REVIEW

Promoting adequate and healthy food in early childhood education: a systematic review

Jéssica de Melo Araújo Moreira [1]
https://orcid.org/0000-0003-1791-6448

Mariana Fernandez Barbosa [2]
https://orcid.org/0000-0002-8704-4852

Rafaele Rosa Febrone [3]
https://orcid.org/0000-0001-6132-8569

Camila da Silva de Castro [4]
https://orcid.org/0000-0002-2878-2783

Leticia Sales Pereira [5]
https://orcid.org/0000-0002-1293-237X

Rosane Valéria Viana Fonseca Rito [6]
https://orcid.org/0000-0002-0891-3774

[1,2,4-6] Faculdade de Nutrição Emília de Jesus Ferreiro. Universidade Federal Fluminense. Rua Mário Santos Braga, 30. 4° andar. Niterói, RJ. Brasil. CEP: 24.020-140. E-mail: jemelo@id.uff.br
[3] Programa de Pós-graduação em Alimentação, Nutrição e Saúde. Instituto de Nutrição. Universidade do Estado do Rio de Janeiro. Rio de Janeiro, RJ. Brasil.
[6] Escola Nacional de Saúde Pública (ENSP), Centro de Investigação em Saúde Pública (CISP), Comprehensive Health Research Center (CHRC), Universidade NOVA de Lisboa, Lisboa, Portugal.

Abstract

Objectives: to identify and describe the characteristics of studies that address the promotion of adequate and healthy food in early childhood education units and their repercussions on the school community.

Methods: the search and selection were performed according to the PRISMA recommendations in the Medline databases via OVID, EMBASE and LILACS. Data extraction took placeusing a table developed by the authors. The evaluation of the quality of the evidence of the studies was carried out through the risk of bias using an adapted scale.

Result: twelve articles that met the eligibility criteria were selected. All studies were applied in public or private educational institutions with a median of 236 participants. In the analysis of food and nutrition education activities, the most adopted with preschoolers were playful; with the parents it was the meetings and counseling; and with the professionals it was the training. The methodological qualification of the studies was considered low, which may be related to their limitations included in this review, mainly due to the types of designs adopted, the time and lack of continuity of interventions and sample size.

Conclusion: food and nutrition education activities seem to be a promising strategy in knowledge, adoption of healthy eating practices and transmission of values in the school community.

Key words *Child, Preschool child, Food and nutrition education, Child nutrition, Preschool education*

Introduction

The nutrition of a child starts with breastfeeding (BF), as preconized by the World Health Organization, exclusive within the first semester of life, and, after this period, complemented with other foods until at least 2 years of age.[1,2] Such practices present important benefits, mainly for growth, development and short, medium and long term health.[3-7]

Considering that the Early Childhood is a stage of intense infant development and formation of habits, the introduction of complementary feeding needs to be offered also in the perspective of adequate and healthy feeding (AHF). This should be done in a regular manner, respecting schedules and particularities of children, with the introduction of varied foods, *in natura* and minimally processed, in a sensorially attractive way and promoting meals together with the family.[2,8]

The infant education units (IEU) are configured as a support network, complementing the family's action, in order to help with the formation of citizens and habits, among them, eating habits. Such units play a determinant role in the dissemination of knowledge and collective, transdisciplinary and intersectoral work, including actions of health promotion. They are considered privileged spaces that allow direct contact with children and their guardians, favoring the development of health education actions.[9]

Kindergartens, nurseries and pre-schools are examples of IEU, which may shelter children from birth until six years of age, a stage defined as Early Childhood, depending on the type of organizational management.[10,11] These institutions are adequate environments for the improvement of healthy eating habits since they are facilities in which preschoolers spend a large amount of time and receive up to 40% of their nutritional needs.[9,12,13]

Food and nutrition education (FNE) in infant education (IE) have, among their objectives, to influence healthy eating practices, including the valorization of breastfeeding and healthy complementary feeding, and the development of autonomy. FNE is a permanent process, which considers the exchange of knowledge, individuality and cultural eating habits by means of complex and active approaches and educational processes that favor communication with individuals and their population groups, considering all life stages.[9,14]

In this perspective, it is also worth highlighting the importance of *ludic*, a word with Latin origin that means "play" and "games". By means of ludic, an educational action may contribute to a better usage of FNE activities, since it favors the learning, making it more interactive, fun and having an intention, objective and conscience of actions in relation to infant development and learning.[15,16]

It is considered the hypothesis that IEUs that develop FNE activities, by means of promoting AHF, have the potential of positively affect knowledge on feeding and the adoption of healthy eating practices by school community.[9,14] However, it is not yet present in the literature a collection of findings concerning the influences of these practices in this educational stage.

In the face of the above, the present study aimed to identify and describe the characteristics of surveys that attempted to promote AHF in IEUs and their repercussions in the school community.

Methods

The present systematic review was conducted according to the protocol Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA).[17] With the guiding question "Do IEUs (nurseries and preschools) that develop FNE activities focused on the school community, as a way of promoting AHF, have the potential of positively influence the adoption of healthy eating practices by the school community?"

This was elaborated by means of the strategy of searching for the PICO[18] acronym: "P" (population) refers to the IEU; "I" (intervention) concerns the promotion of AHF by means of FNE; "C" (comparison) is related to the comparison of the group with itself before and after intervention; and "O" (outcome/result) deals with the knowledge acquired about AHF and adoption of healthy eating practices by the school community.

The research was conducted after registration in the International Prospective Register of Systematic Reviews (PROSPERO) platform, under registry: CRD 42021253335, between October, 2020 and August, 2021, and the searches were performed in the following databases: Medical Literature Analysis and Retrieval System Online (MEDLINE), consulted with the OVID; ExcerptaMedica Database (EMBASE) and Latin American and Caribbean Health Sciences Literature (LILACS), using the descriptors "Child", "Preschool child", according suggested by MeSH (Medical Subject Headings) and the alternative terms "Children", "Preschool Children" and the descriptor "Food and Nutrition Education", being used the Boolean operators "and" and "or" in order to help with the combination – child (ab.ti) OR preschool child (ab.ti) AND food and nutrition education (ab.ti); child (ab.ti) OR preschool (ab.ti) AND food and nutrition education (ab.ti); child (ab.ti) OR preschool children (ab.ti) AND food and nutrition education (ab.ti); children (ab.ti) OR preschool (ab.ti) AND food and nutrition education (ab.ti). In the LILACS database, the search was also performed with terms in Portuguese and Spanish.

Duplicate articles found in the different databases were excluded, both manually and with the Mendeley software. The study selection analysis was performed by

means of the reading of titles and abstracts. The selected articles for full reading were those that presented as intervention FNE activities with IEU preschoolers.

The following inclusion criteria were considered for the selection of articles: studies conducted in IEUs that promote FNE activities focused on the school community (students from 0 to 6 years old, parents and professionals); published in Portuguese, English and Spanish, and without period delimitation. Exclusion criteria were: studies that did not present defined methodology; reviews; case reports; descriptive studies; qualitative studies; those with impossibility of access to the printed or online versions, as well as the article that declared conflicts of interest.

Data extraction was performed by means of a table, previously conceived by the authors, in which the following information was highlighted: 1) identification: title and author's name; responsible researcher; year of publication; reference, and location; 2) eligibility: inclusion criteria and reasons for exclusion; 3) method: design; duration; participants (number, age, sex and sociodemographic characteristics); information on bias; ethical registry; consent of participation; intervention (number of groups, FNE activities types, time of execution of the activity, frequency, material, existence of protocol and duration of intervention; funding source, and conflict of interests; 4) results: number of participants (before and after intervention); type of statistical analysis; estimate of effect (confidence interval and/or p-value); outcome, and main conclusions.

Data synthesis consisted in the analysis of information extracted concerning the obtained results from the individual studies that were included in this review, which were resumed in a table to produce logical and valid observations. Therefore, it was considered whether the results of all included studies were clearly available; if the observed effects were consistent among the studies and if there were possible reasons for any inconsistencies.

The evaluation of the evidence quality of the studies was performed by means of risk of bias, using an adapted scale. It was verified in the studies: presence of structured abstract, introduction with justification and background; method of population recruitment; selection of sample/population; data collection instrument, informed rate of non-response; training of the interviewers; execution of statistical analysis; limitations of the studies and considered bias; results interpreted according to evidence and generalization of results.[19-21]

In the evaluation of evidence quality of each study a maximum score of 29 points could be reached according to criteria, being "zero score" non-specified information within the text or when it did not demonstrate minimum criteria of quality classification, and considered as a high evidence quality study when the score reached between 22 and 29 points.[19-21] However, this classification did not attempt to exclude studies, but to provide the discussion of different results with elements that would base it.

The discussion was performed by means of a planned narrative approach of results. All stages were executed by two reviewers, independently. In case of discrepancy, the opinion of specialists was considered. The authors declared no conflicts of interest.

Results

The entire selection process, from identification, screening and eligibility steps until the inclusion of articles in the systematic review are demonstrated in Figure 1. The initial search identified 2732 studies in the databases, excluding duplicates. Only 12 articles met the eligibility criteria and were included in the systematic review for analysis. Data synthesis of the selected articles was described in Table 1.

The selected studies demonstrated a variation between 26 and 781 participants, with a median of 236 participants. Of these, four articles were executed with preschoolers;[22-25] four with preschoolers, parents and professionals;[28-29] two with preschoolers and professionals;[30,31] one with preschoolers and parents;[32] and one with parents and professionals.[31]

There was a time variability between the studies of 10 to 392 days, with a median of 238 days. Most articles (nine) with applying of FNE activities in public IEUs; [22,23,24,26,27,28,30,31,33] one in public and private units;[29] one only in private institutions,[25] and one did not define the type of institution in which the study was carried out.[32]

Each article presented one or more FNE activities with strategies focused on the assessment of knowledge on AHF and/or changes of eating habits. It was observed that the most adopted activities with preschoolers were the ludic ones, which included painting workshops,[32] theater plays,[24,] puppets,[31] sticker albums,[24]plays,[24,31,32], songs,[29] games[27,29,31,32] and building of thematic stories about nutrition that used fictional characters.[24,25,32] The activity of vegetable gardens was applied in only one study.[29] This activity consisted in: lead the children to care agricultural plants and prepare the soil (sowing and irrigating) and, finally, the vegetables were harvested and consumed in the school and in their homes.

Of the FNE activities performed with the parents, those that promoted reunions and counseling were the most frequent, having as a theme the principles of healthy feeding in childhood.[31,33] and basic nutritional advisement.[27,32] On the other hand, the delivery of educational booklets with information on AHF in order to substantiate knowledge, was the least executed.[28,32]

Concerning the professionals, teachers and collaborators group, the qualification that instructed the correct preparation and portioning of foods,[24,30,31] as well

Figure 1

Flowchart of the processof selection of articles in the systematic review concerning the promotion of adequate and healthy feeding in infant education, 2021.

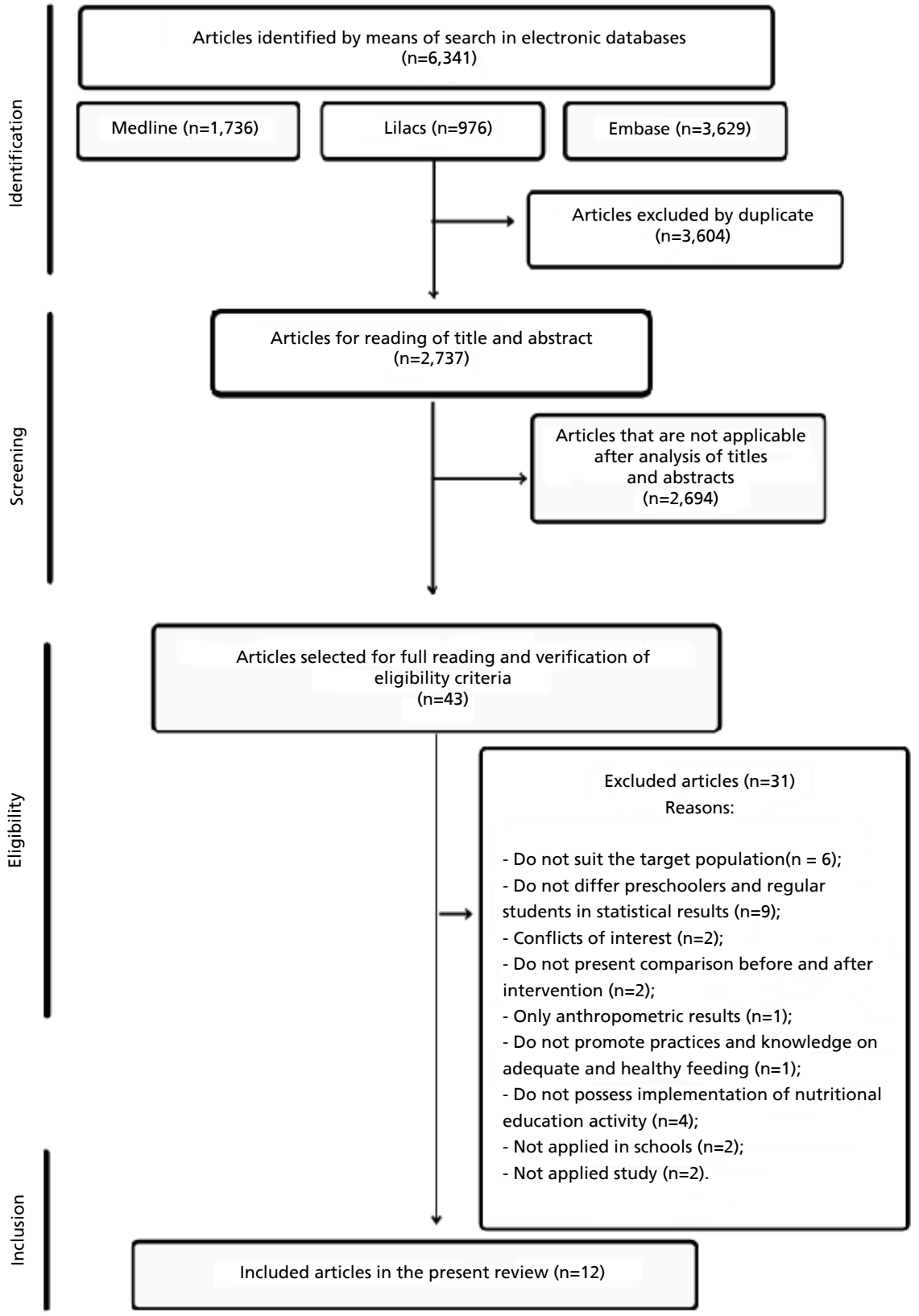

Table 1

Data synthesis of the selected articles in the systematic review concerning adequate and healthy diet, 2021.

Author, Year, Place	Objective	Methods				Results	
		Population	Duration of study	Educational Activity	Assessment of educational activities	Statistics	Repercussions
Cândido *et al.*[33] 2018, Minas Gerais - Brazil	To analyze the effectiveness of different interventions based on food and nutrition education for nursery professionals and parents/ guardians of babies.	202 parents and 90 professionals responsible for children under 2 years of age in a public educational institutional	8 months	CG = received standard written guidelines (professionals – posters placed where they would spent most of workday; parents (reports with information of posters attached to school notebooks once a month) IG = professionals – received the same information than the CG and participated in bimonthly reunions concerning complementary healthy feeding.	Application of an adapted questionnaire concerning breastfeeding and complementary feeding before and after activities.	After intervention, there was a significant result indicating that it is possible to increase the average number of correct answers given by the IG (12.2 vs. 10.7; p= 0.001). Besides, there were improvements between **IG parents concerning beliefs (soups and broths do not feed my child: p=0.012), attitudes (to offer meat as of the sixth month: p= 0.032) and intentions (do not offer soups and broths: p=0.003; to offer vegetables: p=0.018; to offer meat: p< 0.001).	Previously, the professionals presented knowledge on breastfeeding and complementary feeding, although it was insufficient for the adequate care of babies, after the intervention, the CG and IG evolved positively. IG was the group with the highest learning. In relation to parents, in the IG there was a significant improvement of the rate in some assessed parameters, however with a very low adhesion. In the CG, no change was observed with regard to beliefs, attitudes and intentions after intervention. A comparison between CG and IG demonstrated that written guidelines, isolated, without reunions, lead to few effective results.
Joseph *et al.*[26] 2015, Connecticut - United States Gerais - Brazil	To determine whether a short-term educational program may positively influence the choices of snacks of preschoolers in a nursery environment and determine which characteristics of children (sex, age, BMI, z-score, ethnicity, race, preferences and knowledge) are associated to the choice of a healthy snack instead of an unhealthy snack.	49 preschoolers from public educational institutions	2 weeks	Nine interactive lessons of 30 minutes performed by a nutritionist that teaches and qualifies children about the distinction between healthy and unhealthy snacks. Extension classroom materials were provided to each teacher. Informative bulletins with support activities were sent to parents as a reinforcement. The service was provided to each child on a daily basis.	The previous and posterior evaluations included: questionnaires about knowledge and preference for snacks and a rehearsal of selection of these snacks by preschoolers, which allowed children to choose a healthy or an unhealthy option of snack, similar to the current nutritional environment. The choice for the snack of each child and the amount consumed were registered in a registry form of snack test. Height and weight of children were assessed and the BMI z-score was calculated. Reports from parents concerning sociodemographic data and children's eating habits were also collected at the onset of the study. letados no início do estudo.	The children significantly improved their preferences for healthier snacks (p=0.03) and the ability to distinguish them (p=0.03) from other snacks. However, they did not significantly improve (p>0.05) their snack choices in the face of a healthy and unhealthy choice immediately after the short-term nutritional educational program. Younger children (p=0.03) or that had higher scores of knowledge on nutrition (p=0.02) were more prone to select the healthy snack after the intervention.	A program of short-term nutritional education improves the knowledge of preschoolers about healthy snacks, although it is not related to immediate healthier choices for all children..

Nicholson *et al.*[22] 2018, Florida - United States	To investigate whether preschoolers are able to identify and categorize foods and their ability to classify foods as healthy predicts their hypothetical eating choice.	235 preschoolers from public educational institution	12 months	The teachers implemented an intervention of nutritional education in which children were taught to identify and categorize foods, according to their rate of consumption, as "sometimes" (that is, unhealthy) or "anytime" (that is, healthy). In order to select snacks, the PSS tool was used – which include cards with printed pictures of foods and drinks in pairs of high contrast – the easiest (ex: carrots and donuts) and pairs of low contrast – the hardest (golden fish and French fries) to assess their ability to classify food items with more details in differences of nutrients.	The preschoolers saw pairs of foods and were asked to identify the snacks. The researchers registered each answer as 0 (incorrect) or 1 (correct). When a food was incorrectly identified, the researchers provided the correct answer. The TSG was also used: an online tool with which teachers could follow the progress of preschoolers within the year in order to assess the progress in the socioemotional, physical, language, cognitive, literacy and mathematics subscales. At the end of the school year, height and weight of preschoolers were assessed, as well as the BMI.	The number of snacks that preschoolers identified as healthy among the easy pairs (high contrast) was assessed by age, sex, BMI and children's cognition. In relation to categorizing foods as healthy (□=.317; p<0.001) it was a positive predictor that children selected a higher number of healthy snacks. (Change frequency = 18.43; p<0.001)	When controlling the characteristics of each child and their cognitive functioning, preschoolers that were more prone to categorize foods as healthy or unhealthy were more able to say that they would choose healthy foods. The pairs of foods of low-contrast (hardest) in which foods had to be classified based on multiple dimensions were out of the cognitive skills of preschoolers.
Sigman-Grant *et al.*[23] 2014, Nevada, Connecticut, New Jersey and Oklahoma - United States	To determine changes in preschoolers' abilities to distinguish healthy and unhealthy foods and eating preferences reported after the participation in a nutritional education program.	191 preschoolers from public educational institutions in Nevada 128 preschoolers from public educational institutions in Connecticut, New Jersey and Oklahoma	9 weeks	24 classes were given by extension instructors with 8 nutrition lessons presented in the fourth and sixth weeks, however, in all lessons, references to healthy snacks occurred. The researchers were qualified in the PSS test protocols.	Individual interviews were made with each preschooler, in a location separated from other children. The interviews were performed from 1 to 2 weeks before and after intervention. The researchers used 3 rounds of questions: during the first round, the preschooler was asked to name the foods; in the second round, 9 pairs of foods were used, being 1 healthy and 1 unhealthy; in the third round, the preschooler was invited to demonstrate the food that keep heart, muscles and bones strong.	There was a statistically significant improvement in the identification scores before and after study for both groups from Nevada (p<0.001). For preference and distinction of unhealthy and healthy foods, no difference was observed in the pre-test. In the post-test, the intervention group demonstrated significantly a preference for healthier foods (p<0.006) and the ability to distinguish them (p<0.03) than preschoolers from the comparison group. The comparison of results between Nevada and 3 states demonstrated the generalization of the study tool.	Resulted in higher comprehension of preschoolers concerning healthy foods and changed their reported eating preferences.

Baskale *et al.*[32] 2011, Smyrna - Turkey	To develop nutritional education for children in preschool age based on Piaget's theory, and investigate the effects of this education in nutritional knowledge and in the anthropometric measurements of children.	238 binomials (mothers-preschoolers) from educational institutions (not declared if public of private)	14 months	IG= An educational content was elaborated, considering characteristics and the child' learning. The messages were simple, positive and guided for behavior, averting abstract concepts. During the education based on games, the active participation of students was maintained and activities such as playing, painting, coloring and interactive stories were included. When using the food pyramid, the focus was on a single aspect, such as a determined group of foods. Thus, the child was helped with the development of abilities of food classification – colorful pictures of foods were used, specific to the culture. Each intervention session was conducted once a week during 6 weeks. CG = did not receive nutritional education, but received a general education program. The study plan includes courses about nutrition each 2 months. Mothers= Child's feeding is not isolated from the family. Due to this reason, the parents of the experimental and control groups received nutritional education with the principles of adult education. The assessment of mother's knowledge was not performed. After the program, an educational booklet was given to all mothers.	a sociodemographic data form and a children's nutritional knowledge form were used as data collection tools. In this form, there are 30 images of foods in 5 food groups. The form was implemented before the education (pre-test), after the education (post-test1) and 1 year after the education (post-test2). Each correct answer received 1 score point whilst each wrong answer received 0), a food intake frequency form (contained questions about food groups). A form for registry of anthropometric measurements (were registered before and 1 year after education).	Sociodemographic characteristics: the analysis demonstrated that groups were not statistically different ($p>0.05$). Nutritional knowledge: the results of this analysis established that there was a significant difference in the experimental group between pre-test and post-test 1($t=14.395$, $p<0.001$) and pre-test and post-test 2($t+14,080$, $p<0.001$). No significant statistical difference was found between measurements of post-test 1 and 2 of the experimental and control groups. Frequency of food intake CG= some foods (milk and dairy products, white and red meat, fish, some vegetables (green leaves, roots, cabbage) and fruits.) Were slightly higher in pre-test, however no significant difference was observed IG = demonstrated an increase in post-test 1, pre and post-test 2 in citric fruits consumption, as well as other fruits (apples, pears, bananas, strawberries, cherries, grapes, kiwi, watermelons) ($p=0.014$). In the pre and post-test2 there was a decrease in sugar intake ($p=0.042$). There was no significant increase in the cereal consumption (bread, pita bread, pizza, spaghetti and rice), as well as butter, honey, jam, molasses, mayonnaise, ketchup, pasty sweets, dairy desserts and soft drinks. ($p>0.05$). Anthropometric measurements: an assessment of BMI values of the experimental group before and after education according to groups and sex did not show significant difference between experimental and control groups for girls and boys.	The scores of nutritional knowledge of the IG increased and the eating preferences of the group changed positively. No significant difference was observed between anthropometric measurements of the experimental and control groups.

Piziak *et al*.[27] 2012, Texas - United States	To test the effectiveness of a nutrition bilingual game in order to increase portions of healthy foods, mainly vegetables, fruits and water offered to children and decrease the portions of sugary drinks in the Head Start population.	413 binomials (parents-preschoolers) from public educational institution	12 months	Nutritional education game that follows the lottery model – a pictorial bingo game. The game moderator shows a card with colorful images of foods (culturally appropriate) and tells a story or rhyme to describe the image. The players then place a token on the board if they have the image. Both board and cards can be used to play a variety of nutritional bingos. The teachers were authorized to play the game in English or Spanish. The parents learned about the game in a reunion and were encouraged to dispute prizes and counseled about healthy eating habits. The teachers were instructed about the game and received basic nutritional knowledge before the school year.	At the start and end of the school year, the parents answered a questionnaire about food frequency of their children during the week and weekend.	There was a statistically significant increase in vegetables served outside of the Head Start after class during the week and weekends (p=0.02). The study was not able to demonstrate any other statistically significant changes in feeding.	The findings of this study demonstrate that the intake of vegetable portions may be improved in the age group using a simple game of pictorial nutritional education that incorporates elements of familiar culture for most students and their parents. This familiarity simplifies the instruction of parents and teachers. The game is easy to reproduce, helping with the control of costs.
Larsen *et al*.[28] 2017, Califórnia - United States	To assess the impact of Building a Healthy Me (BHM) in public health within classrooms of kindergarten from California using the RE-AIM framework (Reach, effectiveness, adoption, implementation and maintenance).	IG (assessed in pre-post research) = 25 classrooms (414 students and 264 parents) from public educational institution CG (assessed post-research) = 4 classrooms (103 students) from public educational institution	12 months	IG= classrooms that planned to implement the BHM program CG= classrooms that did not request the BHM program. BHM Program: consisted in 8 units – unit 1 provided a global view about the 5 food groups, units 2-6 focused on each food group, unit 7 focused on healthy snacks and unit 8 focused on healthy breakfast Distribution of educational booklets for parents. The program includes a teacher's guide with instructions and class plans, a poster with nutritional information, a box with pictures of foods, a student's book, and homework for the family to develop concepts learned during units.	. . Students- A research that assessed sex, age and nutritional knowledge was carried out, based on images of foods or drinks. Children were invited to circle foods that belonged to the correct group that was asked. Country – the survey assessed sociodemographic data of children and parents, habitual food intake of children during the previous month, parents' usual practices related to nutrition awareness at home and satisfaction of parents with the BHM Program. The assessment of food intake frequency and use of foods labels was also performed Teachers – a registry was fulfilled during the entire program reporting about each lesson and a survey was performed with teachers from the intervention group after the survey about their opinion of each BHM unit.	The intervention students improved on the knowledge about food groups and healthy options of breakfast/snack, and scored higher than control students score in the knowledge of foods in the post-intervention (p<0.05). The parents of children of the intervention group increased the use of food labels, and children from the intervention group increased the intake of several healthy foods and decreased the intake of sweets and French fries (p<0.05). The BHM Program reached 41% of kindergartenstudents that attend public schools in California, and the teachers implemented most of the class material.	The BHM program was effective, broadly implementing with accuracy, emphasizing its potential impact in public health, demonstrating evidence of improvements on the knowledge of children from kindergarten on nutrition, healthy feeding and the use of food labels by the parents.

Santos *et al.*[30] 2017, Minas Gerais - Brazil	To assess the acceptance of school feeding, before and after the execution of gastronomic techniques, by children in preschool age.	26 preschoolers from a public educational institution.	10 days	Stage 1: Children fed on their original meals offered in school for 5 days Stage 2: Alterations occurred in the meals, with the application of gastronomic techniques by food handlers guided by the researchers, so that they could provide a better presentation of the preparations by means of the usage of formatting hoops and spices/aromatic herbs, attempting to color, decorate and assure a better finalization of the offered dishes. Children became to feed on these modified meals for 5 days	Affective test of hedonic facial scale of 5 points for acceptability assessment, applied in stages 1 and 2.	Although the preparations available in 4 of 5 days were accepted (AI≥85%) by the children, after the intervention, an increase of the AI was observed, and all meals started to be accepted. The food offered in day 5 of each stage was similar, however in stage 1 it was not accepted (AI=80%) and stage 2, after alteration of the presentation of dishes, the AI received the adequate classification (88.5%).	The acceptance of a preparation that comprised school feeding in the study increased after the use of gastronomic techniques, possibly due to the fact that the meal was presented in a more colorful, attractive and diversified manner, which encouraged the desire of consumption. In this way, a favorable strategy.
Miguel *et al.*[29] 2011, São Paulo - Brazil	To assess the impact of a short-term program of school vegetable gardens (VEGAPRO) focused on preschoolers and their mothers in São Paulo, Brazil, concerning eating habits in relation to vegetable consumption.	231 mother-preschoolers binomials from two public educational institutions and 2 private. CG= 103 preschoolers that did not participate in VEGAPRO. IG= 129 preschoolers that participated in VEGAPRO.	2 months	The VEGAPRO was developed for preschoolers of the IG a vegetable Garden experience which consisted in 26 educational sessions of approximately 60 minutes, in school hours, without accounting the time used by teachers to reinforce the program in the classroom. During these educational sessions, preschoolers prepared the soil, sowed, irrigated and cared for agricultural plants, harvesting the vegetables and consuming them in school and at home. Lectures were performed with each preschooler, exposing their opinion to researchers and their teachers, regarding their experiences with the Garden, reinforcing their knowledge on nutritional value of each vegetable. Games and songs related to each vegetable were part of these activities.	Pre-test was elaborated to be performed in one session, in order to determine the habits standard related to vegetable consumption of both preschoolers and their mothers. The post-test was started immediately after VEGAPRO conclusion, also in an attempt to determine eating attitudes related to the consumption of vegetables. Both researchers and kindergarten teachers registered their opinions and observations in camp notes.	Preschoolers that participated in the VEGAPRO increased the number of daily meals and the frequency of vegetable intake ($p<0.02$). Mothers from the IG significantly increased the number of daily meals in which they consumed vegetables. ($p<0.01$)	The findings corroborate the hypothesis that preschoolers enrolled in VEGAPRO increased the number of daily meals and the frequency of vegetable intake, as well as the number of vegetables that they like to eat and mothers experienced positive changes in their eating habits under the influence of their children.

Andrade *et al.*[31] 2012, Minas Gerais - Brazil	To evaluate the nutritional profile of preschoolers before and after nutritional education intervention	101 preschoolers from public educational institution	9 months	Students – weekly activities such as plays, games dynamics and puppets Collaborators – qualification courses approaching the subjects: "Good practices of personal hygiene and food manipulation" and "Correct preparing and portioning of foods" Parents and Teachers – Reunions approaching principles of healthy feeding in the childhood.	The children were submitted to anthropometric and dietetic measurements, before and after intervention with works of nutritional education. The consumption of foods by the children in nurseries was assessed by means of the direct weighing of foods during 2 days of the week. Meals prepared at home were evaluated with the foods registry method, directed for parents or guardians, during 1 day of the weekend. The evaluation of the available amount of food for the per capita intake of sodium (salt and spices), sugar and cooking oil was performed by means of data collection in the scholar feeding area. To assess the quality of diet, the DQI-R was used.	It was observed that the average availability of sugar decreased from 20.30g to 14.88g after the nutritional intervention, although this reduction did not significantly affect in the prevalence of inadequacy of consumption ($p=0.14$). It was observed a significant decrease of the prevalence of cooking oil inadequacy, however, without a significant difference in the available amount for consumption. Such an outcome is due to the fact that 35.64% of children, during the study period, changed their age groups and thus, were included in another range of recommendation. It was also assessed, the per capita intake of sodium during the study period, and it was 12.87% of inadequacy. It was not possible to evaluate the sodium intake before and after the intervention period, since the period of salt and spice delivery was annual. It was observed a significant improvement in fruits consumption and significant reduction in the iron, cereals and legumes intake.	The diets of all children were classified as "need modifications", before and after nutritional intervention. In face of this, it was verified the importance of continuity of nutritional education activities, in order to promote healthy eating habits among preschoolers.
Rosa *et al.*[24] 2015, Ceará - Brazil	To evaluate the impact of a nutritional education intervention concerning the knowledge and attitudes of preschoolers, aiming to encourage healthy eating habits and prevention of anemia.	78 preschoolers from a public educational institution.	12 months	Based on learning by modeling with characters representing anemia and super-heroes, iron, Vitamin C and health by means of videos, songs, replicas of foods that are a source of iron and Vitamin C, theater plays and games. Positive reinforcers were used by means of a sticker album, aiming to fix the learning. The school's menu was adjusted to meet what is preconized by PNAE< with the introduction of new preparations and foods, in order to adequate total energy and nutrients intake, specially iron and Vitamin C Food handlers were qualified to execute the new menu.	In order to measure the incorporation of knowledge and the acceptance of preparations with foods rich in iron and Vitamin c, an educational booklet was used. The analysis of satisfaction in relation to the menus was performed by means of the hedonic scale fulfilled by the responsible teacher, observing the child during meals in 3 moments: before and after intervention and at the maintenance stage (of positive reinforcers).	Most (62.74%) answered correctly about how to fight anemia, mentioning educational approaches used during intervention. The low initial acceptance of meals decreased significantly ($p<0.05$). The acceptance index concerning the encouraged foods quintupled after intervention (14.7% to 76%).	The use of a ludic methodology associated to super-heroes and positive reinforcers demonstrate a considerable impact in the assimilation of knowledge on healthy feeding and its effect in preschooler children's health, promoting changes in acceptance and eating habits towards the consumption of more varied foods, mainly fruits and vegetables, as well as foods rich in iron.

Kim *et al.*[25] 2019, Gyeonggi – South Korea	To improve the eating habits and nutritional state of children in preschool age by means of a thematic program of nutrition based on the NASA Mission X, of 10 weeks	679 preschoolers from private educational institutions.	10 weeks	IG= A nutritional intervention was carried out by a team of nutrition professionals with the cooperation of 14 teachers. The Mission X intervention consisted of 4 thematic nutritional items: 1. Energy of an astronaut. 2. Hydration Station. 3. Living bones, Strong bones and 4. Reduced gravity, low fat. The curriculum of the 4 thematic sessions was sent to the teachers and nutrition professionals' team in a total of 3 qualification sessions of 30 minutes. CG= All key-concepts of the nutrition sessions were equally offered to the control group after the follow-up of 10 weeks.	In the beginning of the study, parents were asked about the general characteristics of their children. The measurement of height, weight, BMI and BMI percentile was performed. The eating habits of children, according to the parents' self-report, was assessed with the nutritional coefficient.	Significant changes in anthropometric variables were observed in both groups after intervention ($p<0.05$). Nevertheless, none of the mean differences diverged significantly between the groups in the linear regression model of mixed-effects adjusted for age, sex and type of school The total score of the nutritional quotient of the IG increased significantly ($p<0.05$) after the intervention program There was an increase in the consumption of fruits (2.0 vs - 1.5, $p<0.05$) and a decrease in the foods with high-energy rates, high levels of sodium and snacks (0.5 vs. – 1.2, $p<0.05$), in the IG compared with the CG.	A strong point of this study is the fact that it is the first to promote healthy eating habits in South Korean children in preschool age, improving eating habits and the nutritional status of small children

CG= Control group; IG= Intervention group; BMI= Body mass index; PSS= Preschool Snack Selection; TSG= Teacher Strategies; BHM= Building a Healthy; AI= Acceptability Index; VEGAPRO= Vegetable Gardens Program; DQI-R= Diet Quality Index Revised; PNAE= Programa Nacional de Alimentação Escolar (National School Feeding Program).

as good personal hygiene practices and handling of foods, were the most executed FNE activities.[31] The placement of posters[33] in workplaces to build knowledge on BF, consistency of foods, new offer of rejected foods, AHF and foods to be avoided was the least explored.

Concerning the evaluation of FNE activities implemented in school community, the most used tool was the applying of questionnaires before and after intervention, aiming to know about BF,[33] complementary feeding, [33] knowledge and preferences of snacks,[26] food frequency,[27,28,32] eating attitudes related to the consumption of vegetables[29] and about sociodemographic data[28,32] to associate the population profile with other questionnaires. On the other hand, only one study applied the revisited diet quality index (IQD-R – Portuguese acronym),[31] which measures several dietetic risk factors for chronic diseases, allowing, simultaneously, to assess and monitor diet at population or individual levels.

A methodological qualification analysis was executed in the selected surveys without the perspective of excluding any study. This analysis indicated low evidence quality in these, which obtained a score between 10 and 20 points (Table 2).

Discussion

This review found positive associations among FNE activities, as a manner to promote AHF in IEUs. Piziak *et al*.,[27] in one of the included studies, brought an activity of intervention structurally ludic, following a bingo game model, with positive impact on the vegetables intake outside the educational environment. Similarly, the article of Ferreira *et al.*[34] presented a bingo game activity with students of the fifth grade of the elementary school, which also contributed to the improvement of teaching and learning of the different types of foods and their nutritional characteristics.

FNE activities that involve preschoolers in an active manner make it possible to practice the transmitted knowledge. In this way, they provide both cognitive development, which allows the received information to make sense, and affective development, which encourages the preschooler to interact, remember and understand the informational in a personal and emotional way.[35]

It is worth highlighting that, according to the National Curricular Guidelines for IE and the Common Curricular National Base, the structural axes of pedagogic practices in this step are the interactions and games. Such axes are presented as potentials to the integral development of children, playing an active role in environments and helping with the learning. These instances reinforce the importance of using the ludic as a manner of establishing any type of educational activity.[36,37]

Other authors of the selected studies, such as Rosa *et al*.[24] and Kim *et al*.,[25] brought a FNE activity based in tales with fictional characters. In both of them, after intervention, there was a significant increase in the intake of foods that were encouraged during the educational activity. Whilst in the first one it was also noticed the expansion of knowledge with citations of the preschoolers concerning educational approaches, the second study highlighted an increase in the fast food consumption in the control group. Such findings corroborate with the reports of Drewnowski[38] and Millen *et al*.[39] regarding the adoption of an eating standard with high energy density, rich in sugars and fats and a sedentary lifestyle in modern and industrialized societies.

The least used FNE activity between the analyzed studies was the food garden, although the study of Miguel *et al*.[29] demonstrates evidence on the significant increase in the vegetables intake. The lower implementation of this kind of project is probably due to factors such as low adhesion of voluntary teachers and of the community school, overload of tasks and the need for daily care with the food garden and material resources.[40]

In the nutrition education process, the involvement of the entire school community should be encouraged, since the family has its responsibilities, such as the transmission of ethical, moral and human values.[41,42] It should be noticed that reunions and counseling were the most applied ways of parental inclusion since they were direct manners of communication.

Cândido *et al*.,[33]Baskale *et al*.,[32] Piziak *et al*.[27] and Andrade *et a*l.,[31] when executing reunions and counseling with parents, attempted to demonstrate the activities conducted with preschoolers and to expand the knowledge of adults about the theme. This is because children under five years old depend on their parents for the consumption of food, being a reflection of the family environment.[43] Besides, according to Paro,[44] present and participative parents encourage their children, stimulating them to a better interaction and school performance.

A FNE activity focused on the guardians of children that were less frequently used was the use of educational booklets, such as was observed in the studies of Baskale *et al*.[32] and Larsen *et al*.[28] Moreira[45] points that in this kind of strategy there is no attribution of personal meanings, which leads knowledge to be only stored and reproduced in a mechanic manner.

Another pillar of the community school is represented by professionals that act in these teaching institutions. It was observed that they were included in several FNE activities, being the qualification activities the most frequent ones. This was observed in the study carried out by Andrade *et al*.,[31] which implemented qualification courses that approached the themes: "Good

Table 2

The evaluation of evidence quality of the selected studies in the systematic review concerning the promotion of adequate and healthy feeding in child education, 2021.

Scoring of quality criteria	Cândido *et al.*[33] 2018	Joseph *et al.*[26] 2015	Nicholson *et al.*[22] 2018	Sigman-Grant *et al.*[23] 2014	Baskale *et al.*[32] 2011	Piziak *et al.*[27] 2012	Larsen *et al.*[28] 2017	Santos *et al.*[30] 2017	Miguel *et al.*[29] 2011	Andrade *et al.*[31] 2012	Rosa *et al.*[24] 2015	Kim *et al.*[25] 2019
Type of study: intervention= 5; cohort= 4; case-control= 3; cross-sectional= 2; case study= 1	3	2	2	3	3	2	3	2	3	2	2	3
Structured abstract= 1	1	1	1	1	1	*	1	1	*	1	1	*
Introduction with theoretical background and justification= 1	1	1	1	1	1	1	1	1	1	1	1	1
Recruitment of population: national= 3; local residents = 2; users of units= 1	2	1	2	3	2	2	2	1	2	2	1	2
Selection of population/sample: census= 6; simple random= 5; systemic= 4; stratified= 3; cluster= 2; convenience= 1	5	1	5	4	5	3	3	1	5	3	1	5
Data collection tool: validated and standardized= 3; validated= 2; standardized= 1	1	1	1	1	1	1	3	1	3	1	1	3
Reported non-response rate= 1	1	1	1	1	1	*	1	*	1	1	*	1
Training of interviewers= 1	*	1	1	1	*	1	*	1	*	*	*	1
Statistical analysis performed= 1	1	1	1	1	1	1	1	1	1	1	1	1
Study limitations and considered biases= 1	1	1	*	1	1	*	1	*	1	1	*	1
Results interpreted according to evidence= 1	1	1	1	1	1	1	1	1	1	1	1	1
Scale of generalization of results: any location of the world= 5; continents= 4; same country= 3; same geographic region= 2; specific population= 1	1	1	1	1	1	1	1	1	1	1	1	1
Maximum score= 29	18	13	17	19	18	13	18	11	19	15	10	20

*0 score when information was not specified within the text or did not meet the defined criteria.
Source: Adapted from Vieira *et al.*,[19] Parry *et al.*[20] and Taylor *et al.*[21]

practices of personal hygiene and food handling" and "Adequate preparation and portioning of foods". In the studies conducted by Rosa et al.[24] and Santos et al.,[30] the qualification was implemented not only as a reinforcement of the knowledge on the theme, but also for the learning of modifications done in the school menu. Professional qualification optimizes the execution of tasks, improves the productivity and consolidates the role of professionals as educators.[46]

The FNE activity with professionals using posters was described only in the study of Cândido *et al*.[33] The limitation of this kind of approach may be related to the low attention directed to information contained in such materials, which lead to few effective results. The authors recommend the usage of complementary FNE activity, such as reunions.[33]

Among all the FNE activities mentioned in the selected studies, the ones with higher repercussion were those who dealt with interaction directly with children, since they emphasize the active process that make a permanent involvement between theory and practice possible.[14] The interaction, according to Dal Soto,[47] pervades the comprehension of the child as an active being and involves the possibility of discovery, transformation and production of knowledge in these educational spaces. Brigatto *et al*.[48] indicate that it is possible to comprehend that children's games act as a transition between absolute dependence of the immediate situation, which characterizes the first years of life, and the possibility of the free thinking of real situations, which constitutes a late achievement of human development.

In order to verify the effectiveness of the applied FNE activities, the questionnaires were the most frequent method of assessment, applied before and after intervention, except Baskale *et al*.,[32] which also applied it one year after the project's execution. Nevertheless, Bizzo et al.[49] points out that in order to achieve the effectiveness of nutritional education, the child must be submitted to a constant evaluation of his/her practices and effective health indicators, during the educational process. Another aspect to be valorized would be the replanning for improvement, since a global assessment, compromised with the learning, presupposes the care, being aware of the long-term transformation.[49]

It was noticed that the questionnaires applied in the selected studies did not have a pattern of formulation and common structure, and, mostly, were not validated. According to Gil[50], the questionnaire is limiting and leads to highly critical results in relation to objectivity, since the items may have different meanings for each subject and bring uncertainties about the veracity of information. Vargas *et al*.[51] highlights that this method should not be used in an isolated manner, since it does not provide a follow-up which is closer to the respondent. In this context, there is the possibility of the results to be underestimated or overestimated. Such fact reinforces the idea that more adequate methods to assess the FNE process should be developed and used, according to the particularities of the target public.[51]

The least used method was the IDQ-R found in the study conducted by Andrade et al.[31] Although IDQ-R is an effective evaluation method, it only can be applied in an intervention with diet quantification, which demands time, data tabulation, qualified professionals and resources that impair its applicability.[52]

It was also observed a high variability of duration in FNE activities developed in studies. However, all results were punctual and did not have reported continuity after the interventions, which may represent a limitation in this review. Another limitation of this study was the low number of included articles, due to the majority of FNE activities being applied with both preschoolers and regular students and do not present analyses separated for each population. In the face of this limitation, it is known that systematic reviews conducted with few articles and with low quality of evidence may generate an overestimated effect.[53]

The fact that the methodological qualification of studies was considered low may be related to the limitation of the studies included in this review, such as the design types of studies adopted by the authors, the time and lack of continuity of interventions, as well as the sample size. The mentioned limitations signal the need for investments in the execution of studies that focus on the assessment of the repercussions of FNE activities in the long-term, in the school community.

In this context, it is necessary the investment in validation of tools that allow the conduction of more robust studies in FNE assessment as a way to promote health in IE. In this manner, it will be possible the replication of these studies and their comparability, favoring the building of a consistent and elucidative theoretical framework.

Author's contribution

Moreira JMA and Barbosa MF: conceptualization (equal), data curation (equal), Formal analysis (equal), survey (equal), methodology (equal) , project management (equal), software (equal), writing of the original draft (equal), Writing – review and edition (equal).

Febrone RR and Rito RVVF: conceptualization (equal), Formal analysis (equal), Survey (equal), Methodology (equal), Project management (equal), Supervision (equal), Writing of the original draft (equal), Writing – review and edition (equal).

Castro CS and Pereira LS: conceptualization (equal), Formal analysis (equal), Methodology (equal), Visualization (equal), Writing – review and edition (equal).

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