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Information and communication technologies vs. traditional approaches targeting parents to improve healthy diet or body mass index in preschoolers

Tecnologías de la información y comunicación vs. enfoques tradicionales dirigidas a padres para mejorar alimentación saludable o índice de masa corporal de preescolares: una revisión sistemática

Anahi Julieta León Hernández[a], Andrea Bonilla Matamoros[a], Corina Mariela Alba-Alba[a,*], Natalia Ramírez-Girón[a], Karen D'Alonzo[b]

[a] Department of Health Sciences, University of the Americas Puebla, Puebla, Mexico.

[b] School of Nursing, Rutgers, The State University of New Jersey, New Brunswick, NJ, USA

* cori_alba@hotmail.com

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ABSTRACT

Introduction: Preschool age is a critical period for learning healthy habits and, in the face of technological advances, innovative ways to improve health have emerged. This study aims to compare interventions that use Information and Communication Technologies tools in comparison with traditional approaches, targeted to parents, to improve healthy diet and weight in preschoolers. Specifically, to know its effectiveness, which tools have been used and the main success factors in the interventions.

Methods: Following the PRISMA guidelines, a systematic review was conducted in the PubMed, Scopus, SpringerLink and Cochrane Library databases. The protocol was registered (PROSPERO ID. CRD42021251037). Intervention studies to promote healthy diet and weight in preschoolers and one or both parents were included. The authors assessed risk of bias separately assigning scores with specific tools such as PRISMA or CONSORT. The results were synthesized in Excel tables according to the results sought such as the use of technology, characteristics of the intervention, weight results, and healthy eating.

Results: A total of eight studies were included. Two studies showed positive effects, for both: healthy diet and Body Mass Index. Most of them used mixed tools, with predominant use of traditional approaches. The most frequent technological tool was telephony and, as a traditional approach, direct contact. The success factors seemed to be fictional characters to inspire healthy behaviors, home settings and daily dose of intervention.

Conclusions: Mixing both types of tools was effective in the studies, although the low use of Information and Communication Technologies in the interventions was reflected. In addition, the results increase the evidence that they may be more effective in reducing the consumption of non-recommended food groups and in overweight or obese children.

Key words: Child Preschool; Parents; Healthy Diet; Body Mass Index.

RESUMEN

Introducción: La edad preescolar es un período crítico para el aprendizaje de hábitos saludables y, ante los avances tecnológicos, han surgido formas innovadoras para mejorar la salud. El objetivo fue comparar las intervenciones que utilizan herramientas de Tecnologías de la Información y la Comunicación en comparación con los enfoques tradicionales, dirigidos a los padres, para mejorar la dieta y peso saludables en preescolares. En concreto, conocer su eficacia, qué herramientas se han utilizado y los principales factores de éxito de las intervenciones.

Metodología: Siguiendo las guías PRISMA, se realizó una revisión sistemática en las bases de datos PubMed, Scopus, Springer Link y Cochrane Library. El protocolo fue registrado (PROSPERO ID. CRD42021251037). Se incluyeron estudios de intervención para promover dieta y peso saludables en preescolares y uno o ambos padres. Los autores evaluaron el riesgo de sesgo por separado asignando puntajes con herramientas como PRISMA y CONSORT. Los resultados se sintetizaron en tablas de Excel registrando los resultados de tecnología, características de la intervención, resultados de peso y alimentación saludable.

Resultados: Se incluyeron un total de ocho estudios. Dos estudios mostraron efectos positivos, tanto para: dieta como para Índice de Masa Corporal saludables. La mayoría utilizó herramientas mixtas, con uso predominante de enfoques tradicionales. La herramienta tecnológica más utilizada fue la telefonía y, como enfoque tradicional, el contacto directo. Los factores de éxito parecían ser personajes ficticios para inspirar comportamientos saludables, entornos domésticos y dosis diaria de intervención.

Conclusiones: Mezclar ambos tipos de herramientas fue efectivo en los estudios, aunque se reflejó el escaso aprovechamiento y medición del efecto del uso de las Tecnologías de Información y Comunicación en las intervenciones. Los resultados aumentan la evidencia de que las tecnologías pueden ser más efectivas para reducir el consumo de grupos de alimentos no recomendados en preescolares con sobrepeso u obesidad.

Palabras clave: Niño Preescolar; Padres; Alimentación Saludable; Índice de Masa Corporal.

KEY MESSAGES

- This systematic review showed that although interventions had educational components, it was not ascertained the knowledge acquired through the intervention. Therefore, it should be assessed considering the education levels of parents.
- Studies included showed it is challenging to increase the consumption of recommended food groups, thus, new interventions should be considered to reach this objective.
- Interventions seemed more effective as treatment than prevention for overweight or obesity in preschoolers.
- Telephony was the most used technological tool for two main components of the interventions: motivational interviewing and coaching. Whereas direct contact was the most used traditional approach.

INTRODUCTION

The World Health Organization (WHO) estimated that factors related to nutrition influence 45% of deaths in children under five years old[1]. Child malnutrition has increased worldwide, for children under five years, stunting affects 149.2 (22.0%) million, wasting 45.4 (6.7%) million and overweight 38.9 (5.7%) million. In addition, the impact on lifestyles due to COVID-19 could increase all forms of malnutrition[2].

Consuming a healthy diet early in life helps to prevent malnutrition in all its forms, it is important to ensure an adequate growth and development, moreover, reduce the risk of developing noncommunicable diseases (NCDs)[3,4].

Eearly years of life are critical periods to develop a healthy lifestyle, therefore, eating behaviours must be taught in early childhood[5,6]. After the first three years of life, brain development is able to build the learning networks, thus, in the previous years it acquired the necessary elasticity where the nerve cells multiply rapidly, forming the structures that allow the learning process[7]. All this development and grow process needs a good font of good energy in order to succeed. Nevertheless, there are many factors that could influence this critical stage in preschoolers, such as access for parents to nutritional education[8]. What can influence the present feeding and the future feeding styles in this stage where they begin to take shape.

An innovative form to address health needs is eHealth, defined as the use of Information and Communication Technologies (ICT) in support of health related fields[9]. ICT are defined as tools and resources to transmit, store, create or share information, including computers, the Internet (websites, blogs, mails) live broadcasting technologies, recorded broadcasting technologies and telephony[10]. ICT-based interventions have been previously reviewed for different authors.

A systematic review focused on adolescents, reported effectiveness for increasing the intake of vegetables and decreasing junk food consumption. However, it was recognized that an additional comparison is necessary to identify if ICT are superior or equally effective than traditional programs[11]. Another systematic review about the effectiveness of technology-based interventions to address obesity in children, showed that video games, web-bases or mobile phone communications with further research have the potential of positive impact on weight-related outcomes[12]. In addition, for children, previous reviews already focused on interventions to prevent specific forms of malnutrition such as overweight[13] and obesity[14].

Others interventions evaluated the effectiveness of which ICT interventions improve specific dietary patterns as fruit and vegetables intake[15]. And more recently, one review evaluated interventions with direct parental involvement[16], and just one more evaluated the use of digital tools[17]. Given its importance for health, it is important to begin to explore the benefits of ICT in preschool children and whether they can affect their future lives.

Although previous interventions, ICT-based or traditional approaches, exist, have not been compared. Specifically, in preschoolers, it is not clear about the benefits of ICT. In effort to address this evidence gap, this systematic review aimed to compare interventions using ICT tools in comparison to traditional approaches, targeting parents to improve healthy diet or BMI in preschoolers. Specifically, to know its effectiveness, which tools have been used and the main success factors in the interventions.

METHODS

This systematic review was registered on PROSPERO (ID. CRD42021251037) followed the PRISMA 2020 guidelines[18], to state the comparisons the Population, Intervention, Comparison and Outcomes (PICO) framework was used as follows. P: preschoolers without diseases or treatments that influence weight or metabolism and their parents. I: interventions to improve a healthy diet or

healthy BMI with ICT approach that include preschoolers and their parents. C: interventions with traditional approaches. O: Primary outcomes: “changes in healthy diet or healthy BMI” and “durability of the outcome (follow-up) and Secondary outcomes: “additional positive outcomes reported by the authors or impact between groups, duration or durability of the intervention and follow-up”.

Search criteria

The following databases were used: PubMed, Scopus, Springer Link and Cochrane Library. Terms from the Medical Subject Headings (MeSH) were used as keywords for search strategy, the following syntax was used: “Intervention AND Health Education OR Information Technology AND Healthy Diet AND Body Mass Index AND Parents AND Children Preschool NOT Infants NOT Adolescents”. Search strategy was the same for all the databases, in each one, the necessary filters to meet the inclusion criteria were applied.

Inclusion, exclusion, and elimination criteria

The intervention group to improve healthy diet or BMI had to include one or both parents or guardians and target preschool children (2-5 years according with MeSH). Studies could include other group (teachers, staff or health professionals) as long as in conjunction with parental or guardian participation. The design of studies included were Randomized Controlled Trial (RCT) and systematic reviews. With publication date between 2017 and 2021, in English or Spanish and available in full text or Open Access. Interventions included could be worldwide. Interventions of any category that had ICT educational components or not were included. For this purpose, the ICT United Nations Educational, Scientific, and Cultural Organization (UNESCO) definition, previously mentioned, was used. Whereas traditional approaches were all those tools that are not included in ICT definition. Studies that included multiple ages of children, preschool ages, were excluded. Studies focusing on different populations as well as any variation of the healthy diet (e.g., vegan) were excluded.

Selection process

Reviewers worked independently for the screening process by title and abstract. Duplicate records were removed. Titles and abstracts of articles identified were screened independently for 4 authors, the differences in reviewer selections were resolved by a 3rd reviewers as moderators.

Data extraction

The following items were extracted from the included studies and were tabulated in an Excel table: 1) Identification data, such as the complete reference and the name of the study- 2) Purpose of the study, such as objectives, research question or hypothesis. 3) Methods, such as study design, location, target group, and sample size. 4) Preschooler data, such as age, gender, nationality, race, or ethnicity. 5) Intervention characteristics, such as description, duration, intensity, and follow-up. 6) Main outcomes: changes in healthy diet (CHD) and changes in BMI (CBMI) and use of ICT or other educational components, 7) Secondary outcomes: additional positive outcomes reported by the authors or impact between groups, duration or durability of the intervention and follow-up. For data extraction, reviewers worked independently. In case of missing data or additional details, we would contact the authors, but it was not necessary to do.

Synthesis methods

For the intervention effect, all favorable effects reported for the intervention group (IG) on healthy diet and BMI (e.g., p-value, effect size, odds ratio, standard deviation, confidence interval) were considered. Positive effects (+) refer to all measures of a variable (healthy diet or BMI) in the IG that had a significant difference. Mixed effects (/) means that only some measures in the IG were significant. Negative effects (-) refer to significant differences in the control group (CG). And undefined effects (*) refer to the absence of significant differences in the IG, for all measures of the variables.

Studies were synthesized according to interventional approaches used: 1) education with ICT tools (ICT-T): computers, internet, live broadcasting technologies, recorded broadcasting technologies and telephony or 2) Interventions using Traditional Approaches (TA): printed materials, direct contacts, and didactic materials. Data were tabulated in an Excel table.

Risk of bias assessment

Methodological rigor was assessed according to the guidelines for assessing the different types of included studies (e.g., PRISMA 2020 checklist, CONSORT 2010 checklist), assigning each item a score, 0 points: totally incomplete; 5 points: partially complete; 10 points: totally complete. Then, the percentage of each study was calculated to define its risk of bias category: (A) low 80 to 100%, (B) medium 50 to 80% (C) high 0 to 50%. Reviewers worked independently.

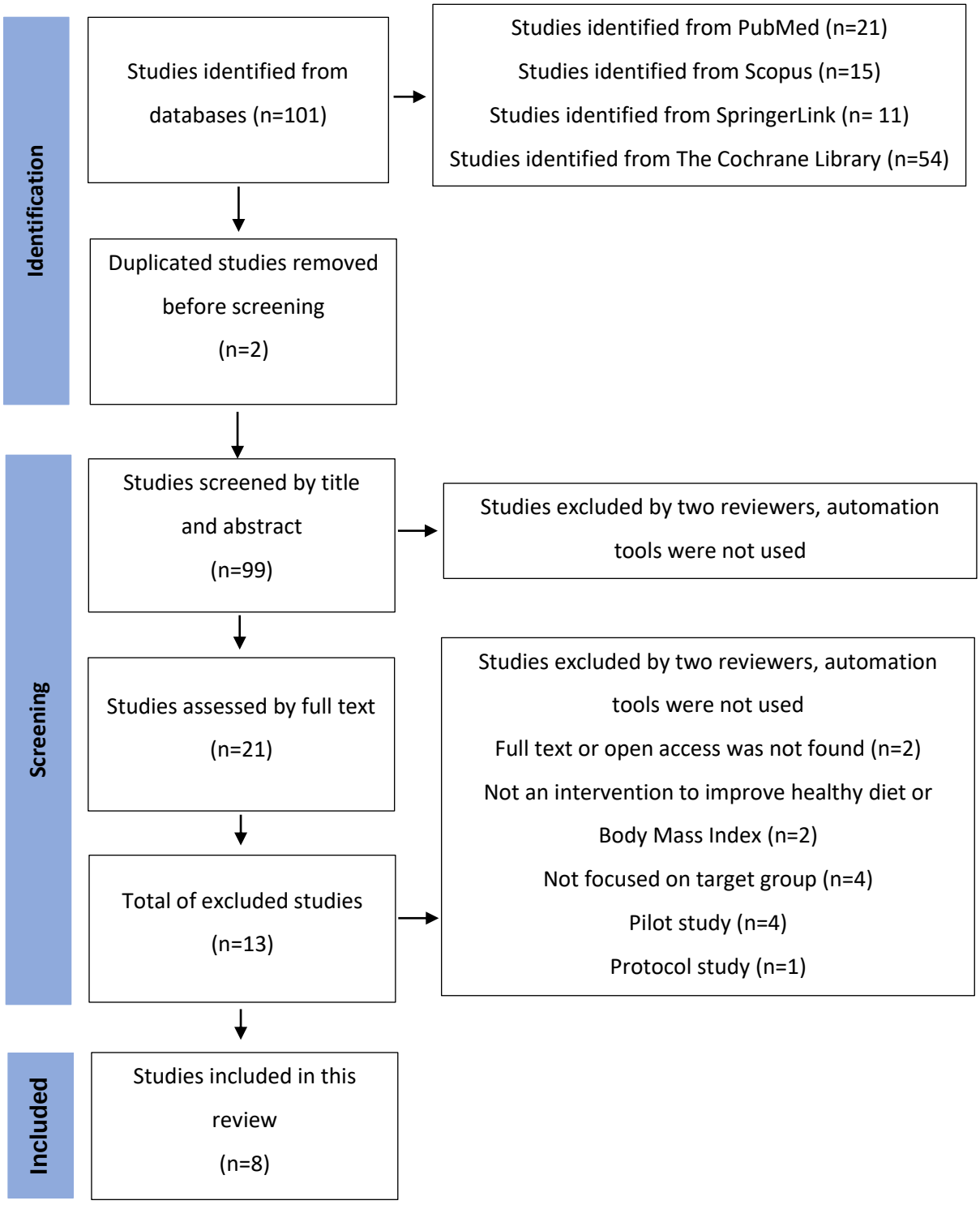
Ethical considerations

This systematic review is considered without risk. In addition, the ethical standards established for the handling of information were compiled with[19].

RESULTS

The following PRISMA flow diagram (Figure 1) shows the search and selection process. Two studies appeared to meet the inclusion criteria, however, some of the studies included were focused on different target groups, interventions did not have educational components, or some did not include parents. Therefore, they were excluded[15,16]. Eventually, a total of 8 studies were included.

Figure 1. PRISMA Flow Diagram.



General characteristics and risk of bias of included studies are represented in Table 1. Two had a not defined setting by the nature of the intervention (ICT-T exclusively). See **Supplementary Material**.

Table 1. General characteristics.

Study	Design	Intervention characteristics[a]	Preschoolers data[b]	Risk of bias[c]
Iaia et al., 2017[20]	RCT	Italy; multidimensional educational; 6 months; childcare centers.	n=425 IG=199 CG=226; 3 years; M (52%) F (48%); Italian (91.2%) or foreign (8.8%).	A (82%)
Barkin et al., 2018[21]	RCT	EEUU; multicomponent behavioral; 36 months; physicians' offices and community settings.	n=610 IG=304 CG=306; 3 to 5 years; M (49.3 %) F (50.7%); Hispanic, Mexican origin (61.7%) Hispanic, Non-Mexican origin (30.4%) Non-Hispanic black (6.3%) Non-Hispanic white (0.7%) Non-Hispanic other (1.0%)	A (94%)
Steenbock et al., 2019[22]	RCT	Germany; multicomponent health promotion program; 40 weeks; daycare facilities.	n=831 IG=440 CG=391; 3 to 5 years; M (50.5%) F (49.5%); German no migration data (75.9%) Others (24.1%)	B (74%)
Romo et al., 2018[23]	RCT	Ecuador; educational and behavioral; 3 (PI) and 7 (EI) months in 2 sequential school	n= 307 IG=152 CG=155; 3 to 4 years; M (53%) F (46.9%); N/R	B (66%)

		years; school and home.		
Nyström et al.,2017[24]	RCT	Sweden; mobile-based; 6 months; N/D	n=313 IG=155 CG=158; 4 years; M (53%) F (47%); Sweden (98.1%) Other (1.9%)	A (86%)
French et al., 2018[25]	RCT	EEUU; multicomponent; 3 years; home and community.	n= 534 IG=265 CG=269; 2 to 4 years; M (49.1%) F (50.9%); Non-Hispanic White (9.1%) Non-Hispanic Black (18.1%) Hispanic, any race (61.9%) Multiracial (9.1%) Other (1.9%)	A (82%)
Natale et al., 2017[26]	RCT	EEUU; multicomponent; 2 years over 3 academic school years; childcare centers.	n= 1211 IG=754 CG=457; 46.7 months[d] M (49.88%) F (50.12%); Hispanic Cubans (15.35%) Other Hispanics (40.96%) Non-Hispanic blacks Haitians (14.12%) Other Non-Hispanic blacks (19.02%) Non-Hispanic whites (6.69%) Other (3.86%)	B (68%)
Karmali et al., 2020[27]	RCT	Canada; coaching-educational; 3 months; N/D	n=50 IG=25 CG=25; 2 to 10 years; M (36%) F (64%); Caucasian (78%) African Canadian (8%) Native/Aboriginal (2%) Latin-American (4%) Asian (2%) Other (4%)	B (74%)

EI, Enhance intervention for IG; N/D, Not defined; N/R, Not reported; PI, Pilot intervention for CG; RCT, Randomized control trial. [a]Location, type, duration, setting. [b]Sample size (n) sex masculine (M), feminine (F), nationality/race/ethnicity for the IG. [c]A:low; B: medium; C: high. [d]Mean by month.

In **Table 2** is reported effectiveness of the interventions. For CHD, the only study with negative effects reported that intake of fruits and vegetables (FV) and unsweetened beverages per day was more pronounced for children in the CG at baseline and follow-up. Otherwise, studies with positive effects had significant differences for all its measures, e.g., FV, sugar-sweetened beverages intake (SSB) and water consumption. For CBMI, the study with negative effects was the same that reported negative effects for CHD. For those with positive effects, one reported maintaining a healthy BMI percentile and less increase on the IG, while the other study showed significant differences for BMI-for-age z score.

Table 2. Effectiveness of interventions.

Study and Effect[a]	CHD	CBMI	Additional outcomes
Iaia et al., 2017[20] (+) Healthy Diet (*) BMI	Low-risk score for fruit and vegetable (≥ 4 s/d[b]: 19.9% vs 9.5%; *p*=.008) and SSB intake (0 glasses/day: 90.7 % vs 78.6%; *p*[c]=.002) at 2-year-follow-up.	RWG[d] increase in BMI ≥ 1 SD[e] was smaller (9.9 vs 14.1%) at 2-year follow-up.	Lack of changes among a low level of education (23% had ≤ 8 years of education). Low-risk for CHBS[f] among medium /high levels of education (OR[g]=2.48; *p*=.006).
Barkin et al., 2018[21] (/) Healthy Diet (*) BMI	Fewer kcal[h] intake 95% CI[i] [38.0-160.7] *p*= 0.002; corrected *p* = .003. SD= (363 vs 397).	No significant BMI difference (B = 0.05, 95% CI [−0.29 to 0.38]; *p* = .79). Lower risk of developing obesity at 3-	Significant effects on the linear *(p*= .03) and quadratic *(p*= .02) growth of BMI of children who were food insecure with

		month follow-up 0.51 95% CI [0.29-0.92]; *p*= .02; corrected *p*= .10.	hunger at baseline.
Steenbock et al., 2019[22] (-) Healthy Diet (-) BMI	Recommended FV per day at baseline 12% vs. 9% and 13% vs. 11% at follow-up. Recommended glasses of unsweetened beverages per day 50% vs. 49% at intervention and 47% vs. 51% at follow-up.	Overweight or obese children increased (5.7 to 9.0 and from 4.6 to 6.25). Body fat increased (9.3 to 10.5%) whereas decreased in the CG (9.4 to 9.0%).	No additional differences were observed.
Romo et al., 2018[23] (+) Healthy Diet (+) BMI	Significant difference *(p*=.05) for higher daily SSB consumption. For water consumption (+8.3%; *p*= .04), SSB consumption (−16.8%; *p* < .001), FV consumption (+15.9%; *p*= .01).	Significant differences in mean BMI-for-age z score (−0.25; *p* < .001).	6.1% of children were at risk for being overweight, or had overweight or obesity, but at follow-up no children were in this category, representing a 6.1% reduction.
Nyström et al., 2017[24] (/) Healthy diet (*) BMI	Intake of sweetened beverages *(p*= .049). IG had 99% higher odds of increasing the composite score[j] for the dietary behaviors (OR: 1.99; 95% CI [1.20, 3.30]; *p*= .008).	No difference (mean difference: −0.03 kg/m^2; *p* =.922).	Children with higher FMI[k] improved composite score (+0.65 ± 1.38 vs. +0.03 ± 1.33 units; *p* = .019), whereas no differences for the children with a lower FMI (+0.04 ± 1.51 vs. −0.13 ± 1.34 units; *p* = 0.506).

French et al., 2018[25] (/) Healthy diet (*) BMI	Fewer kcal per day at 24 (–90 kcal; 95% CI [−164, −16] and 36 months (–101 kcal; 95% CI [−164, −37]). Intake of added sugars was significantly lower (–5.7 g/d[l]; 95% CI [−10.4, −1.0]).	No significant difference in BMI (–0.12 kg/m^2; 95% CI [−0.44, 0.19] or 36 months (–0.19 kg/m^2; 95% CI [−0.64, 0.26]).	Less increase in BMI for overweight or obese children at 36 months (–0.71) kg/m^2; 95% CI [−1.30, −0.12]. Among Hispanic children effective in reducing BMI increases at 36 months (–0.59) kg/m^2; 95% CI [−1.14, −0.04].
Natale et al., 2017[26] (*) Healthy Diet (+) BMI	Not statistically significantly changes for FV consumption (β= .04, [SE[m]] =.04, *p* = .34) and unhealthy food consumption (β=.01, SE= 0.03, *p*= .80)	Significant less increase in PBMI[n] (β= -1.95, [SE]= 0.97, *p* = .04).	Obese children significantly increased consumption of FV over time (β = 0.24, SE= 0.08, *p* = .003).
Karmali et al., 2020[27] (*) Healthy Diet (N/R) BMI	No significant difference for children's protein intake, fiber intake, saturated fat intake, or sodium intake.	N/R	Parents in both groups reported developing changes in perspective, increased awareness of habits, and heightened accountability for making positive changes in themselves.

[a](+): positive; (/): mixed; (-): negative; (*) undefined. [b]Servings per day. [c]*p* value. [d]Rapid weight gain. [e]Standard deviation. [f]Children's combined health behaviour score. [g]Odds ratio. [h]kilocalories. [i]Confidence Interval. [j]Difference in composite scores (follow-up minus baseline) was calculated for

each child. [k]Fat Mass Index. [l]grams per day. [m]Standard error. [n]BMI percentile.

In **Table 3** is reported intervention components. For ICT-T, there was a prevalence for telephony, e.g., telephone calls, while for the TA, there was a prevalence for direct contact, e.g., motivational interviewing (MI). Two studies used only ICT-T for their interventions, while the rest of the studies used mixed tools with predominantly use of TA. There were important differences between duration and intensity from each characteristic of the interventions, for some of them, duration and intensity were not specified. Four interventions added community components (e.g., use of parks); whereas two interventions used more creative tools to interact with parents and children (e.g., puppets). It is worth mentioning that telephone calls were used more than any other ICT-T for two specific components of the interventions: MI and coaching to change behaviours.

Table 3. Intervention components.

Author	Description	Tool[a]	ICT-T[b]	TA[c]	Duration	Intensity
Iaia et al., 2017[20]	Interventionists were training for MI to parents.	TA	N/A[d]	Interviews[e]	20 minutes each one.	2 MI, interval of 1-2 months
	Stories with FV characters. Good vs. bad rating of FV eaters and only water consumption.		N/A	Leaflet, manual, poster[f]	1 hour/day	At least 1 learning experience.
Barkin et al., 2018[21]	Telephone calls regarding nutritional choices and PA	ICT-T, TA	Telephone calls[g]	N/A	12 weeks	Weekly 90-minute
	Coaching calls		Telepho	Personalize	9 months	Monthly calls

	regarding nutritional choices and PA		ne calls[g]	d letters[h]		
Steenbock et al., 2019[22]	One activity/game per week about food groups. Activities with parents.	TA	N/A	Newsletters. Card box[f]	40 weeks	Free to choose the modules
	PA games with parents and general information of PA.		N/A	Newsletters Card box[f]	40 weeks	Free to choose the modules
	Take home instructions for healthy meals and PA games.		N/A	Newsletters [f]	40 weeks	Free to choose the modules
Romo et al., 2018[23]	Story of 4 fictional children and a turtle, about how to grow and eat FV.	ICT-T, TA	N/A	Storytelling [e]	10 months	Not specified
	Focused on drinking water, eating FV and engaging PA.		Songs[i]	Puppets, Models of foods. Pop-up books[h]	10 months	Daily
	A board with stickers to identify healthy habits and PA in		N/A	Board. Stickers[h]	10 months	Daily

	children					
	Parents registered for activities and received a themed magnet.		N/A	Workbook Magnet[h]	10 months	Not specified
Nyström et al., 2017[24]	Focused on healthy eating and PA in preschool children.	ICT-T	Smartphone application[g]	N/A	6 months	N/A
	Parents were able to record their children's FV and SSB intake.		Smartphone application[g]	N/A	6 months	Once a week parents register information.
French et al., 2018[25]	Parenting classes with MI.	ICT-T, TA	Telephone calls[g]	MI Behavior changes models[e]	3 years	1 hour duration and follow-up phone calls
Natale et al., 2017[26]	Beverage policy, snack policy, PA policy.	ICT-T, TA	Music CD's[i]	Food tasting[e]	2 years.	Not specified
	Staff conducted joint parent-teacher meetings that focused on a nutrition and PA curriculum.		N/A	Role modeling[e]	2 years	In year 1, 6 sessions, In year 2, 4 sessions per year.

	Weekly visits to promote positive dietary changes and PA[k]		N/A	Visits[e]	2 school years	It was implemented weekly at the school year
Karmali et al., 2020[27]	Parents received online health education webinars.	ICT-T	Webinars[j]	N/A	3 months	Six webinars approximately 20–30 min each.
	Parents received CALC[l]. The trainer used only his CPCC[m] skills.		Telephone calls[h]	N/A	3 months	20-30 minutes per coaching session

[a]Type of tool used. [b]Name of ICT-T used. [c] Name of TA used. [d]Not applicable. [e]Direct contact. [f]Printed materials. [g]Telephony. [h]Didactic materials. [i]Recorded broadcasting technologies. [j]Internet. [k]Physical activity. [l]Co-active life coaching. [m]Certified Professional Coercive Coach.

DISCUSSION

In the study with positive effects for CHD and CBMI, differentiating characteristics were identified. Were used mixed tools, created cartoons or fantasy characters to inspire healthy behaviors and had group activities. In comparison to other interventions in childcare centers or scholar settings, where parents only had instructions to do activities at home, in this study, its school-based activities had a continuation at home because parents were trained and encouraged to provide evidence of completion of a given activity. Moreover, studies had fictional characters as fruits and vegetables for its stories, but the characters used in the intervention with positive effects, were preschool-aged children and animals. Additionally, most of its components had a daily intensity, in contrast to the intervention that had negative effects, where the dose of interventions was not defined.

Few studies had changes for FV intake. The result is consistent with a recent systematic review, reported that there were no short-term differences in child consumption of FV in meta-analyses of trials examining nutrition education and interventions[15]. In comparison, the only two studies that showed positive effects for CBMI were applied during scholar years, which is consistent with

previous reviews where it mentioned that time is a main factor to evaluate the effectiveness of interventions in weight status, becoming a difficult variable to change in children[16].

Some studies showed significant results for children with overweight or obesity, this is consistent with previous results that mention interventions can be more effective as treatment of childhood obesity14. In addition, it was reported that interventions show greater effects in weight loss compared to prevention in children[13].

For studies with exclusively ICT-T, the intervention that used a smartphone app had mixed effects with significant results to reduce intake of sweetened beverage intake (p = .049) at follow-up. Besides, children had 99% higher odds of increasing the composite score (OR: 1.99; 95% CI [1.20, 3.30]; p = .008) and the effect was more pronounced for children with higher FMI. This is related to a recent systematic review, which mentions that website and app-based interventions can be effective for improving children's dietary intake and nutrition knowledge and can achieve small to moderate changes in nutrient-poor foods and drinks[17]. In addition, another study that tested the efficacy of a smartphone-delivered intervention to reduce parent provision of sugar-sweetened beverages among preschool children, showed that children had a greater reduction for consumption of SSB, even mothers in the IG had a significant weight loss[28].

In contrast, two studies used exclusively TA. One study showed positive effects only for CHD (e.g., SSB intake). This result is related to a previous systematic review where successful strategies to reduce consumption of SSB had provision of written educational materials such as those used in the study included in this review[29]. The other study showed negative effects for CHD and CBMI. It is worth mentioning that this study had a daycare setting, and in a previous systematic review focused on childcare, less than half of included studies had a significant difference in BMI, BMI-z score, waist circumference or body fat[30]. An important characteristic of this study included, is that it gave general information for healthy meals or PA to parents, and this has been previously described as a barrier to obesity prevention in childcare settings instead of being a facilitator, because some parents did nothing for their children to eat healthier when only received information[31].

There were some limitations to this systematic review. Only studies written in English and Spanish were included, therefore, studies written in different languages that could increase the quantity and quality of the evidence reviewed were excluded. Moreover, studies were constrained to be available

in open access, thus, some studies that seemed accomplished inclusion criteria, nevertheless had a cost to be full text read were excluded. Furthermore, all studies included different settings where its characteristics around healthy diet or BMI could condition outcomes. Similarly, its heterogeneity constrains an exact comparison. Finally, according to the methodological quality of the studies included, results and conclusions of this systematic review must be considered with caution.

On the other hand, to our knowledge, is the most recent evidence of comparison ICT-T and TA, where most of the studies had mixed effects and due to the heterogeneity of the studies, seemed difficult to exactly determine which factors were successful. However, differentiating characteristics were identified in the study with positive effects and should be considered for future interventions. In addition, this review showed that although studies had recent publication dates, there were few with ICT-T. In other words, there is a need to increase the use of ICT, as it is recognized that ICT are essential for achieving the Sustainable Development Goals and are innovative forms to address health needs[9].

Furthermore, the results increase the evidence that interventions can be more effective in reducing consumption of not recommended food groups than increasing intake of recommended food groups, as well as are more likely to have effect on children with overweight or obesity. Additionally, interventionists did not evaluate the knowledge acquired through educational components. Therefore, it should be considered and assessed the role of parent's knowledge in children's nutritional status.

CONCLUSIONS

In conclusion, interventions first, seemed more effective as treatment than prevention for preschoolers with overweight or obesity, second, had better results with daily implementation and home settings, and third, showed being successful with a defined dose of the intervention. Similarly, although most used mixed tools, there were few which implemented new methods through ICT-T.

AUTHORS' CONTRIBUTIONS

AJLH, AB-M and CMA-A contributed to the idea and design of the study. AJLH and AB-M performed the literature search, conducted the analyses, and wrote the first draft with the help of CMA-A, K D´A & NR-G reviewed and helped to improve the writing of the manuscript. All authors reviewed this and previous versions of the manuscript.

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CONFLICTS OF INTEREST

Authors declare that there are no conflicts of interest in the writing of the manuscript.

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