Effectiveness of Interventions Promoting Dietary Intake, Physical Activity, and Healthy Weight Status of Children in Family Child Care: A Systematic Review

Lieke Vorage, MPH¹; Lisa Vincze, APD, AEP, PhD²,³; Lucy Tudehope, MD¹; Neil Harris, PhD¹

ABSTRACT
Introduction: This systematic review examines the effectiveness of interventions in family child care (FCC) on (1) children’s dietary intake, physical activity levels and weight, and (2) FCC health-promoting environments, policies, and practices. Quasi-experimental studies measuring these outcomes were included.

Methods: All available articles up to July 2023 were searched using MEDLINE, ERIC, CINAHL, Embase, Scopus, and A+ Education, and 15 interventions were included. Methodological quality was assessed with the Effective Public Health Practice Project Assessment tool.

Results: Thirteen studies were weak, and 2 strong in quality. Four interventions included children’s dietary intake as an outcome measure, 2 included physical activity, and 3 weight status. Twelve interventions assessed nutrition and 7 physical activity environmental outcomes.

Discussion: Interventions in FCC improved children’s dietary intake, but their impact on physical activity and weight status was inconclusive. Furthermore, positive impacts were observed in environmental outcomes related to nutrition, whereas research on physical activity environmental outcomes was limited.

Implications for Research and Practice: Future research could replicate interventions to validate effectiveness and understand positive outcome mechanisms. Future interventions might use FCC stakeholders’ input, incorporate innovative physical activity components, enhance FCC providers’ position as role models, involve parents, and target those groups that are at a high risk of being obese.

Key Words: pediatric obesity, family child care, healthy diet, exercise, sedentary behavior (J Nutr Educ Behav. 2024;56:242–255.)

Accepted December 28, 2023. Published online February 10, 2024.

INTRODUCTION

Early childhood obesity is a major public health issue. In the past few decades, the prevalence of overweight and obesity in young children has risen rapidly.² Globally, in 2020, 39 million children aged <5 years were overweight or obese.² Childhood obesity negatively impacts children’s physical, social, and emotional well-being and academic performance.³ It is well established that health behaviors formed in early childhood track into adulthood.⁴ Evidence also suggests that obesity established before entering school is difficult to reverse.⁵ Obese children are more likely to become obese adults,⁶ which increases their risk for noncommunicable diseases⁷ and creates substantial additional health care costs for society.⁸ Traditionally, interventions targeting preschoolers (children aged 0–6 years) focused on improving the home environment. However, with a growing number of women with young children joining the workforce, early childhood education (ECE) services have become an increasingly important setting for health promotion. In high-income countries, 36% of children aged 0–2 years and 87% aged 3–5 years are enrolled in ECE services in which they typically spend 25–35 h/wk.⁹

There are a variety of ECE services such as long day care, nurseries, and family child care (FCC).¹⁰ Although most ECE services offer care in a child care center, FCC is a particular form of child care in which an educator cares for a small group of children in their home.¹¹ Family child care
educators are often monitored and supported by FCC organizations who employ coordinators to ensure that educators offer high-quality care that adheres to both national regulations and the policies of the FCC organization. In 2021, FCC services in Australia comprised 10% of the ECE sector (excluding outside school hours care), accommodating approximately 100,000 children. Meanwhile, center-based care enrolled around 800,000 children. In the US, 900,000 children attend FCC. Compared with center-based care, FCC is notably favored by low-income and culturally diverse families (Daugherty L. Child care choices of Hispanic families: why aren’t families using child care? Pardee Rand Graduate School; 2010). This is a significant finding in the context of obesity prevention, as children living in culturally diverse households and households with low incomes are at a higher risk for developing obesity. A systematic review of obesity prevention interventions focusing on socioeconomic status found that out of 11 studies showing a positive impact on weight outcomes, 5 failed to demonstrate any improvements in populations with limited resources. Interventions that successfully reduced obesity among populations with limited resources primarily focused on environmental improvements. By enhancing the nutrition and physical activity environment in FCC, we can effectively target children from households with low incomes and culturally diverse families, making FCC a promising avenue to combat childhood obesity and improve health equity.

However, research has identified shortcomings in the nutrition and physical activity environment in FCC, including the absence of nutrition and physical activity policies, inadequate training of FCC providers, poor mealtime practices, insufficient provision of vegetables, and excessive provision of discretionary foods and screen time. Furthermore, a prospective cohort study with 1,138 children revealed an association between receiving care in someone else’s home (such as FCC) and higher body mass index (BMI) z-scores among 3-year-olds. In contrast, no significant association was found between center-based care and BMI z-scores. The FCC environment presents several unique challenges for public health interventions that are not present in center-based child care. For example, in FCC there is 1 caregiver compared with multiple in center-based care, space in the home environment is limited, FCC businesses tend to be less stable, and children have a wide variety of ages compared with predefined classrooms. Although obesity prevention interventions in child care centers have been extensively researched, and the majority of these interventions have demonstrated their intended impact on physical activity, diet, screen time, and to a lesser extent, obesity, evidence in FCC has yet to be adequately examined.

In 2020, Yoong et al published a systematic review of interventions that included a parallel control arm aimed at promoting dietary intake, physical activity, and healthy weight status of children attending FCC. However, because of the limited research on FCC and the strict inclusion criteria, only 2 studies reporting on the FCC environment were included. Because of this, there is currently limited insight into the effectiveness of nutrition and physical activity-based interventions in FCC to improve health behaviors in children. Therefore, the aim of this review is to again examine the effectiveness of interventions in FCC using a quasi-experimental design on children’s diet, physical activity levels, and weight. The secondary aim of this review is to examine the impact of interventions in FCC on the FCC health-promoting environment, policies, and practices.

METHODS

A review by the Institutional Review Board was not required for this systematic review because human subjects were not involved.

Registration

This review is registered with the International Prospective Register of Systematic Reviews (CRD42022347530) and reported in accordance with the Preferred Reporting Items for Systematic Reviews and Meta-Analysis 2020 guidelines.

Search Strategy

In July 2022, 6 electronic databases (MEDLINE, ERIC, CINAHL, Embase, Scopus, and A+ Education) were searched using a search strategy developed in consultation with a research librarian. There was no limitation on the publication date of the articles included in the search. The search strategy contained terms related to dietary intake, physical activity, and weight, and combined these terms with words for the FCC setting. The search was repeated in 2023, encompassing articles up to July 2023, bringing the search results up-to-date. The complete search strategy is presented in Supplementary Table 1. In addition to the computer-based literature search, one author performed a forward and backward citation search of all the included articles in this review.

Inclusion and Exclusion Criteria

To be included in this review, studies had to evaluate an intervention that promotes dietary intake, physical activity, and/or healthy weight status in children attending FCC with an experimental or quasi-experimental design. Study designs included randomized controlled trials, clustered randomized controlled trials, pretest-posttest designs with and without a control group, and posttest-only studies with a control group. Cross-sectional studies without a control group, and qualitative studies were excluded. Any intervention that promoted healthy eating, physical activity, reduced sedentary behavior, and/or aimed to prevent unhealthy weight gain, regardless of its duration, was considered eligible for inclusion. Interventions could be a singular component or multicomponent and target various elements such as the environment (eg, interventions that improved the availability of healthy foods), curriculum (eg, interventions that incorporated scheduled time for active play), policy (eg, interventions that supported FCC providers in setting up nutrition...
or physical activity policies), and education (eg, interventions that enhanced the skills and knowledge of FCC providers, children, and parents). In this review, the introduction of, or changes to, national or regional legislation that impacted the dietary intake, physical activity, and weight status of children in FCC, was also considered an intervention. If the intervention was conducted in multiple settings, including FCC, the study was included when the results for FCC could be isolated. Study outcomes had to be (1) objective or subjective measures of dietary intake, physical activity (including sedentary behavior such as watching television), and/or weight status in children, and/or (2) outcomes related to the FCC health-promoting environment, policies and/or practices.

Manuscripts not published in English, reviews, and study protocols were excluded. Studies without an intervention component delivered within FCC were also excluded. For example, studies that solely used the FCC setting to recruit study participants. Moreover, studies that focused on informal types of child care provided in the child's own home, such as babysitting, were excluded. Interventions that exclusively aimed to promote breastfeeding were excluded, as this falls outside the scope of the FCC environment and the responsibilities of the FCC provider. Finally, interventions that aimed to reduce undernourishment and studies that evaluated the impact of obesity treatment (focusing solely on overweight/obese children) were excluded. Those target groups do not reflect the general population of children attending FCC and were therefore deemed irrelevant for this review.

**Data Collection Process**

We imported the articles from the computer-based search into the systematic review management tool Covidence (Veritas Health Innovation). Two experts in the field of this review independently screened all the articles based on their titles and abstracts. Potentially eligible studies underwent full-text screening, independently conducted by 2 authors. One author extracted data from the included articles on study characteristics, interventions, methods, and outcomes, which a second author verified. During screening and extraction, conflicts were resolved by consensus between the 2 authors. In cases in which consensus could not be reached, the final decision was made by a third author. Both these authors are public health experts and have experience conducting research in the ECE setting. They possess a strong track record of conducting systematic reviews and have provided guidance throughout the review process.

**Assessing Methodological Quality**

We assessed the methodological quality of the included articles using the Effective Public Health Practice Project Assessment (EPHPP) tool. The EPHPP tool was chosen as it can determine the methodological quality of different study designs, is well-adapted to be used in systematic reviews of effectiveness, and has content and construct validity. To assess methodological quality, the EPHPP tool scores a study on 6 domains: (1) selection bias, (2) study design, (3) confounders, (4) blinding, (5) data collection methods, and (6) withdrawals and dropouts. Studies receive a weak, moderate, or strong verdict for each of the domains. Studies without any weak domains have strong methodological quality. One weak domain leads to a moderate quality rating, and ≥ 2 domains with a weak score result in an overall weak quality rating. Two authors independently rated the quality of each study. Any discrepancies in rating were resolved by consensus. When consensus could not be reached, the final decision was made by a third author.

**Analysis**

The interventions in this review are heterogeneous. Therefore, we chose to narratively describe the study outcomes. Outcomes were divided into 2 categories: child outcomes (changes in children's dietary intake, physical activity levels, and/or weight status); and environmental outcomes (changes in the FCC health-promoting environment, policies, and/or practices). Environmental outcomes were further broken down using the Analysis Grid for Environments Linked to Obesity framework. This framework helps users understand the obesogenicity of environments by dividing the environment into different categories. Environmental outcomes were separated into the physical environment (what is available in FCC, including education and development opportunities), the political environment (what are the rules within FCC services), and the sociocultural environment (what practices surround food and physical activity in FCC). Within the sociocultural environment, a range of practices shapes the context of food and physical activity in the FCC setting. These practices include staff members serving as role models by actively participating in physical activities with children and making healthy food choices in their presence. It also encompasses practices such as refraining from using physical activity restrictions as punishment, providing alternative activities during television time, and allowing children to serve their own food. As feeding environment outcomes in the included studies mostly consisted of practices that influence the mealtime atmosphere (eg, serving dishes family style), we have put these outcomes into the sociocultural category. In contrast, changes in the physical activity environment (eg, availability of toys) fit better in the physical environment category. Physical activity practices (eg, withholding physical activity to manage challenging behavior) were put in the sociocultural environment category.

**RESULTS**

**Study Selection**

The computer-based search yielded 6,171 citations after duplicate removal (see Figure). The screening process resulted in 17 eligible articles. A forward and backward citation search of these articles did not yield any additional studies. In 2 cases, 2 articles investigated the same intervention in the same study.
population but assessed different outcomes. In these instances, we merged the results of the 2 articles. This resulted in a total of 15 unique interventions.

### Study Characteristics

Eleven of the 15 included studies were conducted in the US,\textsuperscript{40−52} 2 were conducted in Australia,\textsuperscript{22,53} 1 in Canada,\textsuperscript{54} and 1 in Colombia.\textsuperscript{55} The studies were published between 2000 and 2022. All studies included FCC providers as participants. The number of FCC providers participating ranged from 5 to 533. Some studies also collected data directly from children\textsuperscript{42,48,52,55} (eg, by measuring children’s height and weight). However, most studies collected data from children indirectly by obtaining children’s information through the FCC provider or observations in the FCC home. Thirteen studies reported on the socioeconomic status of FCC providers and/or children in their sample.\textsuperscript{40−53,54} In 10 of these studies, the majority of FCC providers participated in the federally funded \textit{Child and Adult Care Food Program} (CACFP).\textsuperscript{40,41,43−52} This program in the US reimburses child care services for providing meals and snacks to children from households with low incomes,\textsuperscript{56} indicating that many FCC providers in the included studies were serving families with low incomes. Seven studies provided information on the ethnicity of their participants.\textsuperscript{40−42,44,52} Among these, 3 predominantly involved White providers and children,\textsuperscript{42,44,54} 2 studies predominantly included Hispanic providers and children,\textsuperscript{40,45,52} 1 primarily featured African American providers and children,\textsuperscript{48} and 1 involved a diverse sample of providers and children from various backgrounds.\textsuperscript{41} Two studies performed a power calculation to determine the appropriate sample size.\textsuperscript{43,49} Ten studies used a pretest-posttest design without a control group to evaluate the effects of their intervention.\textsuperscript{22,40−42,44−47,49−51,54} One study added a cross-sectional sample of comparable FCC homes as a control group to their prepost design.\textsuperscript{43} Two studies had a posttest-only design with a control group,\textsuperscript{53,55} and 2 studies were cluster-randomized controlled trials.\textsuperscript{48,52} One study conducted a second follow-up assessment.\textsuperscript{42}

Four of the 15 included studies assessed the impact of their intervention on children’s dietary intake.\textsuperscript{44,48,49,52} Among them, 2 studies used the Dietary Observations in Child Care protocol,\textsuperscript{48,52} 1 employed plate waste observations,\textsuperscript{44} and another used photographs of meals preconsumption and postconsumption.\textsuperscript{49} Two studies measured children’s physical activity levels using accelerometers,\textsuperscript{48,52} and 3 studies measured the impact of their intervention on children’s weight status.\textsuperscript{48,49,52} Thirteen studies examined the nutrition and physical activity environment.\textsuperscript{22,40,41,43−51,53−55} Ten of these studies used questionnaires or interviews to evaluate environmental outcomes,\textsuperscript{22,40,43−47,51,53−55} with 4 employing the Nutrition and Physical Activity Self-Assessment for Child Care (NAPSACC).\textsuperscript{43,46,47,51} Two studies complemented questionnaire data with observations,\textsuperscript{40,44,45} whereas 2 other studies exclusively conducted observations.\textsuperscript{41,48} Three studies using observations employed the Environment and Policy Assessment and Observation tool.\textsuperscript{40,41,48} Finally, 1 study assessed the nutrition and physical activity environment through menus.\textsuperscript{49,50} Regarding the process evaluation outcomes of the interventions, 3 studies addressed intervention fidelity,\textsuperscript{46,52,54} whereas 7 provided information on the
intervention dosage that participants received.\textsuperscript{22,41,42,44,45,48,52,54} None of the studies reported the presence or absence of food insecurity in their samples. A comprehensive overview of the characteristics of the included studies, including information on the intervention, methods, and outcomes, can be found in the Table. To ensure clarity, effect sizes, and $P$ values are not reported in the Table because studies commonly report a high number of different outcomes. Additional details on study power, funders, intervention fidelity, intervention dosage delivered and received, and the presence or absence of food insecurity in the samples can be found in Supplementary Table 2.

**Methodological Quality**

Thirteen out of the 15 included studies received a weak quality rating.\textsuperscript{22,40−47,49,50,53−55} and 2 studies were rated as having strong methodological quality.\textsuperscript{48,52} The weak quality ratings were due to the large amount of pretest-posttest and post-only with control group study designs. Selection bias was also an issue, as participants in most studies were self-selected. The 2 studies with a strong quality rating were both randomized controlled trials.\textsuperscript{48,52} Detailed information about the methodological quality of the included studies can be found in Supplementary Table 3.

**Interventions**

Of the 15 included interventions, 6 focused on improving children’s nutritional intake,\textsuperscript{22,40,48−51,54,55} 2 focused on improving physical activity levels,\textsuperscript{41,46} and 7 aimed to improve both.\textsuperscript{42−45,47,48,52,53} All interventions, except the updated CACFP regulations,\textsuperscript{49,50} were multifaceted (consisting of two or more components).\textsuperscript{56} Three interventions were developed with input from FCC providers and/or FCC organizations.\textsuperscript{22,40−55,57−62}

**Child Outcomes**

**Effect on dietary intake.** Four studies measured the impact of their intervention on children’s dietary intake.\textsuperscript{34,48,49,52} Three interventions reported significant positive changes in children’s diet.\textsuperscript{48,49,52} The Healthy Start intervention and the Keys intervention calculated the Healthy Eating Index (HEI) score of children enrolled in the intervention and control study,\textsuperscript{48,52} with higher scores indicating better adherence to dietary guidelines.\textsuperscript{61} Children enrolled in the intervention had significantly higher HEI scores than children enrolled in the control study (7.2 and 5.4 points, respectively). Specifically, the Healthy Start intervention improved the total vegetable and added sugar HEI subcomponents. In contrast, the Keys intervention led to improvements in the HEI subcomponents of whole grains, seafood/plant protein, refined grains, and sodium, with a slight decline in the total vegetable component. The improved CACFP regulations also led to positive changes in children’s nutritional intake, including an increased consumption of fruit and whole grains.\textsuperscript{49} The Healthy Eating and Active Living (HEAL) intervention did not produce any significant changes in the dietary intake of children.\textsuperscript{44}

**Effect on physical activity levels.** Two interventions measured children’s physical activity levels using accelerometers.\textsuperscript{48,52} The Healthy Start intervention significantly reduced sedentary time (−5.7%) among children in the intervention group when compared with the control group. However, no differences were found in time spent in moderate-to-vigorous physical activities.\textsuperscript{49} The Keys intervention measured time spent in moderate-to-vigorous physical activities, active play and sedentary time but found no significant differences between the intervention and control groups.\textsuperscript{48}

**Effect on weight status.** Three studies measured the impact of their intervention on children’s weight.\textsuperscript{42,48,55} Two studies, the Keys intervention\textsuperscript{48} and the child care vocational program,\textsuperscript{55} did not find significant changes in weight between children enrolled in the intervention and control study. The Healthy Opportunities for Physical Activity and Nutrition Home intervention found that BMI z-scores of children did not significantly increase from preintervention to postintervention, but they did significantly increase from postintervention to the second follow-up.\textsuperscript{42}

**Environmental Outcomes**

The physical environment-nutrition. Ten studies measured the impact of their intervention on the nutritional quality of the foods and drinks served in FCC. Eight of these studies reported improvements in foods and drinks served\textsuperscript{22,40,41,43,44,47,49−51} and 2 did not find any changes.\textsuperscript{48,54}

Nine interventions assessed changes in nutrition education and development opportunities for FCC providers, FCC organizations’ staff, children, and parents. Seven of these studies found an increase in educational opportunities,\textsuperscript{22,41,43,47,48,51,53} whereas 2 studies did not find any significant changes.\textsuperscript{44,55}

The physical environment-physical activity. Six interventions measured changes in physical activity opportunities for children in FCC, such as indoor and outdoor play and adult-led physical activities. Five of these interventions reported improvements in some to all physical activity opportunity outcomes,\textsuperscript{41,43,45,46,48} whereas 1 intervention negatively impacted physical activity opportunities.\textsuperscript{53} The Healthy Kansas Kids intervention increased active play opportunities and decreased the amount of inactive time provided to children,\textsuperscript{44} and the NAP SACC intervention of Dinkel et al\textsuperscript{46} resulted in more time provided for physical activity and outdoor playtime. The HEAL project, the Active Early 2.0 intervention, and the Keys intervention reported some increase in physical activity opportunities, but most of their reported outcomes did not change.\textsuperscript{41,45,48} Finally, the Romp & Chomp intervention reduced organized active play and free inside play.\textsuperscript{53}

Six studies measured the impact of their intervention on screen-time opportunities. Four interventions found that screen-time opportunities decreased because of the intervention,\textsuperscript{43,45,47,53} whereas 2
## Table. A Summary of Included Studies (n = 15) That Examine the Effectiveness of Interventions in FCC, Using a Quasi-experimental Design, on Children’s Diet, Physical Activity Levels, and Weight and/or the FCC Health-promoting Environment, Policies, and Practices

<table>
<thead>
<tr>
<th>Author (y), Country</th>
<th>Intervention</th>
<th>Methods</th>
<th>Outcomes</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Bernal (2015)</strong>&lt;sup&gt;55&lt;/sup&gt; Colombia</td>
<td>Description: 2,640-h degree in early childhood education aimed at improving the nutritional intake of children</td>
<td>Design: posttest-only with control group</td>
<td>Child outcomes: no changes in children’s weight-for-age and weight-for-height. Physical environment: no changes in providers’ frequency of sharing nutrition information with parents.</td>
</tr>
<tr>
<td><strong>Bravo et al (2008)</strong>&lt;sup&gt;22&lt;/sup&gt; Australia</td>
<td>Title: GFFDC project Description: nutrition and food safety intervention with an advisory committee, FCC organization staff workshops, and nutrition resources</td>
<td>Design: pretest-posttest, no C group</td>
<td>Physical environment: nutrition score for children aged 1–5 years increased; no changes found for infants; percentage of organization staff and providers that had undertaken nutrition and food safety training increased.</td>
</tr>
<tr>
<td><strong>Burden et al (2000)</strong>&lt;sup&gt;54&lt;/sup&gt; Canada</td>
<td>Description: intervention promoting providers’ menu planning and problem eating-solving skills through an in-person workshop or mailed case study</td>
<td>Design: pretest-posttest, no control group</td>
<td>Physical environment: the percentage of providers that met food group criteria did not change from pretest to posttest.</td>
</tr>
<tr>
<td><strong>de Silva-Sanigorski et al (2011)</strong>&lt;sup&gt;53&lt;/sup&gt; Australia&lt;sup&gt;d&lt;/sup&gt;</td>
<td>Title: Romp &amp; Chomp intervention Description: intervention promoting healthy eating and active play through workshops, media coverage, newsletters, nutrition and physical activity resources and provider professional development</td>
<td>Design: posttest-only with C group</td>
<td>Physical environment: organized play time, free inside play time and screen time use was reduced in the intervention group; the availability of physical activity resources increased, and providers received more physical activity and nutrition training; no changes in free outside play time, the physical activity-physical environment rating, and the outdoor equipment range. Political environment: providers in the intervention group were less likely to allow unhealthy items but also less likely to have a set minimum time for outside play and organized active play; they had more rules about healthy foods; no changes in the number of healthy items allowed. Sociocultural environment: the intervention improved the food environment, availability of nutrition resources, and food practices and reduced the use of food as a reward; no changes in the number of strategies used to promote healthy eating or physical activity.</td>
</tr>
</tbody>
</table>

(continued)
<table>
<thead>
<tr>
<th>Author (y), Country</th>
<th>Title</th>
<th>Intervention</th>
<th>Methods</th>
<th>Outcomes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dev et al (2018) US</td>
<td>NAPSACC</td>
<td>Intervention aiming to improve nutrition and screen-time policies and practices through online self-assessments, goal setting, training, and technical assistance.</td>
<td>Pretest-posttest, no C group</td>
<td>Physical environment: the categories foods provided (2/13), menus and variety (1/2), education and professional development-nutrition (5/6), availability-screen time (5/5), and education and professional development-screen time (4/4) improved, whereas there was no change in beverages. Political environment: policy-nutrition (1/1), and policy-screen time (1/1) improved.</td>
</tr>
<tr>
<td>Dinkel et al (2018) US</td>
<td>NAPSACC</td>
<td>Intervention promoting physical activity and outdoor play through online self-assessments, goal setting, training, and technical assistance.</td>
<td>Pretest-posttest, no control group</td>
<td>Sociocultural environment: feeding environment and practices (5/17) and daily practices-screen time (1/2) improved.</td>
</tr>
<tr>
<td>Gans et al (2022) US</td>
<td>Healthy Start</td>
<td>Intervention promoting a healthful FCC environment, healthy diet and physical activity through self-assessment, a feedback report, active play toys, goal setting meetings and tailored mailings</td>
<td>Cluster-randomized control trial</td>
<td>Child outcomes: the total HEI-score of intervention children improved by 7.2 points; the HEI-components total vegetable and added sugar improved by 0.9 and 1.0 points respectively, whereas the intervention decreased sedentary time by 5.7%; there were no changes in MVPA.</td>
</tr>
<tr>
<td>Kao et al (2018) US</td>
<td>Healthy Eating and Active Living</td>
<td>Intervention supporting providers in creating nutrition and physical activity policies through site visits, workshops, and resources, such as monthly newsletters, parent handouts, and policy templates</td>
<td>Pretest-posttest, no C group</td>
<td>Child outcomes: no changes in food group consumption. Physical environment: the categories physical activity opportunities (2/11), physical activity space and resources (3/6), physical activity education for parents, children, and FCC providers (1/5), screen-time opportunities (1/4), and foods and beverages provided (5/29) improved, whereas there were no changes in nutrition education for parents, children and FCC providers.</td>
</tr>
<tr>
<td>Woodward-Lopez et al (2018) US</td>
<td>Healthy Eating and Active Living</td>
<td>Intervention updating CACFP regulations</td>
<td>Pretest-posttest, no C group</td>
<td>Child outcomes: breakfast-fruit consumption increased; lunch-fruit and whole grain consumption increased, refined grain consumption decreased, snacks-refined grain consumption increased. Physical environment: Breakfast-fruit servings increased; lunch-whole grain servings increased, whereas refined grain servings decreased; snacks servings of 100% juice decreased.</td>
</tr>
<tr>
<td>Kenney et al (2020) US</td>
<td>Updated CACFP regulations</td>
<td>Regulations were updated to align them with current nutrition science, the impact of this change on the dietary intake of children was assessed</td>
<td>Pretest-posttest, no C group</td>
<td>Child outcomes: breakfast-fruit consumption increased; lunch-fruit and whole grain consumption increased, refined grain consumption decreased, snacks-refined grain consumption increased. Physical environment: Breakfast-fruit servings increased; lunch-whole grain servings increased, whereas refined grain servings decreased; snacks servings of 100% juice decreased.</td>
</tr>
</tbody>
</table>
and after the updated CACFP regulations were analyzed to assess nutrition standard compliance. The menu assessment showed that FCC services met the whole grain standard more often but not the other CACFP standards; 100% juice and refined grain servings decreased and 1% milk servings and whole grain servings increased.

**Physical environment:** the categories infant foods (3/3) and infant feeding education and professional development (4/4) improved.

**Political environment:** infant feeding policy (1/1) improved.

**Sociocultural environment:** infant feeding practices (6/6) improved.

**Ritchie et al (2021)**

**Title:** NAPSACC

**Description:** intervention promoting providers’ adherence to nutrition standards through in-person workshop, self-assessment, and goal setting.

**Duration:** 3 mo

**Design:** pretest-posttest, no C group.

**Sample:** 35 providers (83% participated in CACFP, 63% Hispanic) and children in their care.

**LTFU:** 14%

**Assessment:** provider survey to assess served foods and beverages; researchers conducted observations of 1 meal and 1 snack using a modified version of the EPAO tool.

**Physical environment:** adherence to foods/beverages standards for children improved, but not for infants.

**Sociocultural environment:** adherence to infant feeding practice standards and child feeding practice standards improved.

**Trost et al (2011)**

**Title:** Healthy Kansas Kids program

**Description:** Intervention aiming to prevent obesity. Trainers attended workshops and supported FCC providers with self-evaluation, goal setting, action planning, progress evaluation and resources.

**Duration:** 1 y

**Design:** Pretest-posttest with cross-sectional data collected preintervention from the C group.

**Sample:** I = 236 providers (85% participated in CACFP).

**C = 297 providers (83% participated in CACFP).**

**LTFU:** 33%

**Assessment:** Data were collected with the NAPSACC self-assessment tool.

**Physical environment:** the fruits and vegetables, fried foods and high-fat meats, meals and snacks, menus and variety, foods outside of regular meals and snacks, nutrition education, active play and inactive time, television use and viewing, play environment, and physical activity education scores improved; there was no change in the beverage score.

**Political environment:** the physical activity policy score improved. No changes in the nutrition policy score.

**Sociocultural environment:** the supporting healthy eating and supporting physical activity policy scores improved.

**Walch et al (2020)**

**Title:** Healthy Opportunities for Physical Activity and Nutrition Home

**Description:** Intervention promoting children’s asking skills for a healthful home through provider training, a play area, children’s workshops, songs, and home connection activities.

**Duration:** 12 wk

**Design:** pretest-posttest including a second follow-up assessment, no C group.

**Sample:** 5 FCC providers, 25 children aged 3–5 years (28% low-income households, 91% White).

**LTFU:** providers, 0%; children, 16%

**Assessment:** children’s height and weight were measured.

**Physical environment:** the fruits and vegetables, fried foods and high-fat meats, meals and snacks, menus and variety, foods outside of regular meals and snacks, nutrition education, active play and inactive time, television use and viewing, play environment, and physical activity education scores improved; there was no change in the beverage score.

**Political environment:** the physical activity policy score improved. No changes in the nutrition policy score.

**Sociocultural environment:** the supporting healthy eating and supporting physical activity scores improved.

**Child outcomes:** BMI z-scores increased (pretest, 0.61; posttest, 0.57; second follow-up, 0.71).
<table>
<thead>
<tr>
<th>Author (y), Country</th>
<th>Title</th>
<th>Intervention</th>
<th>Methods</th>
<th>Outcomes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ward et al (2020)</td>
<td>Keys intervention</td>
<td>Design: Cluster-randomized control trial</td>
<td>Child outcomes: intervention children's total HEI-score (5.4 points) and HEI-components (whole grains [1.6], seafood/plant protein [0.7], refined grains [2.0], and sodium [1.4]) improved, whereas the HEI-component total vegetable got worse (–0.5); no changes in children’s MVPA, active play minutes, sedentary time, BMI, or BMI percentile. Physical environment: for the I group, the education and professional development-nutrition, time provided-physical activity, and education and professional development-physical activity scores improved, whereas there were no changes in foods provided, beverages provided, menus, outdoor playtime, indoor play equipment, outdoor play environment, and screen-time scores. Political environment: no changes in nutrition policy, physical activity policy, and screen-time policy scores. Sociocultural environment: the physical activity practices score improved, whereas there were no changes in feeding practices, feeding environment, and screen-time practice scores.</td>
<td></td>
</tr>
<tr>
<td>US</td>
<td>Description: Intervention promoting a healthy FCC environment consisting of 3 modules: provider health, environment, and business practices. Modules consisted of a workshop, a home visit, and telephone or email contacts from trainers. Duration: 9 mo. Developed with input from FCC.</td>
<td>Sample: I = 83 providers, 242 children; C = 83 providers, 254 children; 91% of providers participated in CACFP and 74% were African American. 63% of children were African American. LTFU: I = providers 4%, children 38%; C = providers 5%, children 39%. Assessment: Children’s dietary intake (DOCC protocol), physical activity (accelerometers) and height, weight and waist circumference were measured. The EPAO-FCCH instrument was used to assess the physical activity and nutrition environment.</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
interventions did not find any significant changes.41,48

Six studies measured changes in the physical activity environment, such as the availability of fixed play equipment. Four of these studies reported positive outcomes,43,45,46,53 whereas 2 interventions did not find any changes.41,48 The Healthy Kansas Kids program significantly improved the play environment,41 and the NAPSACC intervention of Dinkel et al46 found some improvements in the indoor and, to a lesser extent, the outdoor play environment. The HEAL intervention increased the availability of physical activity resources, such as play equipment, posters, and books, but did not improve the size of the indoor and outdoor space.46 Similarly, the Romp & Chomp intervention increased the availability of physical activity resources but did not find changes in a physical activity-physical environment rating or the availability of outdoor equipment.53

Seven interventions measured changes in education and development opportunities regarding physical activity41,43,45,46,48,53 and screen time,47 for FCC providers, children, and parents. Six of these interventions reported positive changes in physical activity43,45,46,48,53 or screen-time education opportunities,47 and 1 intervention, the Active Early 2.0 intervention, did not find any changes in physical activity education opportunities.41

The political environment-nutrition. Seven interventions measured changes in the presence of nutrition policies, the content of these policies and/or the communication of these policies with parents. Five interventions reported improvements in some to all nutrition policy outcomes41,44,47,51,53 and 2 interventions did not have any significant impact.43,48

The political environment-physical activity. Six interventions measured physical activity policy outcomes.41,43,45,46,48,53 Four of these interventions reported improvements in some to all physical activity policy outcomes.41,43,45,46 One intervention had a negative effect on physical activity policy outcomes,53 and another did not find any effects on physical activity policy outcomes.48

Two interventions assessed changes in screen-time policies.47,48 Dev et al47 found a significant increase in screen-time policies after the intervention, whereas the Keys intervention did not.48

The sociocultural environment-nutrition. Eight studies measured changes in feeding practices and the mealtime environment. Seven of these studies reported improvements in some to all feeding practices and mealtime environment outcomes.40,41,43–45,47,51,53 However, the improvements reported for the HEAL intervention were very minimal: 2 out of the 29 feeding practice and mealtime environment items showed improvement.44,45 The Keys intervention did not report any significant changes in feeding practices or the mealtime environment.48

The sociocultural environment-physical activity. Five interventions assessed changes in physical activity practices. Three interventions showed improvements in some to all physical activity practices43,46,48 and 2 interventions did not have any impact on physical practices.45,53

Two studies measured screen-time practices. One intervention significantly improved screen-time practices,47 and 1 intervention did not.48

DISCUSSION

This review aimed to examine the evidence on the effectiveness of interventions in FCC on (1) the dietary intake, physical activity levels, and weight status of children, and (2) FCC health-promoting environments, policies, and practices. Most studies in this review involved FCC providers and children from households with low incomes. In addition, a few studies included FCC providers and children from culturally diverse backgrounds. We found evidence that interventions in FCC can improve children’s diets. In contrast, evidence about the impact of interventions in FCC on children’s physical activity levels and weight status is limited and inconsistent. If we look at the environmental outcomes related to nutrition, we see that interventions in FCC improve FCC health-promoting environments, policies, and practices. There is less research on environmental outcomes related to physical activity, possibly because of the difficulties in evaluating the physical activity environment. For example, obtaining accurate information about the time provided for physical activity often requires observations or detailed record-keeping by providers. In contrast, certain nutritional outcomes can more easily be assessed (eg, through a provider survey). The impact of interventions on the FCC health-promoting environments, policies, and practices related to physical activity was less convincing compared with the environmental outcomes for nutrition.

It is encouraging that interventions in FCC improve children’s dietary intake. This aligns with the results of obesity prevention interventions in child care centers, which have also demonstrated effectiveness in improving children’s dietary habits.31,64 The fact that 2 interventions in FCC48,52 increased the HEI scores of children by 5.4 and 7.2 points is especially relevant, as such an increase has been shown to predict lower all-cause mortality in adults.65 However, the results do not reveal a clear trend regarding which food groups can be improved through interventions in FCC. The fact that interventions were able to improve environmental outcomes related to nutrition is also promising. Research has shown that the food environment in FCC is associated with children’s dietary intake.66,67

The impact of interventions in FCC on physical activity levels and physical activity environmental outcomes was limited and not as conclusive as the nutrition outcomes. Conversely, obesity prevention interventions in child care centers have demonstrated significant success in improving both children’s physical activity31,68 and the physical activity environment of child care centers.31 Family child care providers face several barriers when providing physical activity that are less or not present in center-based child care. For example, space in the home environment is limited, which makes providing
physical activity complicated. Limited space means that FCC providers tend to have less physical equipment than center-based providers. The available equipment tends to be portable and smaller, such as balls and foam mats, instead of larger stationary physical activity equipment, such as fixed climbing structures. Furthermore, FCC providers care for children of different ages, making it harder to implement physical activities that work for all. Finally, FCC providers are very time-constricted. Time tends to be a barrier for ECE personnel in general, but the FCC operational model is likely to exacerbate time constraints. Family child care providers fulfill various roles, such as managing finances and ensuring compliance with regulations, alongside their primary responsibility of caring for children. As most studies that aimed to improve children’s physical activity did not involve FCC stakeholders in the development of their interventions, these interventions might not have been able to address specific FCC barriers. The 2 physical activity interventions that conducted formative research with FCC providers found some positive changes in children’s physical activity levels and physical activity environmental outcomes, but the impact was relatively small. Both authors encouraged more research to be undertaken to optimize physical activity interventions in FCC. Gans et al suggested enhancing physical activity components in future interventions beyond their Healthy Start intervention. For instance, by giving FCC providers data on children’s physical activity levels and guidance on high-intensity exercises, helping reconfigure indoor spaces for more movement-based activities, providing specialized training for provider-led physical activity, scheduling indoor dance sessions as part of daily routines, offering resources for active screen time that engage children of different ages in moderate-to-vigorous physical activity, and addressing safe physical activity opportunities within the FCC neighborhood.

On a similar note, Ward et al observed that while the Keys intervention improved the physical activity environment, it did not translate into increased physical activity in children. They speculate whether FCC providers’ low physical activity levels might explain this. Despite dedicated efforts involving workshops, home visits, and telephone calls, the Keys intervention failed to increase the physical activity levels of FCC providers.

Of the 15 included studies, 3 evaluated the impact of interventions in FCC on children’s weight status. The results showed that the interventions were not able to prevent weight gain or induce weight loss in children. Research on the effectiveness of obesity prevention interventions in child care centers has yielded inconsistent results. A review by Sisson et al examined 29 interventions in child care centers and revealed that less than half of them reported improvements in children’s weight status. Effective obesity prevention interventions in child care centers are typically targeted toward children who are at greater risk for obesity, such as those in higher weight categories, or from households with low incomes. In addition, high parental involvement also increases the effectiveness of obesity prevention intervention in child care centers.

Currently, there is limited communication between FCC providers and parents about health behaviors: less than half of FCC providers share information about physical activity or nutrition with parents. A potential barrier for FCC providers to discuss nutrition and physical activity with parents could be their lack of knowledge about best practices. For instance, a study showed that 23% of Australian FCC providers could correctly identify the recommended fruit intake, and 55% were aware of the recommended vegetable intake for preschool children. Furthermore, research has indicated that FCC providers find it challenging to talk with parents about healthy eating and physical activity (eg, because of differences in perspectives between staff and parents on these matters).

The findings of this review should be considered with respect to its strengths and limitations. Our review was executed according to the gold standard for systematic reviews: screening and appraisal were conducted independently by 2 researchers, and the extracted data were checked to ensure accuracy. A major limitation of this systematic review is the limited number of included studies, and their generally weak quality. Most studies used prepost designs, which means that their outcomes could be influenced by factors aside from the intervention. Moreover, some of the studies included in this review used a very small sample size (< 30 FCC providers), and power calculations were generally not performed. This may have resulted in changes being undetected. In addition, only 1 study conducted a second follow-up assessment, so it is not possible to make conclusions about the longevity of the outcomes. Environmental outcomes were often assessed using questionnaires, introducing a potential risk of self-report bias. Moreover, some of these questionnaires were not tested for validity and/or reliability. Process outcome data, important for the validity of study results, was frequently overlooked. Furthermore, most studies were conducted in the US, and participants were usually self-selected, which limits the generalizability of the findings. Finally, as interventions and study outcomes were heterogenous, it was not possible to conduct a meta-analysis.

**IMPLICATIONS FOR RESEARCH AND PRACTICE**

This systematic review highlights the potential of interventions in FCC to enhance children’s diet and FCC health-promoting environments, policies, and practices related to nutrition. Because of the suboptimal dietary quality and nutrition environment of FCC, there is a clear need to expand these interventions on a larger scale. However, it is important to note that the current findings come from a limited number of studies with few replications. In addition, the methodological quality of the included studies was generally weak. The implications are that results must be considered with caution. In future research, it would be valuable to
prioritize high-quality replication research to validate the effectiveness of these interventions, delve into the mechanisms that lead to positive outcomes, and assess their long-term impact. Furthermore, in future research, an exploration of which food groups’ intake can be improved through interventions in the FCC setting could provide a more comprehensive understanding of dietary enhancements in this context.

Family child care providers face unique barriers to promoting physical activity that are not or less prevalent in center-based care, including limited space and physical activity equipment, catering to diverse age groups, and time constraints. Therefore, future interventions aiming to improve children’s physical activity levels in FCC could benefit from actively engaging FCC stakeholders in the intervention development process. In addition, future interventions could enhance their effectiveness by incorporating innovative physical activity components. Some suggestions by Gans et al.52 include providing FCC providers with data on children’s physical activity levels and guidance on high-intensity exercises, enhancing the indoor space for movement-based activities, and providing training on provider-led physical activity. Moreover, enhancing FCC providers’ physical activity levels could potentially elevate children’s physical activity by establishing them as influential role models.

Finally, to enhance the effectiveness of obesity prevention interventions in FCC, valuable lessons can be drawn from approaches used in child care centers. Prioritizing FCC services in low-socioeconomic areas for obesity prevention initiatives could be beneficial. Moreover, enhancing parental involvement, a key factor in successful obesity prevention in child care centers, could also strengthen FCC interventions.

SUPPLEMENTARY DATA

Supplementary data related to this article can be found at https://doi.org/10.1016/j.jneb.2023.12.011.

REFERENCES

23. Daniels LA, Franco B, McWhinnie J-A. An assessment of the potential of family day care as a nutrition