improved health behaviors including self-efficacy, healthy eating, fruit and vegetable intake, moderate and vigorous exercise, and stretching exercises; decreases in consumption of SSB and junk food, and decreased sedentary behavior. |
Yang et al., 2015. (17)  Improve intake of food groups and nutritional elements using technology-enhanced game-based team learning  Quasi-experiment al design  Number: 87  Age: 15-16  Gender: Girls only  **Intervention:** Two experimental groups (E1 and E2): E1, use of CDAS for self-monitoring and metacognitive strategies; E2, CDAS was also used as an online team-based competitive game  **Control:** Traditional lecture-based instruction plus motivational elements (video clips related to healthy eating)  Dietary intake of food groups, macronutrients, and micronutrients  **Duration:** 8 weeks  **Frequenc y:** 50 minutes per week  **Follow-up:** after 8 weeks  **Social-interdepende nce theory/social learning**  E2 improved dietary behaviors of most food groups (dairy, meats, proteins, vegetables and fruits), macronutrients (calories and fiber), and micronutrients (calcium, vitamin C, and B2). Improvements were greater in E2 compared to the other two groups.

**DISCUSSION**

Eleven studies were systematically reviewed. All of them used an ICT-based intervention designed mainly for adolescents. This review is different from others for presenting studies that included all types of technology within the scope of nutrition, not focusing only on weight status or obesity. Besides, the main objective of this review is the intervention, particularly, the trends of ICT used for teens in the last 10 years; therefore, the description of its effectiveness is only a consequence. This fact can allow researchers to design innovative interventions so that the scientific community can experience a greater
understanding about those programs for youth, allowing a wide range of technology's efficiency to be tested.

The majority of studies recruited individuals from schools’ facilities. According to Hoelsher et al. (2002), this can be positive for providing a continuous contact with the participants, in addition to promoting a more cost effective way of research.

Only one of those studies whose population were minorities did not present at least one significant outcome in the intervention group compared to control group post-intervention. Ricci-Cabello et al. (2014) and Nierkens et al. (2013) concluded that educational programs targeted to minorities can be more effective; however, this fact can be easily influenced by the design, duration of intervention and follow up, as well as sample size. Extra research, including more homogeneous nutritional studies, need to further explored.

Both studies which exposed participants once or daily presented immediate significant results. Nonetheless, the long-term effects of the interventions were not maintained later in studies with a lower frequency of exposure. It can be seen continuous interventions are needed for outcomes be tracked into adulthood. These findings are consistent with Norman et al. (2007) and Shaya et al. (2008).

Social Cognitive Theory was the predominant theoretical basis. Although all of the studies using this theoretical framework showed immediate post-intervention significant outcomes, it cannot be stated if it is a result of this particular theory. Health behavior change is complex and involves social, emotional and cognitive determinants that ultimately influence on how people adopt certain eating behaviors. These theories and models focus on understanding how such determinants influence health behaviors in order to guide future interventions. These theories tend to use different constructs and are often used in combination. It can be suggested that the use of more than one type of health behavior theory or model can
potentially be beneficial to promote healthy eating, because different elements are taking into consideration (20).

Related to intervention strategies, only one of them used a CD-ROM, showing new types of ICTs, for example games, are emerging in the health care scenario. In this systematic review, all interventions using games showed to be effective; this fact can be explained by the entertaining way of promoting educative learning so that is extremely appealing to the youth population (7). The exclusively smartphone-based study had positive outcomes, but the quality assessed was rated as weak, showing a gap for future research. For the success of the intervention, it is crucial an identification of the type of technology most present in the routine of adolescents, once it can facilitate the availability of the information since the device is already a part of the adolescent’s environment (7).

Most interventions reported being effective for promoting a variety of health benefits related to nutrition. It seems that studies targeting a single behavior, such as those focused on fruit and vegetable consumption, had better outcomes after the intervention. Although this evidence is questionable due to moderate and weak studies qualities as well as short duration of follow-up and small sample size, it is in accordance with Norman et al. (2007).

This systematic review found a number of heterogeneous studies, making data difficult to be simply synthesized. For a better scientific insight, experimental studies need to be done isolating the ICT component, in a strong-evidence design. Based on Whiteley et al. (2008), a greater understanding only can be achieved once future research address randomization, representativeness of the population, and sufficient length of duration and follow-up of the intervention.

**IMPLICATION AND CONTRIBUTIONS**

The advantages of nutritional education programs for adolescents using technologies have been evidenced. This method of delivery information has the benefit of being interactive and
attractive to youth. Once new types of ICT are emerging, results of intervention studies are basically preliminary. Heterogeneity of studies makes it hard to state what kind of intervention is more effective; however, we can suggest that long-term interventions with more frequent exposure to technology resources that also have a theoretical component targeted to a single health behavior change can potentially improve nutrition behaviors.

**FUNDING SOURCES AND CONFLICT OF INTERESTS**

No funds were received for the development of this systematic review. All authors declare there is no conflict of interests.
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