EARLY CARE AND EDUCATION (ECE) INTERVENTIONS FOR PROMOTING NUTRITION AND PHYSICAL ACTIVITY & PREVENTING OBESITY

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EXECUTIVE SUMMARY

Introduction: In an era of great concern over children's rates of overweight and obesity, policy makers and public health professionals recognize the potential utility of the Early Care and Education (ECE) setting for improving children's nutrition, physical activity, and weight status. It is critical to reach children in this age group because lifelong habits are formed early in life and many young children already have obesity or are at risk prior to entering kindergarten. ECE is one of the few settings where larger percentages of preschool-age children can be reached.

Obesity prevention interventions in ECE have been implemented in varied facilities (e.g., child care centers, Head Start sites, preschools, family child care homes) throughout the U.S. This includes interventions designed to help facilities meet new standards enacted by the U.S. Department of Agriculture (USDA) governing foods and beverages offered to children at sites that participate in the USDA Child and Adult Care Food Program (CACFP). These interventions reach many young children, and while their potential influence is great and a variety of specific interventions have been reported in the literature, detailed understanding of their comparative impacts has not been available to practitioners who seek to develop and implement the most effective interventions. Given the importance of this setting, the Nutrition Education and Obesity Prevention Branch of the California Department of Public Health (NEOPB-CDPH), a state implementing agency for the Supplemental Nutrition Assistance Education Program (SNAP-Ed) in California asked the Nutrition Policy Institute (NPI) to conduct a literature review to identify effective interventions for reducing obesity and improving nutrition and physical activity to inform their SNAP-Ed funded work in the ECE setting.

Methods: The authors conducted a review of the peer-reviewed literature published in upper-middle and high-income countries from January 1, 1998 to October 26, 2016 on ECE-based interventions for nutrition and physical activity promotion and obesity prevention. A total of 65 primary studies describing 70 interventions in a variety of ECE sites (including centers and family child care homes) met criteria for inclusion in this report. Inclusion criteria included intervention setting, study design, nature of the intervention, and outcome measures. Intervention effectiveness was evaluated according to impact on outcomes aligned with California's statewide objectives for SNAP-Ed, including nutrition (changes in consumption patterns), physical activity (changes in physical activity of various intensities), and weight status (changes in BMI, skinfold thickness, percent body fat, waist circumference, prevalence of overweight/obesity.)

Results: Of the 70 ECE interventions reviewed, 44 had at least one nutrition component and 51 had at least one physical activity (PA) component; 68 evaluations measured at least one outcome aligned with a CA SNAP-Ed objective; 44/68 (65%) were effective for any CA SNAP-Ed objective-related outcome; 20/40 interventions (50%) that measured a PA outcome were associated with a statistically significant increase in PA; 16/36 (44%) interventions that measured a body weight/composition-related outcome were associated with a statistically significant decrease in weight or improvement in body composition (BMI, waist circumference, skinfold, % body fat); 12/19 (63%) interventions that measured fruit and/or vegetable consumption showed a statistically significant increase in fruit and/or vegetable consumption;

2/8 (25%) interventions that measured added sugar intake showed a statistically significant decrease in added sugar intake or availability; and several interventions showed an improvement in meal (2/4 interventions, 50%) and snack (3/6 interventions, 50%) quality. As this review looked at interventions focused on infants and children aged 0-5, objectives related to improving food resource management were not relevant.

The review found that interventions that focused exclusively on PA successfully increased PA a little more than half the time and improved BMI about one-third of the time. Findings suggest that to increase PA, interventions should include parent engagement as well as improvements in both the quality and quantity of PA offered.

Interventions that focused exclusively on nutrition usually (76% of studies) improved dietary intake, but not weight outcomes (20% of studies). Findings suggest that to improve dietary intake, interventions should include both nutrition education and changes to the foods and beverages offered as well as parent engagement and staff training. Compared to nutrition-only and PA-only interventions, interventions that addressed both nutrition and PA more consistently impacted weight-related outcomes.

Among the studies reviewed, interventions implemented in low-income communities and/or communities of color, which were well represented in the interventions reviewed, were less consistently effective at improving outcomes of interest, particularly nutrition, than those implemented in higher income, predominately white communities.

Conclusions and Recommendations Studies reviewed indicate that to improve body weight, early childhood interventions should be specifically designed to address body weight, include both PA and nutrition components, and have the characteristics described in the box below.

To improve weight status, interventions should:

- address both nutrition and physical activity (PA);
- increase both time and quality of PA offered;
- make improvements to the food and beverages offered;
- offer PA plus some combination of PA education, PA environment changes and/or nutrition education;
- include comprehensive parent engagement;
- last at least 6 months (longer tends to be better) and;
- include written wellness policies to support the nutrition and PA changes.

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Introduction

With one in four US children ages two-five years overweight or obese, the need for effective obesity prevention interventions targeting this age group is dire[1]. Early care and education (ECE) sites (e.g., child care centers, Head Start, preschools, and family child care homes) provide an opportune setting for intervention: an estimated 75% of US children under age six attend an ECE program[2]. Therefore, interventions in the ECE setting reach a large proportion of young children (and their parents) for a significant portion of time during their early years when lifelong habits are formed.

In 2016, the USDA strengthened regulations governing foods and beverages offered to children attending programs that participate in the Child and Adult Care Food Program (CACFP), and states across the nation have implemented policies on nutrition, physical activity and screen time[1]. In 2012, legislation regarding the allowable beverages at licensed childcare sites was implemented in California. This legislation required that sites provide all day access to safe drinking water (including at all meal, snack and play times); limit one-hundred percent juice consumption to one serving per day; restrict milk offerings to fat-free or one-percent unsweetened dairy; and prohibit all beverages with added sweeteners, natural or artificial, except infant formulas or complete balanced nutritional products designed for children[3].

Research has informed and motivated many of the positive changes underway and continues to guide further intervention in the ECE setting. Many types of intervention strategies have been evaluated empirically and the ever-expanding literature offers increasingly greater insight into promising interventions for preventing childhood obesity.

With the intent of informing evidence-based practices for implementation through the California SNAP-Ed program, we conducted a review of the peer-reviewed, published literature on ECE-based interventions for nutrition and physical activity promotion and obesity prevention. This report presents the findings, which will be combined with those from future reviews to inform comprehensive SNAP-Ed work across multiple settings. It first outlines the methods used to conduct the review, then presents descriptive and analytic findings, and concludes with a discussion and recommendations for California SNAP-Ed.

Methods

The literature review involved the following steps, which are described in detail in this section:

1. Developed inclusion and exclusion criteria (I)
2. Developed key word search strategies and searched for literature (II & Appendix 2)
3. Screened references for inclusion and exclusion (III)
4. Abstracted key pieces of information from the included studies (Appendix 1)
5. Organized, analyzed and summarized the evidence (IV & V)

I. Inclusion and Exclusion Criteria

Inclusion and exclusion criteria guided development of search strategies and selection of relevant references for inclusion in the review. All retrieved references were screened for relevance by applying the following criteria.

- **Setting:**
  - Interventions conducted at a center- or home-based ECE site were eligible for inclusion. Interventions that included elementary school children were ineligible.
  - Interventions must have been conducted in upper-middle- or high-income countries; categories defined by the World Bank based on Gross National Income per capita in US dollars[4]. Studies conducted in developing countries were excluded due to their questionable generalizability to US populations.
  - Multi-setting interventions in which ECE sites were not a primary setting of implementation were excluded from this review.

- **Study Design:**

  Studies included in this review must have had a control group and measures of the outcome(s) of interest taken before and after an intervention occurred. They could be experiments or natural experiments, defined as follows:

  - **Randomized Controlled Trial (RCT):** includes an exposure randomly assigned by the investigator, measurement of outcome(s) before and after the intervention occurred, and a control group not exposed to the intervention under investigation.
  - **Quasi-Experimental Study:** includes an exposure not randomly assigned by the investigator, measurement of outcome(s) before and after the intervention occurred, and a control group not exposed to the intervention under investigation.
  - **Cross-over Trial:** includes an exposure assigned by the investigator to the same individuals at different points in time, measurement of outcome(s) before and after the intervention occurred, and a control group not exposed to the intervention under investigation.
  - **Natural Experiments**: includes an intervention that occurred outside of the investigator's control (the exposure was not assigned by the investigator), measurement of outcome(s) before and after the intervention occurred, and a control group not exposed to the intervention under investigation.

- **Intervention:**
  - Studies must have involved a change in a nutrition- or physical activity-related exposure or another exposure with a potential impact on children's weight status.
  - Interventions were not excluded based on expectations regarding feasibility of implementation through SNAP-Ed.

- **Outcome Measures:**

  Studies must have measured and reported at least one of the following outcome variables both before and after the intervention occurred:

  - **Nutrition:** change in food and beverages offered, served or consumed.
  - **Physical Activity:** change in time spent engaged in PA or change in intensity of PA.
  - **Weight Status:** change in body weight, BMI, skinfold, percent body fat, waist circumference, or other measures of body composition.
- **Population:**
  - Children ages two-five years attending ECE programs.

II. Evidence Search

Guided by the inclusion and exclusion criteria, we created Boolean operator search strategies to run in PubMed (Appendix 2). To maximize efficiency without sacrificing comprehensiveness, we searched for and identified relevant review papers published since January 1, 2005 (date of search: March 4, 2016) and extracted all relevant primary studies from them. We then searched for review papers and primary studies published since January 1, 2005 (date of search: October 26, 2016) to obtain the most recent publications. The PubMed searches yielded a total of 3,609 references, which we screened for relevance by their title, abstract and/or full paper.

Key word searches (Appendix 2) were also conducted in other relevant literature databases, including Health Systems Evidence; USDA's Nutrition Evidence Library; Robert Wood Johnson Foundation's *What Works for Health*; Transtria; Academy of Nutrition and Dietetics' Evidence Analysis Library; and Center for Training and Research Translation for any relevant studies not indexed in PubMed.

III. Evidence Synthesis and Analysis

To organize and interpret the literature, we identified nine common components that were included in the interventions (Appendix 4.) Then, we categorized interventions that had similar components into nine different groups (Table 4.)

We evaluated intervention effectiveness according to impact on outcomes aligned with the California SNAP-Ed statewide objectives (Appendix 3,) which include the following:

- **Nutrition:** change in consumption or offering of fruits and vegetables, healthy meals and snacks, foods and beverages characterized by added sugar and/or calories.

- **Physical Activity:** change in total physical activity, vigorous physical activity, moderate-vigorous physical activity, moderate physical activity, and light physical activity.

- **Weight Status:** change in BMI, BMI z-score, skinfold thickness, percent body fat, waist circumference, and/or prevalence of overweight and obesity.

All analyses presented in this report are limited to California SNAP-Ed statewide objective-aligned (SO) outcomes. Interventions were defined as "effective" or "null" as follows (Appendix 5):

- **Effective** interventions demonstrated statistical significance for ≥1 SO-related outcome, and had no negative or undesirable outcomes.
- **Ineffective or Null** interventions did not demonstrate statistical significance for ≥1 SO-related outcome. Any studies which had combinations of null or any negative results were also included in this category.

The following summary terms are used to indicate the quantity of evidence available for any given analysis:

- **Ample:** ≥20 interventions
- **Sufficient:** 10-19 interventions
- **Limited:** 6-9 interventions
- **Insufficient:** <6 interventions

Results

IV. Descriptive Results

Sixty-five primary studies describing 70 interventions met the criteria for inclusion in this review (Appendix 1). Publication dates ranged between 1998 and 2016 though most (n=54; 77%) were published after 2010. Sixty-eight interventions were tested via experiments, including 53 RCTs, five cross-over trials, and ten quasi-experiments, and two interventions were tested via natural experiments.

Forty-two interventions were tested in the United States (U.S.); six in Belgium; five in Australia; four in Germany; two each in Thailand, China, and Switzerland; one each in Scotland, Israel, Canada, Chile, Spain, England, and Turkey; and one study did not report a location. All interventions were implemented in ECE centers, including preschools, nursery schools, Head Start centers, and day care centers. None were implemented in home-based childcare sites. Most of the interventions (>90%) were tested among samples that included low-income children and/or ethnic/racial minorities.

The interventions generally involved ECE site-based changes regarding nutrition and/or physical activity. Two studies were of state-level policies; one that regulated nutrition standards[20] and the other PA standards[21]. We grouped activities included in the interventions into nine categories (see Appendix 4 for definitions.)

1. Nutrition education for children (***Nut. Ed.***)
2. Foods and/or beverages served during meals (***Meal FB***)
3. Foods and/or beverages served outside of meals (***FB Outside Meals***)
4. Physical activity offered to children (***PA Offered***)
5. Changes made to the physical activity environment (***PA Environment***)
6. Physical activity education for children (***PA Education***)
7. Screen time regulations (***Screen time***)
8. ***Parent engagement***

9. Wellness-related policy (***Policy***)

   Note: "FB" without a qualifier refers to all foods and beverages (including meals and outside meals).

Then, we categorized interventions that had similar combinations of activities into 9 different groups:

- ***PA Offered Only***
- ***PA Offered + PA Education and/or PA Environment (PA Offered + PA Ed. and/or PA Env.)***
- ***PA Env. Only***
- ***Nutrition Education Only (Nut. Ed. Only)***
- ***Nutrition Education + Food and Beverage (FB) Changes (Nut. Ed. + FB)***
- ***FB Only***
- ***Nut. Ed. + PA Ed.***
- ***Nut. Ed. + PA Ed. + PA Offered***
- ***FB + PA offered +/- PA Ed./Env.+/-Nut. Ed.***

Screen time regulations, parent engagement and wellness-related policies were not offered as solo interventions but were rather one component, but not a distinguishing component, of some of the interventions in the groups described above. Parent engagement was also analyzed separately because it was a common component of the various combinations above.

Of the 70 interventions included in this review, 45 had at least one nutrition component, 52 had at least one physical activity component, and 24 had at least one nutrition component and at least one PA component. The most frequently included intervention components were ***Nut. Ed., PA Offered, PA Ed.*** and ***Parent Engagement*** (Table 1). The most commonly paired nutrition and PA components were ***PA Offered + PA Ed.; Nut. Ed. + PA Ed.***, and ***Nut. Ed***. ***+ PA Offered*** (Table 2). On average, interventions had 3.5 components, and the number of components per intervention ranged from one to nine.

Table 1. Number of interventions that included each component

Component	***Nut. Ed.***	***Meal FB***	***FB Outside Meals***	***PA Offered***	***PA Environ.***	***PA Ed.***	***Screen Time***	***Parent Engagement***	***Policy***
Frequency	35	15	11	36	16	27	9	39	12

Table 2. Number of interventions that included each pairwise combination of components

	Nut. Ed.	***Meal FB***	***FB Outside Meals***	***PA Offered***	***PA Environ.***	***PA Ed.***	***Screen Time***	***Parent Engagement***	***Policy***
Nut. Ed.	35	9	11	16	5	18	8	30	6
Meal FB	9	15	10	7	3	8	2	11	5
FB Outside Meals	11	10	11	6	2	7	2	12	6
PA Offered	17	7	6	6	11	24	8	19	3
PA Env.	5	3	2	11	16	8	1	9	2
PA Ed.	16	8	7	24	8	27	6	20	4
Screen Time	8	2	2	8	1	6	9	7	2
Parent Engagement	32	11	12	19	9	20	7	39	10
Policy	6	5	6	3	2	4	2	10	12

All 70 intervention evaluations measured at least one outcome aligned with a CA SNAP-Ed objective; 26 interventions measured at least one outcome aligned with a nutrition state objective, 41 measured at least one outcome aligned with a PA state objective, and 36 measured at least one weight status outcome. The magnitude of effects demonstrated for weight status outcomes are described in Appendix 6. Some outcomes were measured more frequently than others, with the most common being fruits and vegetables (FVs) offered, served or consumed, Moderate to Vigorous Physical Activity (MVPA), Total PA, and BMI (Table 3).

Table 3. Number of interventions that measured each outcome

Outcome[i]	# Interventions that Measured
Any Nutrition	26
Fruits and Vegetables (FV)	20
Added Sugar	9
Meal Quality	4
Snack Quality	6
Energy Intake	7
Any PA	41
Light PA	13
Moderate PA	9
Vigorous PA	16
Moderate-to-Vigorous PA	25
Total PA	27
Any Weight Status[ii]	36
BMI	27
BMI z-score	17
Skinfold Thickness	10
Percent Body Fat	7
Waist Circumference	4
Percent Overweight	2

[i]Nutrition outcomes refer to foods and beverages offered, served or consumed.
[ii]Magnitudes of effects are described in Appendix 6

V. Analytic Results

i. Component Combination Analyses

This section presents the results of analyses conducted to understand if combining different components increased the intervention effectiveness. We synthesized the existing evidence in four broad intervention categories: 1) just PA components, 2) just Nutrition components, 3) PA + Nutrition components. Two interventions incorporated only staff training; these were put into a fourth category: 4) just Staff Training components. (See: Table 4)

A. PA Only interventions

PHYSICAL ACTIVITY INTERVENTIONS IN ECE ARE EFFECTIVE AT INCREASING PA LEVEL A LITTLE MORE THAN HALF THE TIME, AND EFFECTIVE AT IMPROVING BMI ABOUT ONE-THIRD OF THE TIME.

MULTI-COMPONENT PA INTERVENTIONS TEND TO BE MORE CONSISTENTLY EFFECTIVE AT INCREASING PA THAN THOSE USING A SINGLE APPROACH.

Twenty-five ***PA Only*** interventions[8-11, 13-16, 21, 22, 26, 30, 31, 34, 36, 37, 48-50, 54, 59, 60, 64, 66, 70] included changes in the quantity or quality of PA opportunities provided to children during the ECE day, changes in the PA environment, and/or activity-based curriculum to emphasize the importance of PA. Approximately half of the studies found a positive impact in at least one outcome of interest: 23 studies measured PA outcomes[8-11, 13-16, 21, 22, 26, 30, 31, 34, 36, 37, 48, 49, 59, 60, 64, 66, 70] and 13 of them were effective at increasing PA [10, 13-16, 22, 30, 31, 34, 48, 49, 60, 66, 70]. Nine studies of these interventions evaluated BMI outcomes [13, 16, 22, 30, 31, 48, 50, 54, 64, 66] and three found a positive effect[13, 16, 54].

Several ***PA Only*** interventions changed the quality of activities but did not increase the allocated time for the activities[9-11, 22, 30, 31, 36, 37, 48, 50, 59, 66]. For example, some of them changed free outdoor playtime to more structured activities, or promoted locomotor and manipulative skills, such as running, jumping, climbing, kicking, throwing and catching, and dancing, among others[22, 30, 31, 36, 37, 48, 50, 54, 59, 60, 66].

The duration of the interventions varied from a minimum of four weeks[26] to 24 months[64] with an average of seven months. Four interventions included parents, mainly by providing educational flyers[30, 31, 34, 64, 66]; two of them provided more active parent engagement by including a variety of activities such as interactive education seminars and workshops on PA and nutrition, family events, engagement in project management committees, and at-home activities[30, 31, 66].

In most studies, the control group received the standard PA curriculum or program, which varied across studies, but generally consisted in approximately 30 minutes per day of free outdoor playtime or structured activities. It is therefore likely that children were physically active to some degree before the implementation of the intervention.

Findings:

- A bit more than half of the studies (13/23) found that ***PA Only*** interventions were effective at increasing PA.
- One third of the studies (3/9) found that ***PA Only*** interventions were effective at improving BMI.
- Generally, effective ***PA Only*** interventions were implemented over a longer period of time (≥6 months) in comparison to ineffective interventions.
- Around two-thirds of ***PA Only*** interventions (9/12 interventions that reported SES or race/ethnicity) were implemented among low-income populations and/or communities of color. The results of interventions in these communities did not differ from those implemented among other populations.
- ***PA Only*** interventions that included active parent engagement strategies were consistently effective (2/2 interventions) at improving physical activity outcomes.

- Multi-component ***PA Only*** interventions were more consistently effective (9/13 interventions) at increasing PA than those using a single approach (4/12 interventions).
- Interventions that increased the quality and quantity of PA opportunities were more consistently effective (6/8 interventions) at improving PA outcomes than those that increased just the time (1/3 interventions) or just the quality of PA (2/4 interventions).

(1) PA Offered Only

INCREASING BOTH TIME AND QUALITY OF PA OFFERED MIGHT BE MORE EFFECTIVE THAN JUST CHANGING ONE COMPONENT.

Nine ***PA Offered Only*** interventions[8, 10, 11, 21, 22, 49, 54, 59, 66] only included changes in the quantity and/or quality of PA opportunities provided to children during the ECE day, including additional recess time, structured indoor or outdoor activities, games and dancing. Eight studies measured PA outcomes[8, 10, 11, 21, 22, 49, 54, 59, 66] and four of them[10, 22, 49, 66] found positive effects. Three studies analyzed the intervention effect on BMI[22, 54, 66] and one found positive results, but just among girls[54].

Four ***PA Offered Only*** interventions changed the quality of PA opportunities to more structured activities without increasing the allocated time for PA [10, 11, 22, 59]. Two of these four interventions were effective at improving PA outcomes [10, 22].

Three interventions increased only PA quantity by providing 60 minutes of extra recess[8]; enacting a state-level policy requiring 60 minutes of light, moderate and vigorous PA per day[21]; and/or adding a morning walk and afternoon aerobic dance[54]. Two[8, 21] of these three interventions measured PA outcomes; of these two; neither was effective at improving PA outcomes.

Two studies increased both PA quantity and quality and were consistently effective (2/2 interventions) at increasing PA[49, 66]. The majority of ***PA Offered Only*** interventions included 30-60 minutes of daily PA.

The average **duration** of the studies was eight months. Only one intervention included parents and it was effective at improving PA outcomes, but not BMI (66). Five studies[8, 11, 21, 49, 59] were of interventions implemented among low-income communities and/or communities of color and only one found a positive effect[49] on PA outcomes.

Findings:

- One half of the ***PA Offered Only*** interventions (4/8 interventions) were effective at increasing PA.
- One third of ***PA Offered Only*** interventions (1/3 interventions) were effective at improving weight outcomes.
- Increasing both quantity and quality of PA offered may be more effective (2/2 interventions) than changing quantity only (0/2 interventions) or quality only (2/4 interventions) at improving PA outcomes.

- Generally, ***PA Offered Only*** interventions that were implemented over a longer period of time (≥6 months) were more frequently effective (3/5 interventions) at improving PA outcomes than those implemented over a shorter period of time (1/3 interventions).

- ***PA Offered Only*** studies implemented among low-income communities and/or communities of color were not consistently effective, only 1 of 5 interventions improved PA outcomes. However, only 7 of the 9 studies provided information about race/ethnicity or income. The one study implemented among middle- to higher-income white children had a positive outcome.

(2) PA Offered + PA Ed or Environment

IMPROVING AND/OR INCREASING PA OFFERED COUPLED WITH PA EDUCATION OR PA ENVIRONMENT CHANGES MAY HAVE AN ADDITIVE OR SYNERGISTIC POSITIVE EFFECT ON PA.

Thirteen interventions made changes in ***PA Offered*** and a combination of ***PA Ed. and/or PA Env***. changes[9, 13-16, 30, 31, 34, 36, 37, 48, 50, 60, 64, 70]. These ***PA Offered + PA Ed. and/or PA Env.*** interventions included providing structured PA instead of free outdoor playtime or offering activities and games to increase PA time. Some studies integrated PA education into the curriculum or changed the physical environment by enhancing the fixed and portable play structures to engage children in PA.

Fourteen studies of ***PA Offered + PA Ed. and/or PA Env.*** interventions evaluated PA outcomes [9, 13-16, 30, 31, 34, 36, 37, 48, 60, 64, 70] and nine found statistically significant increases[13-16, 30, 31, 34, 48, 60, 70]. Seven ***PA Offered + PA Ed. and/or PA Env.*** studies measured BMI[13, 16, 30, 31, 48, 50, 64] and two found a positive effect[13, 16]. Two interventions involved parents by providing flyers and newsletters[34, 64] (passive engagement), and one[30, 31] included a participatory parent-focused approach (active engagement). Five studies[9, 13, 14, 16, 34] looked at ***PA Offered + PA Ed. and/or PA Env.*** implemented among low-income communities and/or communities of color and four[13, 14, 16, 34] found at least one positive effect. The interventions had an average duration of seven months.

In most studies, the control group received the standard PA curriculum (depending on the study: 30 minutes of unstructured play; structured PA time without receiving PA education; one hour of gym class without receiving parent engagement or environment changes, etc.)

Findings:

- ***PA Offered + PA Ed. and/or PA Env.*** interventions were more consistently effective at improving PA outcomes (9/12 interventions) than ***PA Offered Only*** interventions (4/8 interventions), but were equally effective at improving BMI (2/6 ***PA Offered + PA Ed. and/or PA Env.*** interventions; 1/3 ***PA Offered Only*** interventions).

- ***PA Offered + PA Ed. and/or PA Env.*** interventions were more consistently effective at improving PA outcomes (9/12 interventions) than any other combination of PA components: ***PA Offered Only*** (4/8 interventions) and ***PA Env. Only*** (0/3 interventions).

- Generally, ***PA Offered + PA Ed. and/or PA Env.*** interventions that were implemented over a longer period of time (≥6 months) were less frequently effective at improving PA outcomes, but more frequently effective at improving BMI than those implemented over a shorter period of time.

- ***PA Offered + PA Ed. and/or PA Env.*** interventions implemented among low-income communities and/or communities of color were more consistently effective at improving PA (4/5 interventions) and BMI outcomes (2/2 interventions) compared to those implemented among higher income white children.

(3) PA Environment Only

PROVIDING PLAYGROUND EQUIPMENT OR MARKINGS ALONE MAY NOT BE AN EFFECTIVE WAY OF INCREASING PA.

Three ***PA Env. Only*** interventions[26] involved providing playground equipment and/or playground markings and none of them proved effective. All three interventions were implemented in Flanders and had a duration of less than six months. The evidence suggests that providing playground equipment or markings alone might not be an effective way of increasing PA.

B. Nutrition Only interventions

NUTRITION ONLY INTERVENTIONS ARE EFFECTIVE AT IMPROVING DIETARY INTAKE BUT MAY BE LESS EFFECTIVE AT IMPROVING WEIGHT OUTCOMES.

Twenty-one studies evaluated the impact of interventions including nutrition components only[17, 18, 20, 29, 32, 43, 45-47, 52, 51, 61-63, 65, 68, 69, 71-74]. ***Nutrition Only*** strategies included 1) ***Nut. Ed.***, 2) ***Nut. Ed + FB***, and 3) ***FB Only***.

Fourteen of the 21 studies[18, 32, 43, 45-47, 52, 61-63, 65, 68, 69, 71, 72, 74] found a positive impact in at least one outcome of interest (dietary intake or weight). Fifteen studies measured dietary outcomes[18, 20, 32, 43, 45-47, 52, 51, 65, 68, 69, 71, 72, 74] and 13 studies showed improved dietary intake[18, 32, 43, 45-47, 52, 65, 68, 69, 71, 72, 74]. One limitation was the lack of consistency in how dietary outcomes were measured across studies. Three[61-63] of the seven studies that measured weight outcomes[17, 29, 32, 61-63, 73] found a positive effect, although these three studies were of one intervention. Furthermore, significant positive effects were only seen for the 3-year follow-up subscapular skinfold z-score but not for BMI, waist circumference, or subscapular skinfold z-scores taken at 2-year and 1-year follow-up.

The duration of ***Nutrition Only*** interventions ranged from five weeks[68] to three school years[61-63], with an average of seven months. Eight interventions provided active parent engagement strategies such as nutrition education sessions with take-home materials and activities for parents to do with children, recipes, meetings, and focus groups[18, 32, 46, 51, 71-74]. Eight interventions were implemented in low-income communities or in ECE sites with a high proportion of children of color[18, 20, 32, 45, 51, 72, 73, 74].

Findings:

- Most of the studies (13/15) found that ***Nutrition Only*** interventions were effective at improving at least one aspect of dietary intake.
- Less than half (3/7) of the studies found that ***Nutrition Only*** interventions were effective at improving at least one weight-related outcome.
- Interventions with active parent engagement strategies were consistently effective (6/7 interventions) at improving dietary intake.

- Interventions that were implemented over a longer period of time (≥6 months) were nearly as consistently effective (5/7 interventions) at improving dietary outcomes as those implemented over a shorter period of time (8/10 interventions).
- The only ***Nutrition Only*** intervention that measured BMI had a duration of ≥6 months and was not associated with any significant positive effect.
- Interventions among low-income children and/or children of color were slightly less effective at improving dietary outcomes (4/6 interventions) compared to those implemented among higher income and/or white children (6/7 interventions).

(4) Nutrition Education Only

NUTRITION EDUCATION ONLY INTERVENTIONS ARE CONSISTENTLY EFFECTIVE AT IMPROVING DIETARY INTAKE AMONG MIDDLE TO HIGH INCOME CHILDREN IN THE SHORT TERM BUT HAVE NOT PROVEN EFFECTIVE AT IMPROVING WEIGHT OUTCOMES. IMPACT ON LOW INCOME CHILDREN AND/OR CHILDREN OF COLOR HAS NOT BEEN ADEQUATELY STUDIED.

Nine interventions (examined in 11 studies) focused on nutrition education only[17, 29, 43, 46, 61-63, 65, 68, 69, 74]. ***Nut. Ed. Only*** interventions generally entailed teachers or trained professionals delivering an activity-based curriculum to children in designated, regularly occurring time sessions (i.e., lessons). Teachers or other trained professionals covered topics such as food groups, the human body and digestion, nutrients, and the importance of healthy eating and active living. Six [43, 46, 65, 68, 69, 74] of 11 ***Nut. Ed. Only*** studies measured nutrition outcomes and all six found a combination of positive and null outcomes. However, nutrition outcomes were measured differently across studies. The remaining five ***Nut. Ed. Only*** studies (of 11 total), representing three interventions, only measured weight outcomes[17, 29, 61, 62, 63]. Of those five, three studies[61, 62, 63], all of the same intervention, found positive weight outcomes.

Nut. Ed. Only interventions had an average duration of five months. Two interventions had active parent engagement[46, 74].

Four out of 6 ***Nut. Ed. Only*** interventions that reported participants' income level were implemented in middle- to high-income communities[43, 65, 68, 69]. Only one of the nine interventions that provided ***Nut. Ed. Only*** was implemented in a low-income community that also had diverse racial composition[74]. This intervention also included active parent engagement consisting of six modules of 30-60 minute weekly lessons with take-home materials and activities for parents to do with children. Parents reported a significant increase in vegetables consumed at home and in use of low-fat milk at home. No change was reported in fruit consumption or number of days that the child requested a fruit or vegetable as a snack.

Findings:

- ***Nut. Ed. Only*** interventions are consistently effective at improving dietary outcomes in middle- to high-income children (6/6 interventions) and weight outcomes (1/1 intervention).
- Only one ***Nut. Ed. Only*** study reported including low-income participants. The intervention was effective at improving some dietary outcomes (described above), but the study did not measure weight-related outcomes.

- Most ***Nut. Ed. Only*** interventions that measured dietary outcomes had a duration of less than six months; only 1 had a duration of ≥6 months. All interventions were effective at improving some dietary outcomes regardless of intervention length.

(5) Nutrition Education + FB Changes

COMBINING FB CHANGES WITH NUTRITION EDUCATION IS EFFECTIVE A LITTLE MORE THAN HALF THE TIME AMONG LOW- INCOME, ETHNICALLY/RACIALLY DIVERSE CHILDREN BUT HAS NOT PROVEN EFFECTIVE AT IMPROVING WEIGHT OUTCOMES.

Seven interventions[18, 20, 32, 51, 71-73] focused mainly on food and beverage modification to improve meal healthfulness. These interventions also encouraged nutrition in the school curriculum through classes and activities such as games, crafts, tales, songs, working in the garden, and taste tests, among others. Nutrition classes covered topics such as food types, food preparation, eating cultures, food variety and healthy behaviors. Four interventions included wellness-related policies governing foods and beverages provided by the ECE sites[18, 20, 51, 71].

Four[18, 32, 71, 72] of the six studies[18, 20, 32, 51, 71, 72] that measured nutrition outcomes of ***Nut. Ed.+ FB*** interventions found a positive effect for at least one outcome. Two interventions that measured BMI found a null effect[32, 73]. Two out of the four interventions mentioned above that included wellness-related policies were effective: one in modifying policies and practices and providing healthier food and beverage offerings (foods consistent with Dietary Guidelines for Americans; water and plain milk)[18]; and the second in increasing fresh fruit consumption[71].

The majority of ***Nut. Ed.+ FB*** (4/7 interventions) interventions were implemented in low-income communities[18, 51, 72, 73]. Included studies were heterogeneous in the intervention components and outcomes measured. The majority of ***Nut. Ed. + FB*** interventions (4/7) were effective for at least one outcome[18, 32, 71, 72], particularly in increasing fruit consumption[18, 32, 71]. However, these studies[18, 32, 71, 72] on ***Nut. Ed.+ FB*** interventions all found a combination of positive and null dietary outcomes. Only one study found positive results in eight out of nine diet measurements including fruit and vegetable consumption[18]. The intervention studied had a strong focus on training the staff that helped to implement a FB policy to provide only non-sweetened drinks and foods. Compared with ***Nut. Ed.*** interventions, ***Nut. Ed. + FB*** interventions had a longer duration- all lasted six months or more, with an average of one year.

Findings

- Two-thirds of the studies (4/6), most of which include low-income participants, found that ***Nut. Ed. + FB*** interventions were effective at improving at least one dietary outcome.
- Neither of 2 studies found that ***Nut. Ed. + FB*** was effective at improving BMI.
- Interventions with active parent engagement were consistently effective (2/2 interventions) at improving dietary outcomes.
- Interventions that had a strong staff training component were more frequently effective at improving dietary outcomes (3/4 interventions) than those that did not have a strong staff training component (1/2 interventions).

- Effective interventions with nutrition-related policies offered support to implement the policy, monitored the adoption of the policy components and provided performance feedback to the ECE sites.

(6) FB Only (meal and/or non-meal FB)

A LIMITED NUMBER OF STUDIES INDICATE THAT MAKING SMALL CHANGES IN FEEDING PRACTICES OR PORTION SIZE WAS EFFECTIVE A LITTLE MORE THAN HALF THE TIME. MORE STUDIES ARE NEEDED THAT EVALUATE MORE SUBSTANTIVE CHANGES IN FEEDING PRACTICES AND FOODS AND BEVERAGES OFFERED.

Five interventions[45, 47, 52] provided small changes in food service style (i.e. family style vs. provider-portioned lunch service style, timing of meal components)[45, 47] or changes in portion size[47, 52]. Three out of five interventions in this category found a positive effect on at least one nutrition outcome[45, 47, 52]. The duration of ***FB Only*** interventions ranged from two weeks to six weeks. None of the ***FB Only*** interventions included parents. Two interventions[45] were implemented in a predominantly African American community and only one was effective for increasing fruit intake. This intervention provided fruits and vegetables before serving other items via family style during lunch.

C. Nutrition + PA interventions

ECE INTERVENTIONS ARE MOST CONSISTENTLY EFFECTIVE AT IMPROVING BMI WHEN THEY INCLUDE BOTH PA AND NUTRITION.

ECE INTERVENTIONS THAT INCLUDE NUTRITION AND PA COMPONENTS TEND TO BE LESS EFFECTIVE AT IMPROVING DIETARY INTAKE THAN THOSE THAT FOCUS ONLY ON NUTRITION, AND LESS EFFECTIVE AT IMPROVING PA OUTCOMES THAN THOSE THAT FOCUS ONLY ON PA.

Twenty-six studies[5-7, 12, 19, 23-25, 27, 28, 33, 35, 38-41, 53, 55-58, 67, 75-78] evaluated the effect of 22 interventions that provided a combination of ***Nutrition + PA*** interventions. Nutrition-focused intervention components included nutrition education and food and beverage changes. Intervention components to improve PA included increasing time allocated to PA, providing structured physical activity lessons, integrating the importance of PA into the curriculum (***PA Ed.***) and changing the PA environment (***PA Env.***). Over two-thirds (19/26) of these studies reported at least one positive weight, dietary, and/or PA outcome of interest[5-7, 12, 23-25, 27, 33, 35, 38, 40, 55-57, 67, 76-78]. Of the 19 that measured a weight outcome, 10 (53%) were effective, suggesting that these types of interventions are more consistently effective at improving BMI than providing PA or nutrition alone.

The duration of these types of interventions varied from a minimum of six weeks[76] to two years[33] with an average of 11 months. Most of the interventions had some kind of parental involvement[5-7, 12, 19, 23-25, 27, 28, 33, 38-41, 53, 55-58, 67, 75-78], and many interventions provided active parent engagement strategies such as interactive education seminars and workshops on PA and nutrition, family events, engagement in project management committees, cooking classes and at-home activities[5-7, 12, 24, 25, 27, 28, 33, 41, 53, 55-58, 67, 75, 77, 78].

With regard to PA, five of the interventions increased only the allocated time assigned to PA[38, 39, 40, 41, 78], two interventions increased only quality[33, 75], and seven increased both quantity and quality of PA[19, 24, 25, 27, 28, 35, 53,77]. In terms of nutrition, the majority of the interventions (19/22) provided nutrition education[5-

[7, 12, 19, 23-25, 27, 28, 35, 38-41, 53, 55-57, 67, 75-77]. Nine interventions [5-7, 12, 27, 28, 33, 53, 55-58, 78] provided improvement to FB offered. The control group in most of these interventions received the usual nutrition and PA supports and activities.

Findings

- Compared with interventions that focus only on nutrition, ***Nutrition + PA*** interventions were less consistently effective (5/10 interventions) at improving dietary intake.

- Compared with interventions that focus only on nutrition or only PA, ***Nutrition + PA*** interventions were more frequently effective (10/17 interventions) at improving BMI.

- ***Nutrition + PA*** interventions with active parent engagement strategies were not more frequently effective (9/14 interventions) at improving any outcome compared to those that provided passive parent engagement (4/5 interventions) or no parent engagement at all (2/2 interventions).

- Interventions that increased both quantity and quality of PA offered were more frequently effective at improving PA outcomes (4/5 interventions), compared to interventions that increased only quantity of PA (1/4 interventions) or just the quality of PA offered (0/2 interventions.

- Generally, ***Nutrition + PA*** interventions that were implemented over a longer period of time (≥6 months) were more frequently effective at improving BMI (6/10 interventions) than those implemented over a shorter period of time (4/9 interventions).

- Fourteen ***Nutrition + PA*** interventions were implemented among low-income populations and/or ethnic/racial minorities. Interventions implemented in these communities were equally effective at improving PA outcomes (4/12 interventions), but less consistently effective at improving nutrition (3/8 interventions) and BMI outcomes (6/13 interventions) compared to those implemented among higher income white children.

(7) Nutrition Education + PA Education

INTERVENTIONS THAT COMBINE NUTRITION AND PA EDUCATION APPEAR PROMISING WITH REGARD TO WEIGHT OUTCOMES AND NUTRITION OUTCOMES, BUT TOO FEW STUDIES HAVE BEEN CONDUCTED TO ARRIVE AT A DEFINITIVE CONCLUSION, ESPECIALLY FOR LOW-INCOME CHILDREN.

Three studies of three interventions investigated the impacts of integrating nutrition education and physical activity education into the curriculum via interactive lessons, games and/or books to teach children about healthful eating and PA[23, 67, 76]. All three studies reported a positive effect on at least one outcome of interest. One study measured PA and found a significant positive impact[23]. Two studies that measured a weight status outcome found a combination of positive [67] and null[23] results. Positive results included decreases in skinfold thickness, % body fat, fat mass index and fat-free mass index, both among obese and normal weight children[67].

The average duration of the interventions was 6.5 months with a minimum of six weeks[76] and a maximum of 12 months[67]. One intervention included active parent engagement that included

workshops for parents on nutrition and physical activity[67]. This intervention was also conducted among low-income children and was effective[67].

Overall, there are too few studies in this category to analyze what, if any, element increased the effectiveness of nutrition and PA education.

(8) Nutrition Education + PA Education+ PA Offered

ALTHOUGH NUT. ED. + PA ED. + PA OFFERED STRATEGIES WAS THE MOST COMMON COMBINATION OFFERED, THE INTERVENTIONS WERE LESS EFFECTIVE FOR WEIGHT AND NUTRITION OUTCOMES AND MORE EFFECTIVE FOR PA OUTCOMES THAN OTHER COMBINATIONS.

Ten interventions integrated nutrition education and PA education into the curriculum and changed the quantity or quality of PA opportunities provided to children during the ECE day[19, 24, 25, 35, 38, 39, 40, 41, 75, 77]. Nutrition education and PA education generally entailed teachers or trained professionals delivering activity-based curriculum that addressed the importance of healthy eating and PA through games and interactive activities. Four interventions modified the quality by providing structured PA[19, 41, 77], and six increased both the time and the quality of PA offered[24, 25, 35, 38, 39, 40, 75].

Five of ten interventions were effective[24, 25, 35, 40, 77] at improving PA outcomes and four were effective at improving BMI[24, 25, 35, 38, 77]. Of the five studies that measured nutrition outcomes[24, 25, 40, 41, 77] and only two interventions had a significant impact[24, 25, 77].

The average duration of these types of interventions was five months, and varied from a minimum of 14 weeks to 11 months. Eight interventions included parents[24, 25, 19, 38, 39, 40, 41, 75, 77], but only four had active parent engagement strategies including nutrition and PA educational sessions and take-home activities[24, 25, 41, 75, 77]. Of these interventions that included active parent engagement: the same two interventions were found to be effective at improving weight outcomes, dietary outcomes, and PA outcomes [24, 25, 77]. It is important to note that one of these references[77] included two slightly different interventions; the intervention found to be effective on improving these three outcome categories was a combined child care center- family home approach. The child care center-only intervention did not show any statistically significant improvements in BMI z-score, whereas the combined center- family home approach did[77].

Nine of these ten interventions were implemented in low-income and/or communities of color [19, 24, 25, 38, 39, 40, 41, 75, 77]. All studies on these nine interventions measured weight outcomes, and three interventions were effective [24, 25, 38, 77]. Similarly, all of these studies measured PA outcomes, and four interventions were effective [24, 25, 40, 77]. Several studies measured dietary outcomes [24, 25, 40, 41, 77], and two interventions were found to be effective [24, 25, 77].

These findings confirm the findings from other interventions with a combination approach: nutrition education without food and beverage changes is not consistently effective at improving dietary outcomes among low-income populations and/or populations of color; combining nutrition and PA is more effective at improving body weight than either alone; and an exclusive focus on PA is more effective at improving PA than a more comprehensive nutrition and PA approach.

Findings:

- Compared with nutrition-only interventions, interventions that provided ***Nut. Ed. + PA Ed. + PA Offered*** were less effective (2/5 interventions) at improving dietary intake, but more effective (4/10 interventions) at improving weight outcomes.
- Compared with all other ***PA + Nut.*** interventions, ***Nut. Ed. + PA Ed.+ PA Offered*** interventions were similarly effective (2/4 interventions) at improving nutrition outcomes, more effective at improving PA outcomes (5/10 interventions) and less effective (4/10 interventions) at improving weight outcomes.
- ***Nut. Ed. + PA Ed.+ PA Offered*** interventions with active parent engagement (compared to no active parent engagement) were more effective at improving dietary outcomes and PA outcomes (2/3 interventions in each case); and a bit more effective at improving weight outcomes (2/4 interventions).
- Since only two of ten ***Nut. Ed. + PA Ed.+ PA Offered*** interventions lasted more than six months it is not possible to arrive at conclusions regarding intervention duration FB changes + PA offered + PA education, PA environment and/or Nut Ed
- Given that 9 of 10 studies were conducted with low-income and/or communities of color, these results are applicable to those populations.

(9) FB Changes + PA Offered + PA Ed or Environment ± Nutrition Education

FB CHANGES + PA OFFERED + PA ED./ENV. AND/OR NUT. ED. INTERVENTIONS ARE MORE CONSISTENTLY EFFECTIVE AT IMPROVING WEIGHT THAN THE MAJORITY OF OTHER INTERVENTION COMBINATIONS.

Nine interventions provided changes in food and beverages, offered physical activity and a combination of PA/ Nutrition education and/or PA environment changes[5-7, 12, 27, 28, 33, 53, 55-58, 78]. Foods and beverages in these interventions were modified by improving preparation and serving, providing healthier beverages, snacks and meals, and/or increasing water access. Two interventions modified PA quality/environment by providing games-based fine motor skills development, improving the playground environment[5-7, 33] and implementing health-focused PE[33], and four increased both the time and the quality of PA offered[27, 28, 53, 78]. Four interventions included curriculum-based nutrition education with activities such as taste tests, healthy cooking classes or puppet shows[5-7, 28, 53, 55-57].

Six out of nine interventions were effective for at least one outcome of interest[5-7, 12, 27, 33, 55-57, 78]. Six[5-7, 55-57] of the nine studies[5, 6, 7, 12, 33, 53, 55, 56, 57] that measured nutrition outcomes for this group of interventions found positive outcomes, although these six studies looked at two interventions only. Only one [27, 58] out of five interventions (7 studies)[5, 6, 7, 12, 27, 33, 58] that measured PA found positive effects. However, five[5-7, 12, 33, 55-57, 78] out of seven interventions (9 of 11 studies) that measured weight outcomes[5-7, 12, 28, 33, 55-58, 78] found a positive effect. In these nine studies of five interventions, all participants were low-income and/or people of color.

The duration of these types of interventions varied from a minimum of six months[58] to two years[33], with an average of 14 months. All interventions had active parent engagement. Most interventions in this group (seven) had a strong training component for child care providers and other staff[5-7, 12, 28, 53, 55-57, 58, 78]. Researchers maintained regular contact with the staff and provided technical assistance and monitoring to ensure implementation.

Eight interventions[5-7,12, 27, 28, 33, 53, 55-58] were implemented in ECE sites serving predominantly low-income children and/or children of color, and five were effective for any outcome of interest[5-7,12, 27, 33, 55-57]. Of

the eight interventions; 4/6 interventions were effective at improving weight outcomes [5, 6, 7, 12, 33, 55, 56, 57], 2/5 interventions were effective at improving dietary outcomes[5, 6, 7, 55, 56, 57], and only 1/5 of interventions was effective at improving PA outcomes [27].

Findings:

- These interventions were more frequently effective at improving weight outcomes (5/7 interventions) than the majority of other interventions.
- These interventions were less frequently effective at improving PA outcomes (1/5 interventions) than ***PA Only*** interventions.
- These interventions were less frequently effective at improving nutrition outcomes (2/5 interventions) than ***Nutrition Only*** interventions.
- Of interventions that measured weight outcomes, interventions that included wellness-related policies[5-7, 12, 33, 55-58] were slightly more effective (4/5 interventions) at improving weight outcomes than those without any wellness-related policy that measured weight outcomes[28, 78] (1/2 interventions).
- Only one of nine interventions lasted less than six months; it was shown to be effective at improving both outcome categories measured (weight and dietary); PA outcomes were not measured.
- Of the eight interventions in this category that included low-income children and/or children of color: 4/6 interventions were effective at improving weight outcomes, 2/5 interventions were effective at improving dietary outcomes, and only 1/5 of interventions was effective at improving PA outcomes.
- Since all interventions included active parent engagement and most had a strong training component, no conclusions can be drawn about their contribution to the outcomes.

D. Parent Engagement

INTERVENTIONS WITH ACTIVE PARENT ENGAGEMENT WERE ONLY A BIT MORE FREQUENTLY EFFECTIVE THAN THOSE WITH PASSIVE PARENT ENGAGEMENT.

Twenty-five interventions with active parent engagement[5-7, 12, 18, 24, 25, 27, 28, 30-33, 41, 46, 51, 53, 55-58, 67, 71-73, 75, 77, 78], defined as including in-person educational sessions or meetings, were only slightly more frequently effective at improving least one of the outcomes of interest than those that had only passive parent engagement[17, 19, 23, 34, 29, 38, 39, 40, 61, 62, 63, 64, 65, 68, 69, 74, 76], defined as exposure to print-based educational materials. The proportion of effective interventions using active methods of parent engagement was 72% (18/25) versus 67% (9/15) for those employing passive intervention strategies.

Table 4. Proportion of Effective Interventions by Component Combinations

Number of effective interventions/number interventions that measured a given outcome (percent)

Category	Total number of interventions	Effective for any outcome	Effective for weight outcome	Effective for nutrition outcome	Effective for PA outcome
PA Only components	**25**	**14/25 (56%)**	**3/9 (33%)**	N/A	**13/23 (57%)**
PA Offered Only	9	5/9 (56%)	1/3 (33%)	N/A	4/8 (50%)
PA Offered + PA Ed./Env.	13	9/13 (69%)	2/7 (33%)	N/A	9/12 (75%)
PA Env. Only	3	0/3 (0%)	N/A	N/A	0/3 (0%)
Nutrition Only components	**21**	**14/21 (67%)**	**1/5 (20%)**	**13/17 (76%)**	N/A
Nut. Ed. Only	9	5/9 (78%)	1/3 (33%)	6/6 (100%)	N/A
Nut. Ed. + FB	7	4/7 (57%)	0/2 (0%)	4/6 (67%)	N/A
FB Only	5	3/5 (60%)	N/A	3/5 (60%)	N/A
PA + Nutrition	**22**	**15/22 (68%)**	**10/19 (53%)**	**5/10 (50%)**	**7/16 (44%)**
Nut. Ed.+ PA Ed.	3	3/3 (100%)	1/2 (50%)	1/1 (100%)	1/1 (100%)
Nut. Ed. + PA Ed.+ PA Offered	10	6/10 (60%)	4/10 (40%)	2/4 (50%)	5/10 (50%)
FB + PA Offered +/- PA Ed./Env.+/- Nut. Ed.	9	6/9 (67%)	5/7 (71%)	2/5 (40%)	1/5 (20%)
Only staff training	**2**	**2/2 (100%)**	**1/1 (100%)**	**1/1 (100%)**	**1/1 (100%)**
TOTAL	**70**	**45/70 (64%)**	**15/34 (44%)**	**19/28 (68%)**	**21/40 (53%)**

Interpretation example: Of the 25 interventions with PA Only components, 14 of the 25 interventions (56%) were effective for any outcome (weight, dietary/nutrition, PA).

PA Offered Only: Change in the quantity or quality of PA offered; no changes in PA environment and/or education delivered

PA Offered + PA Ed. and/or PA Env.: Change in the quantity or quality of PA offered, changes in PA environment and/or education delivered

PA Env. Only: Change only in PA environment

Nut. Ed. Only: Intervention offered only nutrition education; no changes in PA (offered, env. and/or ed.) or FB changes
Nut. Ed + FB: Intervention offered nutrition education and FB changes; no changes in PA (offered, env. and/or ed.)
FB Only: Modification of FB offered; no changes in PA (offered, env. and/or ed.) or nutrition education
Nut. Ed. + PA Ed.: Change in nutrition education and PA education delivered
Nut. Ed. + PA Ed. + PA Offered: Change in nutrition education and PA education delivered, and change in quality or quantity of PA offered
FB + PA offered +/- PA Ed./Env.+/-Nut. Ed.: Modification of FB, change in quality or quantity of PA offered, and/or PA education/environment and/or nutrition education
Staff Training: Interventions that only included staff training
** For more detail on definitions, please see* ***Appendix 4: Definitions of Intervention Components (p. 61)***

N/A= not applicable
Note: denominators may change, since not all interventions measured the different outcomes.

ii. Additional Analyses

This section presents the results of analyses conducted to further understand why some interventions reported effectiveness while others did not. We describe findings for which there is ample (≥20 interventions) or sufficient (ten to 19 interventions) evidence available in the literature. Instances where evidence was limited (one-ten) interventions) are noted.

E. Number of intervention components

INTERVENTIONS WITH THREE TO FIVE COMPONENTS WERE MOST FREQUENTLY EFFECTIVE FOR NUTRITION AND PA OUTCOMES. INTERVENTIONS WITH MORE THAN OR EQUAL TO SIX COMPONENTS WERE MOST FREQUENTLY EFFECTIVE FOR WEIGHT STATUS OUTCOMES.

We examined whether there was a difference in the number of components as described in Table 2 (i.e. ***Nut. Ed., Meal FB, FB Outside Meals, PA Offered, PA Env., PA Ed.***, ***Screen Time, Parent Engagement,*** and ***Policy***) included in effective relative to null interventions, for any state objective and for each of the three main outcome categories (PA, nutrition, and weight-related). The number of components was categorized as follows (Table 5):

- Few: ≤2 components
- Moderate: 3-5 components
- Many: ≥6 components

Findings:

- With regard to nutrition and PA outcomes, interventions with a moderate number of components were the most consistently effective.

- With regard to weight outcomes, interventions with the most components were the most effective.

- However, given the lack of linearity and the unequal number of interventions in each category, it appears the number of components alone may not have a consistent influence on intervention outcomes.

Table 5. Proportion of effective interventions by number of intervention components

Number of effective interventions/number interventions that measured a given outcome (percent)

Component count category (n=# Intx)	Effective for **any state objectives**	Effective for **nutrition** outcomes	Effective for **PA outcomes**	Effective for **weight** outcomes
Few (n=23 Intx)	12/23 (52%)	5/8 (63%)	6/12 (50%)	4/8 (50%)
Moderate (n=33 Intx)	24/33 (72%)	8/10 (80%)	11/20 (55%)	6/18 (33%)
Many (n=12 Intx)	8/12 (67%)	3/6 (50%)	3/8 (38%)	6/10 (60%)
Interpretation example: Of the eight interventions with few components, five of the eight (63%) that targeted nutrition outcomes were effective.				

F. Outcome measured and targeted

Interventions that measured fruit and vegetable outcomes were the most common and the most consistently effective; 65% of these studies demonstrated an improvement (Table 6). The impact of the interventions on other foods was less frequently studied and was less consistently effective (improvements occurred in 50% or fewer of the studies).

Table 6. Proportion of interventions that were effective by type of nutrition outcome

Outcome	**Number of effective/number of measured a given outcome (%)**
Fruits and Vegetables	12/19 (63%)
Added Sugar	2/8 (25%)
Meal Quality	2/4 (50%)
Snack Quality	3/6 (50%)
Energy Intake	2/7 (28%)
Interpretation example*: Of the 19 interventions that measured fruits and vegetables offered or consumed, 12 (63%) were effective.*	

Interventions tended to be less effective at improving BMI-related outcomes and most frequently effective at improving measures of body fat (Table 7).

Table 7. Proportion of interventions that were effective by type of weight status outcome measure

Outcome	Number of effective interventions/number of interventions that measure a given outcome (%)
BMI	6/21 (29%)
BMI z-score	5/13 (28%)
Skinfold	4/12 (33%)
% Body Fat	5/9 (56%)
Waist Circumference	1/5 (20%)
Overweight prevalence	0/2
Interpretation example: Of the 21 interventions that measured BMI, six were effective (29%).	

Interventions that targeted a given outcome, much more frequently impacted that outcome than those that did not target that outcome (Table 8). Interventions that targeted nutrition outcomes were more than twice as likely to improve dietary intake, interventions that targeted PA outcomes were about 70% more likely to impact PA, and interventions that targeted weight outcomes were over seven times more likely to improve body weight. Conscious targeting of outcomes appears to be a critical aspect of successful interventions, especially those targeting weight outcomes.

Table 8. Proportion of effective interventions by whether or not the outcome was a target of the intervention

	Number of effective interventions/ number interventions that targeted (or not) the outcome measured (%)		
	Nutrition outcomes	**PA outcomes**	**Weight outcomes**
Targeted	15/20 (75%)	18/33 (55%)	13/22 (59%)
Didn't target	1/3 (33%)	2/6 (33%)	1/12 (8%)
Interpretation example: *Of the 20 interventions that targeted nutrition outcomes, 15(75%) were effective at improving a nutrition outcome.*			

G. Time period for outcome measure and duration of intervention

Interventions tended to be most effective when they measured PA or dietary intake over a shorter time period (e.g. PA during recess or dietary intake during one meal) (Table 9). This effect was more pronounced with regard to PA. This suggests that PA interventions are more likely to have an impact over a short time period, and it may be more challenging to have an impact on overall PA levels. It may therefore be important to measure impact on PA throughout the day to ensure that the additional PA is adding to total daily PA and not just replacing other PA. For dietary intake, the interaction of time and effect was less consistent and therefore inconclusive.

Table 9. Proportion of effective interventions by time period for outcome measured

Number of effective interventions/number interventions that measured a given outcome (percent)

Measure		Total day	During ECE day	During recess/play period or meal
# Effective	PA	8/20 (40%)	7/14(50%)	6/10 (60%)
	Dietary intake	5/8 (63%)	7/13(54%)	10/14 (67%)
Interpretation example: Of the 8 interventions that measured dietary intake for a whole day, 5 (63%) were effective at improving a targeted outcome.				

*Of note, none of the intervention evaluations in this table accounted for foods and beverages brought from home. Most of the interventions that were effective for weight outcomes had a duration of six months or more suggesting that to impact weight outcomes an intervention should last for at least 6 months.

Conclusions and Recommendations

To date, the published evaluations of ECE interventions to prevent obesity and promote nutrition and physical activity among young children suggest elements that show promise for achieving these goals. The evidence base is incomplete and is evolving, with more attention now being paid to interventions for young children. The following conclusions and recommendations drawn from the current literature should be reviewed as the body of published evaluations increases, particularly of interventions directed at low-income groups, FB interventions, and interventions aiming to change BMI.

The bullet lists below describe what we discerned from the literature are the critical elements of ECE interventions for the promotion of healthy eating, active living and healthy weight. All of the recommendations are likely applicable to SNAP-Ed work since many of the studies include low-income populations. No recommendations are based on studies conducted solely among higher income groups. The recommendations support the current SNAP-Ed approach in California which advises the combination of education and policy, systems and environmental change (PSE). In the ECE setting, comprehensive approaches that include the elements outlined below are the most likely to produce measurable outcomes targeted by SNAP-Ed in California.

- Interventions that target ***PA Only*** are the most consistently effective at increasing PA; interventions that target only nutrition are the most consistently effective at improving dietary intake, and interventions that address both nutrition and PA are the most consistently effective at improving body weight. Although neither ***PA Only*** nor ***Nutrition Only*** interventions consistently impacted weight related outcomes, ***PA Only*** interventions appeared to be slightly more effective than nutrition only interventions. While the studies did not explore the reason for this difference, it may be related to the healthfulness of ECE site offerings resulting in less room for improvement for nutrition compared to physical activity. Deliberate targeting of an outcome appears to increase the probability of achieving that outcome. For example, interventions that targeted healthy weight were much more likely to improve body weight than those that did not.

Recommendations:

- If improvement in body weight is a primary objective, interventions should be consciously designed to address body weight and should include both PA and nutrition components.
- If increases in PA are desired, focusing exclusively on PA is likely to be the most effective.
- If improvements in dietary intake are desired, focusing exclusively on nutrition is likely to be the most effective.

- **To increase PA**, interventions should include:
  - Comprehensive parent engagement that includes a variety of activities, such as interactive education seminars and workshops on PA and nutrition, family events, engagement in project management committees, and at-home activities.
  - Multiple strategies, such as PA education, PA environment changes, improved quality of PA offered, and increased quantity of PA offered.
  - Increases in both quantity of PA and improvements in quality of PA offered.
- **To improve dietary intake**, interventions should include:
  - Both nutrition education and changes to FB offered
    - Nutrition education alone has not been shown to be effective with low-income populations and/or populations of color.
    - Limited changes to FB offered (in the absence of education or more comprehensive food and beverage changes) is not a consistently effective strategy; more substantial changes to FB offered and targeted education may be required to achieve effects
  - A robust nutrition education component
  - Active parent engagement (defined as including in-person educational sessions or meetings, as opposed to passive engagement, defined as exposure to print-based educational materials)
  - Policy approaches that include support for policy implementation, monitoring of performance and provision of feedback
  - A strong staff training component
- **To improve body weight** (especially among low-income populations and/or populations of color) interventions should include:
    - Both nutrition and PA components

- An increase both in time and quality of PA offered
- Changes to FB offered
- Improvements in PA offered plus some combination of PA education, PA environment changes and/or nutrition education
- Comprehensive parent engagement
- Sufficient duration (at least six months); longer tends to be better
- Wellness policies to support changes

- **Duration:** Generally, interventions that were implemented over a longer period of time (≥6 months) were more frequently effective at improving any outcome than those implemented over a shorter period of time. Duration seems to be particularly important at improving weight outcomes.

- **Staff training**: Having a strong focus on staff training was an important element when implementing nutrition interventions, particularly food and beverage modifications. This includes providing training, support, and feedback to teachers and other staff.
- **Strong parent engagement**: Strong parent engagement is an important component for most intervention categories. Generally, interventions with active parent engagement, defined as including in-person educational sessions or meetings and take-home activities, were more frequently effective than those that had only passive parent engagement, defined as exposure to print-based educational materials. Strong parent engagement is particularly important when implementing **nutrition** interventions.

Additional conclusions

- Improving both the quantity and the quality of PA is generally more effective than modifying just one component.
- Providing playground equipment or other changes in the PA environment without modifying PA offered might not be an effective strategy to improve PA.
- Studies among low-income communities and/or communities of color (compared to white or higher-income communities) were less often conducted and less consistently effective at improving outcomes of interest, particularly PA.
- When implementing multi-component nutrition and PA interventions, providing strong training for teachers, child care providers and other staff, as well as technical assistance and monitoring, are important elements in promoting the effectiveness of the interventions.
- Even when nutrition and/or PA education interventions are effective at improving dietary outcomes among middle- and high-income children, they have proven less effective among low-income children. This may indicate that either nutrition education in general is less effective among low-income children or that further tailoring of interventions for these population groups is needed. The scope of this review does not provide sufficient information to discern the types of modification to education programs that would be needed to improve effectiveness among low-income populations.

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Appendices

Appendix 1. Study and Intervention Summaries

Note: Some interventions were examined by multiple studies; other single papers look at several intervention combinations. **Each row in the following table always corresponds to one intervention, but may correspond to one or more studies. All applicable studies are listed in the first column**.

First Author et al., Year Study Design Intervention Focus Setting	Sample Characteristics	Intervention Description	Outcomes Measured Results (effect size)
Adams et al., 2009 Zask et al., 2012a Barnett et al., 2015 **Study Design:** cluster RCT **Intx Category:** Nut+PA **Setting:** Center, preschools n=31 (18 intx, 13 ctrl) in Australia	**Age:** 3-6y **Size:** 560 children with 1005 records total (10months): **# energy dense nutrient poor items in lunchbox:** n=966 records (641 intx, 325 ctrl) (10 months) **BMI z-score:** n=936 records (621 intx, 315 ctrl) (10 months) **Mean WC:** n=470 records (263 intx, 207 ctrl) (10 months) **BMI, WC, MVPA:** n=111 children (61 intx, 50 ctrl) (3 years) **Race/ethnicity:** NR **SES:** NR	**Intx Name:** Tooty Fruity Vegie **Intx Description:** ***Nutrition Education:*** health professional visit (each term) - new food introduction - taste test, healthy cooking class, grow FV in gardens/pots ***Meal FB:*** policy that identified appropriate/inappropriate foods for lunchboxes, water access policy ***FB Outside Meals:*** water access policy ***PA Education:*** games-based FMS development ('Fun Moves') (2 terms of 10 sessions - each session 2x/week & each term 2x/year) ***PA environment:*** playground env review and alterations, small grants for sports equipment ***Parent Engagement:*** skills development, awareness-raising, social support, engagement in project management committees, workshops, newsletters, nutrition education, PA education, ran cooking class, education on how to limit screen time ***Policy:*** food/drink policies ***Staff Engagement:*** engagement in project management committees, ran cooking class, trained to implement Fun Moves program **Intx Duration:** 10 months **Follow-Up Times:** -**# energy dense nutrient poor items in lunchbox, FV servings**: 10 months -**BMI z-score**: 10 months -**BMI:** 3 years	**Diet:** + Researchers observed foods in lunch boxes through lunch box audits: -Servings of FV: 0.61; **p=0.0013** -% of children with 0 energy-dense nutrient-poor items in lunchbox: 29.1%; **p<0.0001** -% of children with 2+ energy-dense nutrient-poor items in lunchbox: -24.5%; **p<0.0001** **PA:** Ø Measured by accelerometer: -MVPA: -0.11; p=0.913 **Weight:** +/Ø **-**BMI z-score at 10 months: -0.15; **p=0.022** **-**WC at 10 months: -0.80; **p=0.020** **-**BMI at 3 years: -0.313; p=0.234 **-**WC at 3 years: -0.35; p=0.731

First Author et al., Year Study Design Intervention Focus Setting	Sample Characteristics	Intervention Description	Outcomes Measured Results (effect size)
		-**WC:** 10 months and 3 years -**MVPA:** 3 years	
Alhassan et al., 2007 **Study Design:** RCT **Intx Category:** PA **Setting:** Center, Preschool n=12 Redwood City, CA, USA	**Age:** 3-5 y **Size:** n=33 (18 intx, 15 ctrl) **Race/ethnicity:** Latino	**Intervention Name:** NA **Intx Description:** ***PA Offered***: 60 mins of extra recess time, 3 times/wk. Free play ***Control*:** received normal recess time Duration: 3 months	**PA: Ø** % time spent in PA-Accel-Total day: -Light PA: 0.2%; NS -MVPA: -0.1%; NS Mins of PA-Accel-school time: -Light PA: -0.1%; NS -MVPA: -0.1%; NS Mins of PA-Accel-After school: -Light PA: 0.6%; NS -MVPA: 0.2%; NS **Diet:** NA **Weight:** NA
Alhassan et al., 2012 **Study Design:** RCT **Intx Category:** PA **Setting:** Center, Preschool Springfield, MA, USA	**Age:** 3-5 y **Size:** n=114 (69 intx, 45 ctrl) **Race/ethnicity:** Latino and African American **SES:** Low SES	**Intx Name:** NA **Intx Description:** ***PA Offered***: 30 min, 5 days/wk of locomotor skills activities (running, hopping, galloping, throwing, catching, kicking) ***Staff*:** 8-hour staff training by a PE specialist ***Control***: 30 min of free outdoor playtime Duration: 6 months	**PA: Ø** % time spent in PA during total day, measured via accelerometer: -Light PA: +1.4%; p=0.45 -MVPA: +2.9%; p=0.23 % time spent in PA during school day, measured via accelerometer: -Light PA: +2.9%; p=0.19 -MVPA: +3.4%; p=0.13 **Diet:** NA **Weight:** NA
Alhassan et al., 2013 **Study Design:** RCT **Intx Category:** PA	**Age:** 3-5 y **Size:** n=67(38 intx, 29 ctrl) **Race/ethnicity:** NR	**Intx Name:** SPARK **Intx Description:** ***PA Offered*:** 30 min of structured outdoor activities (3 days per wk). ***Control*:** 30 min of free outdoor playtime (3 days per wk)	**PA: +/Ø** % time spent in PA during total day, measured via accelerometer: -light PA: ANR; p=0.32 -MVPA: +1.8 mins; p=0.03 % time spent in PA during school day, measured via accelerometer:

First Author et al., Year Study Design Intervention Focus Setting	Sample Characteristics	Intervention Description	Outcomes Measured Results (effect size)
Setting: Center, Preschool n=2 Springfield, MA, USA	**SES:** NR	Duration: 1 month	-light PA: ANR; p=0.24 -MVPA: +1.6 mins; p=0.03 % time spent in PA-Accel-After school: -light PA: ANR; 0.08 -MVPA: ANR; 0.12 **Diet:** NA **Weight:** NA
Alhassan et al., 2016 **Study Design:** cluster RCT **Intx Category:** PA **Setting:** Center, preschool n=10 (5 intx, 5 ctrl); (16 classrooms in intx, 20 classrooms in ctrl) Springfield, MA US	**Mean Age:** 4.1y **Size:** n=248 (118 intx, 130 ctrl) (3 months) n=238 (120 intx, 118 ctrl) (6 months) **Race/ethnicity:** 41% Hispanic, 25% African American **SES:** NR	**Intx Name:** Short bouTs of Exercise for Preschools **Intx Description:** ***PA Offered:*** structured PA (SBS-PA) in classroom setting (10 min gross-motor playtime + 20 min free playtime, 5 days/week) ***Staff Engagement:*** SBS-PA led by teachers **Control Description:** unstructured free playtime (30 min, 5 days/week) **Intx Duration:** 6 months **Follow-Up Times:** **-Total preschool-day PA:** 3 months and 6 months -**BMI:** 6 months	**PA:** +/-/Ø Observed % time spent in PA levels over one day during intervention time using a modified version of the Observational System for Recording Physical Activity in Children-Preschool Version: -Group by visit interaction for MVPA: 1.14; p=0.32 -Group by visit interaction for light PA: 2.79; p=0.06 -Group main effect for MVPA: **p <0.001** -Group main effect for light intensity PA: **p <0.001** Measured % time in PA level during preschool day by accelerometer: -Group by visit interaction for MVPA: p=0.03 – undesired effect -Group by visit interaction for light PA: 1.33; p=0.26 **Diet:** NA **Weight:** NA
Alkon et al., 2014b **Study Design:** cluster RCT **Intx Category:** Nut+PA **Setting:** Center, CCCs	**Age:** 3-5y **Size:** **BMI:** n=209 (99 intx, 110 ctrl) **Other Outcomes:** n=552 (248 intx, 279 ctrl)	**Intx Name:** Nutrition and Physical Activity Self-Assessment for Child Care (NAP SACC) **Intx Description:** ***Parent engagement*:** "Raising Healthy Kids" workshop (at 7 of 9 CCCs), info sheets ***Policy:*** develop/update CCC nut & PA policies ***Other***: nut & PA posters displayed [nut ed/pa env or ed	**Diet:** Ø Researchers observed center-level foods offered (lunch) using the Diet Observation in Child Care: **-**healthy foods: p>0.05 **PA:** Ø

First Author et al., Year Study Design Intervention Focus Setting	Sample Characteristics	Intervention Description	Outcomes Measured Results (effect size)
n=17 (9 intx, 8 ctrl) CA, US CT, US NC, US	**Race/ethnicity:** Mixed (intx 55%, ctrl 37% White) **SES:** low	***Staff engagement:*** workshops (5/site), additional consultation/TA as needed, info sheets **Control Description:** usual practice **Intx Duration:** 7 months **Follow-up Times:** 7 months	Researchers observed PA during the school day using the Observation System for Recording Activity in Preschools: **-**PA Type/Intensity**:** p>0.05 **Weight:** + -Child-level zBMI: -0.14; **p=0.02** -Center-level zBMI: -0.26; **p=0.02**
Annesi et al., 2013a **Study Design:** RCT **Intx Category:** PA **Setting:** Center, Preschool-YMCA n=11 GA, USA	**Age:** 4-5 y **Size:** n=273 (144 intx, 129 ctrl) **Race/ethnicity:** African American **SES:** Low-income	**Intx Name: Start for life** **Intx Description:** ***PA Offered***: 30 min, 5 days/wk of structured PA. ***PA Education***: behavioral skills based in social cognitive theory emphasizing self-efficacy and self-regulation ***Control***: 30 min per day sessions of structured PA. PA did not differ in intensity or duration from the intx group. Duration: 9 months	**PA: +** % time spent in PA during class time, measured via accelerometer: -VPA: +2 percentage points; p<0.05 -MVPA: +2 percentage points; p<0.05 **Weight: +** BMI-Measured by researcher: -BMI at 9 months: -0.19; p<0.05 **Diet:** NA
Annesi et al., 2013b Study Design: RCT Intx Category: PA **Setting:** Center, Preschool-YMCA n=19 (8 ctrl, 11 intx) Atlanta, GA, USA	**Age:** 2-5 y **Size:** n=338 (202 intx, 136 ctrl) **SES:** Lower to middle class	**Intx Name:** NA **Intx Description:** ***PA Offered***: 30 mins, 5 days/wk, of structured PA. ***PA Education*:** behavioral skills, goal setting, self-monitoring ***Staff*:** Teachers received a 4 hour training Duration: 2 months	**PA: +/Ø** % time spent in PA during total day, measured via accelerometer: -VPA: 9.3%; p=0.058 -MVPA: 8.7%; p=0.026 **Diet:** NA **Weight:** NA
Annesi et al., 2013c **Study Design:** RCT **Intx Category:** PA	**Age:** 3-5 y **Size:** n=275 (154 intx, 121 ctrl)	**Intx Name: Start for Life** **Intx Description:** ***PA Offered***: 30 mins, 5 days/wk, of structured PA. ***PA Education*:** behavioral skills, goal setting, self-	**PA: +** % time spent in PA during class, measured via accelerometer: -VPA: 1.37%; p=0.037 -MVPA: 2.65%; p=0.013

First Author et al., Year Study Design Intervention Focus Setting	Sample Characteristics	Intervention Description	Outcomes Measured Results (effect size)
Setting: Center, preschools, YMCA n=31 (21 intx, 11 ctrl) Southeast USA	**Race/ethnicity:** African American **SES:** NR	monitoring ***Staff*:** Teachers received a 4 hour training ***Control*:** 30 min per day sessions of structured PA. Duration: 2 months	**Diet:** NA **Weight:** NA
Annesi et al., 2013d **Study Design:** QE (non-random assignment) **Intx Category:** PA **Setting:** Center, Preschool Southeast USA	**Age:** 3-5 y **Size:** n=885 (716 intx, 169 ctrl) **Race/ethnicity:** 86% African American, 9% Latino **SES:** Lower to lower-middle class	**Intx Name: Start for Life** **Intx Description:** ***PA Offered*:** 30 min, 5 days/wk of structured PA. ***PA Education**:* behavioral skills based in social cognitive theory emphasizing self-efficacy and self-regulation (goal setting, self-monitoring of incremental progress) ***Control:*** 30 min per day sessions of structured PA. PA did not differ in intensity or duration from the intx group. Duration: 9 months	**PA: +** % time spent in PA during class, measured via accelerometer: -VPA: +1.8 percentage points; p<0.001 -MVPA: +1.4 percentage points; **p=0.016** **Weight: +/Ø** -BMI at 9 months: -0.06; **p=0.023** -BMI among overweight at 9 months: NS -BMI among obese at 9 months: -0.57; **p=0.028**} **Diet:** NA
Başkale and Bahar, 2011 **Study Design:** RCT **Intx Category:** Nutrition **Setting:** Centers, Nursery Schools n=12 (6 intx, 6 ctrl) Turkey	**Age:** 5y **Size:** n=115 (67 intx, 48 ctrl) **Race/Ethnicity:** NR **SES:** Low, middle and high income	**Intx Name:** NA **Intx Description:** ***Nut Ed:*** 6 weekly 20-30 min lessons guided by Piaget's cognitive development theory ***Parent*:** Nut ed. session and educational booklet ***Control*:** usual nut ed. for children; mothers in intx and ctrl groups received nut ed. **Duration**: 12 months **Follow-up:** 15-16 months	**Weight: Ø** -BMI: NS -Mid-upper arm circumference percentile: NS **Diet:** NA **PA:** NA
Bell et al., 2014 **Study Design:** QE **Intx Category:** Nutrition **Setting:** Center, Preschools	**Age:** 3-6y **Size:** n=102 (50 intx, 52 ctrl) menu changes n=431 (240 intx, 191 ctrl) beverage practice changes	**Intx Name:** Good for Kids Good for Life **Intx Description:** ***Meal FB and FB Outside Meals*:** provided only non-sweetened drinks (milk and water) and foods consistent with dietary guidelines and accreditation requirements ***Parent*:** participated in nutrition policy or programs.	**Diet: +/Ø** Researchers analyzed menu contents: -High-fat, -salt and/or -sugar processed foods: **p=0.001** -SSBs: **p<0.001** -Fruit servings: **p=0.05** -Vegetable servings: **p<0.001**

First Author et al., Year Study Design Intervention Focus Setting	Sample Characteristics	Intervention Description	Outcomes Measured Results (effect size)
n=431 (n=240 intx, n=191 ctrl) Hunter New England region of New South Wales Australia	**Race/Ethnicity:** NR **SES:** low-middle income	***Control*:** No state-wide healthy eating initiatives at the beginning of the intx (2007), but after July 2008, preschool services in NSW could access support via a government program that promoted PA and healthy eating. **Duration**: 20 months	Researchers analyzed menu compliance with guidelines: -No high-fat, -salt and/or -sugar processed food menu items: p=0.11 -No SSBs: **p<0.001** -One fruit serving on the menu/day: p<0.001 -# vegetable servings on the menu/day is appropriate to hours open: p=0.01 **PA:** NA **Weight:** NA
Bellows et al., 2013 **Study Design:** RCT **Intx Category:** Nutrition & PA **Setting:** Centers, Head Starts n=8 Rural and urban sites, CO US	**Age:** 3-5y **Size:** n=301 (98 intx, 103 ctrl) **Race/Ethnicity:** NR **SES:** Low-income	**Intx Name:** The Food Friends: Get Movin' With Mighty Moves **Intx Description:** ***PA*:** 15–20 min lessons 4 days/week (total of 72 lessons) comprised of multiple activities led by the classroom teacher. Each week focused on a gross motor skill and movement concepts introduced by characters. ***Nut Ed*:** Food Friends, a 12-week intervention shown to increase willingness to try new foods. ***Parents*:** Materials sent home, including educational handouts and a copy of the Mighty Moves music CD. ***Staff***: Materials supporting the lessons provided as a kit; included a teacher activity binder, custom music CD, activity mats, flashcards, puppets, scarves, balls, beanbags, ropes, and parent materials. ***Control*:** intx and control classes implemented Food Friends **Duration**: 18 weeks	**PA: Ø** Step counts measured via pedometer: -Steps/day: NS -Steps/week day: NS -Steps/weekend day: NS **Weight: Ø** -BMI: NS -BMI z-score: NS **Diet:** NA
Benjamin-Neelon et al., 2016a **Study Design:** NE **Intx Category:** Nutrition	**Age:** NR **Size:** n=177 (99 intx, 78 ctrl) (measured 3 children/center)	**Intx Name:** NA **Intx Description:**	**Diet: Ø** Researchers observed foods served to children using the Diet Observation in Child Care & Environment and Policy Assessment and Observation:

First Author et al., Year Study Design Intervention Focus Setting	Sample Characteristics	Intervention Description	Outcomes Measured Results (effect size)
Setting: Centers, CCCs n=59 (26 intx, 33 ctrl) Columbia, SC (intx) Raleigh, North Carolina (ctrl) US	**Race/Ethnicity:** Predominately Black intx group Approximately equal Black and White Ctrl Group **SES:** Low	***Policy*:** In April 2012, SC issued the following 13 compulsory nut standards for the ABC Child Care Program, a statewide subsidized care program: 1. Only skim or 1% milk for children ≥2y; 2. SSBs not served; 3. Juice allowed ≤1 4-oz serving/day; 4. At least 2 different fruits served 2 or more times per day; 5. Vegetable other than white potatoes served at least once per day; 6. Fried or pre-fried vegetables served once per week or less; 7. Whole-grain foods served once/day; 8. High-fat meats served twice/week or less; 9. Sweet food items served ≤ twice/week; 10. Staff attend nutrition training at least once/year; 11. Children learn about nutrition at least 1 time/week; 12. Food not used as a reward or punishment; 13. Create and consistently implement a written nutrition policy. The policy was administrative and not legislative. **Duration**: 2 years **Follow-ups:** 3 years	- SSBs not served: OR=0.93; p=0.88 - Juice ≤1 4-oz serving/day: OR=1.19; p=0.86 - Fruits of ≥2 varieties served ≥2 times/day: OR=1.14; p=0.08 - Vegetables served ≥once/ day: OR=0.96; p=0.18 - Sweet food items served ≤2 times/week: OR=1.12; p=0.09 **PA:** NA **Weight:** NA
Benjamin-Neelon et al., 2016b **Study Design:** NE **Intx Category:** PA **Setting:** Centers, CCCs n=36 (16 intx, 20 ctrl) *4 intx centers dropped out Boston, MA (intx) Providence, RI (ctrl) US	**Age:** 3-5y **Size:** n=324 (144 intx, 180 ctrl) (randomly selected 9 children from each center at each measurement) **Race/Ethnicity:** Majority white, but some representation of other racial/ethnic groups **SES:** Low **Other:** Mostly female (95%)	**Intx Name:** NA **Intx Description:** **Policy:** a state regulation passed in 2010 requiring 60 minutes of light, moderate, and vigorous PA (LMVPA)/day for children in child care **Duration**:9 months **Follow-ups:** 3 years	**PA: Ø** Researchers observed children's minutes of PA during the preschool day using Observation System for Recording Activity in Preschoolers (OSRAP): -Light PA: -0.9; p=0.90 -Moderate PA: -1.0; p=0.80 -Vigorous PA: -2.1; p=0.40 -MV PA: -3.2; p=0.54 -Light PA+MVPA: -4.6; p=0.46 **Diet:** NA **Weight**: NA
Specker and Binkley, 2004	**Age:** 3-5 y	**Intx Name:** NA	**PA: +/Ø**

First Author et al., Year Study Design Intervention Focus Setting	Sample Characteristics	Intervention Description	Outcomes Measured Results (effect size)
Study Design: RCT **Intx Category:** PA **Setting:** Center, day care SD, USA	**Size:** n=178 **Race/ethnicity:** NR **SES:** NR	**Intx Description:** ***PA Offered***: 30-min sessions/day of structured PA. Activities such as jumping, hopping and skipping. ***Control*:** 30-min sessions/day of fine motor activities that kept children sitting quietly and doing crafts. **Duration:** 12 months **Follow-up***:* 12, 18 and 24 months	Step counts per day measured via accelerometer at 12 months: -PA: p<0.05 % time spent in PA at 12 months: -VPA: NS Step counts/day at 18 months: -PA: p<0.05 % time spent in PA at 18 months: -VPA: p<0.05 counts/day - 24 months: -PA: NS % time spent in PA at 24 months: -VPA: NS **Diet:** NA **Weight: Ø** Whole body scan with DXA -Total body % fat at 24 months: NS
Bonis et al., 2014 **Study Design:** cluster RCT **Intx Category:** Nut & PA **Setting:** Center, CCCs n=26 (13 intx, 13 ctrl) Louisiana, US	**Age:** 3-5y **Size:** n=209 (110 intx, 99 ctrl) **Race/Ethnicity:** NR **SES:** NR	**Intx Name:** NAP SACC **Intx Description:** ***Parent engagement:*** PA & nutrition materials ***Policy:*** plan to improve 3-4 assessment areas ***Staff engagement:*** nutrition and PA education workshops (4 workshops/site) **Control Description:** usual practice **Intx Duration:** 6 months **Follow-up Times:** 6-9 months, depending on data collection schedule (for all measures)	**PA:** + PA level from 8:30a to 3:00p 2 days in 1 week measured by accelerometer: -MPA: **p<0.05** -VPA: **p<0.05** -MVPA: **p<0.05** **Weight:** Ø **-**WC**:** p>0.05 **-**BMI**:** p>0.05 **Diet:** NA
Burgi et al., 2012**;** Puder et al., 2011 **Study Design:** RCT	Mean age: 5.2 **Size:** n=652 (333 intx, 292 ctrl)	**Intx Name:** NA **Intx Description:**	**Diet: +** Parents reported diet using a semi-qualitative FFQ: -% healthy eaters: +1.9**; p<0.01**

First Author et al., Year Study Design Intervention Focus Setting	Sample Characteristics	Intervention Description	Outcomes Measured Results (effect size)
Intx Category: Nut+PA **Setting:** Center, Preschool Switzerland	38% low SES **Race/ethnicity:** NR **SES:** NR	***Nut Ed****:* 22 lessons on healthy nutrition, media use and sleep. ***PA Offered*****:** 45 mins, 4 times/wk. Aerobic fitness and coordination skills ***PA Environ***: Fixed and mobile equipment (climbing walls, hammocks, balls, cords or stilts) ***Staff:*** 3 hour workshops ***Parents*****:** 3 interactive information and discussion evenings about PA, healthy food, screen time and importance of sleep Control: regular school curriculum which included 1 45 min PA lesson/wk Duration: 11 months	**PA: +/Ø** Counts per minute using accelerometer: -Total PA: -12.3; p=0.54 % active children: -Reported PA: +1.9%; **p=0.04** **Weight: +/Ø** Measured-BMI: -0.07; p=0.31 -WC: -1.0 cm; **p=0.001** -Sum of four skinfolds: -2.78 mm; **p=0.001** -% overweight: 0.65; p=0.23 -% body fat: -0.07; **p=0.02**
Cardon et al., 2009a **(same paper as 2009b-c)** **Study Design:** RCT **Intx Category:** PA **Setting:** Center, public pre-schools n=20 (10 intx, 10 ctrl) Flanders, Belgium	**Age:** 4-5y **Size:** n=291 (145 intx, 146 ctrl) **Race/ethnicity:** NR **SES:** NR	**Intx Name:** NA **Intx Description:** ***PA environment:*** provided playground equipment ***Staff engagement*****:** made play equipment available, provided introduction to equipment Duration: 4-6wks	**PA: Ø** % time spent in PA during 1 hour recess, measured via accelerometer: -sedentary activity: 2.1; NS -light activity: 0.4; NS -moderate activity: -0.2; NS -vigorous activity: 1.3; NS -average activity: 62.5; NS **Diet:** NA **Weight:** NA
Cardon et al., 2009b **(same paper as 2009a,c)** **Study Design:** RCT **Intx Category:** PA **Setting:** Center, public pre-schools	**Age:** 4-5y **Size:** n=292 (147 intxB, 146 ctrl) **Race/ethnicity:** NR **SES:** NR	**Intx Name:** NA **Intx Description:** ***PA environment:*** provided playground markings ***Staff engagement:*** made play equip available, provided introduction to equip Duration: 4-6wks	**PA: Ø** % time spent in PA during 1 hr recess, measured via accelerometer: -sedentary activity: -1.1; NS -light activity: -1.0; NS -moderate activity: -0.3; NS -vigorous activity: -0.12; NS -MVPA: -0.7; NS -average activity: -38.9; NS

First Author et al., Year Study Design Intervention Focus Setting	Sample Characteristics	Intervention Description	Outcomes Measured Results (effect size)
n=20 (10 intx, 10 ctrl) Flanders, Belgium			**Diet:** NA **Weight:** NA
Cardon et al., 2009c **(same paper as 2009a-b)** **Study Design:** RCT **Intx Category:** PA **Setting:** Center, public pre-schools n=20 (10 intx, 10 ctrl) Flanders, Belgium	**Age:** 4-5y **Size:** n=291 (145 intxAB, 146 ctrl) **Race/ethnicity:** NR **SES:** NR	**Intx Name:** NA **Intx Description:** ***PA environment*:** provided both playground equipment and playground markings (intxAB) ***Staff engagement*:** made play equip available, provided introduction to equip Duration: 4-6wks	**Diet:** NA **PA: Ø** % time spent in PA during 1 hr recess, measured via accelerometer: -sedentary activity: -1.7; NS -light activity: 0.5; NS -moderate activity: 0.8; NS -vigorous activity: -0.2; NS -MVPA: 0.8; NS -average activity: 11.3; NS **Weight:** NA
Cruz et al., 2016 **Study Design:** cluster RCT **Intx Category:** Nut+PA **Setting:** Center, Head Start n=16 (8 intx, 8 ctrl) Rural New Mexico US	**Mean Age:** 4.1y **Size:** n=629 (309 intx, 320 ctrl) **Race/ethnicity:** ~60% Hispanic ~40% American Indian **SES:** NR	**Intx Name:** Child Health Initiative for Lifelong Eating and Exercise (CHILE) **Intx Description:** ***Nutrition Education:*** curriculum ***Meal FB:*** Head Start food service component ***FB Outside Meals:*** food service component ***PA Education***: curriculum ***PA Offered:*** activity breaks, 30 min PA sessions ***Parent Engagement:*** family component, take-home materials, quarterly family events ***Staff Engagement***: professional development training **Intx Duration:** 2 academic years **Follow-Up Times:** multiple time points over two academic years: time 1: fall 08-spring09 time2: fall08-fall09 time3: fall08-spring10	**PA:** +/Ø Caregiver reported on questionnaire: -pooled PA at time 1: 1.63; **p<0.05** -pooled PA at time 2: 1.56; **p<0.05** -pooled PA at time 3: 1.12; p>0.05 Caregiver reported whether or not children engaged in the following activities 'often' via questionnaire: -ball playing at time 1: p>0.05 -dancing at time 1: p>0.05 -playing active games at time 1: p>0.05 -jumping at time 1: p>0.05 -walking at time1: p>0.05 -ball playing at time 2: p>0.05 -dancing at time 2: p>0.05 -playing active games at time 2: p>0.05 -jumping at time 2: p>0.05 -walking at time 2: p>0.05 -ball playing at time 3: 1.9; p>0.05 -dancing at time 3: 3.3; **p<0.05**

First Author et al., Year Study Design Intervention Focus Setting	Sample Characteristics	Intervention Description	Outcomes Measured Results (effect size)
			-playing active games at time 3: 1.3; p>0.05 -jumping at time 3: 1.5; p>0.05 -walking at time 3: 1.2; p>0.05 **Diet:** NA **Weight:** NA
Davis et al., 2016 **Study Design:** cluster RCT **Intx Category:** Nut+PA **Setting:** Center, Head Start n=16 (8 intx, 8 ctrl) Rural New Mexico US	**Age:** <4y **Size:** n=1816 (945 intx, 871 ctrl) **Race/ethnicity:** ~60% Hispanic ~40% American Indian **SES:** NR	**Intx Name:** Child Health Initiative for Lifelong Eating and Exercise (CHILE) **Intx Description:** ***Nutrition Education:*** curriculum, taste tests ***Meal FB:*** food purchasing, preparation, and serving by HS food service staff ***FB Outside Meals:*** food service component ***PA Education:*** curriculum ***PA Offered:*** add 30 min of PA to class activities (daily) ***Parent Engagement:*** take-home materials, family events (2x/school year) ***Staff Engagement:*** professional development training (quarterly) ***Other - Community:*** local grocery store component, health care provider component **Intx Duration:** 2 academic years **Follow-Up Times:** 7 months, 12 months, and 19 months	**Weight:** Ø -BMI at 7 months: 0.01; p=0.57 -BMI at 12 months: -0.07; p=0.06 -BMI at 19 months: -0.02; p=0.68 **Diet:** NA **PA:** NA
Dennison et al., 2004 **Study Design:** RCT **Intx Category:** Nutrition & Screen time **Setting:** Centers, Preschools and Day Care Centers n=16 (8 intx, 8 ctrl)	**Age:** 2.6-5.5y **Size:** n=78 (40 intx, 38 ctrl) **Race/Ethnicity:** Predominately white **SES:** NR	**Intx Name:** Brocodile the Crocodile **Intx Description:** ***Nut Ed:*** 20 lessons on healthy eating ***Parent*:** home-based activities to reduce TV-viewing ***Control*:** safety and injury prevention program **Duration**: 9 months **Follow-up:** 12 months	**Weight: Ø** -BMI: -0.36; p=0.38 -BMI z-score: -0.19; p=0.54 -Tricep Skinfold: -0.41; p=0.78 **Diet:** NA **PA:** NA

First Author et al., Year Study Design Intervention Focus Setting	Sample Characteristics	Intervention Description	Outcomes Measured Results (effect size)
Rural communities in Upstate New York, NY US			
DeBock et al., 2010, DeBock et al., 2013 **Study Design:** RCT **Intx Category:** PA **Setting:** Center, Preschool n=37 Baden-Wurttemberg, Germany	**Age:** 4-6y **Size:** n=826 (441 intx, 385 ctrl) **Race/ethnicity:** NR **SES:** NR	**Intx Name:** NA **Intx Description:** ***PA Offered:*** 1hr gym class (2x/wk for 6 months), active transport, active games, outdoor excursions, gardening, hiking, dance ***Parent Engagement*:** website, video, books, trainings (9 months) ***PA environment*:** built parcours, tree house, play construction site **Ctrl:** 1hr gym class (2x/wk for 6 months) Duration: 9 months Follow-up: 12 months	**Diet:** NA **PA: +/Ø** Accelerometer during 6 consecutive days: -mean accelerometer counts/15 sec: 1.38; .019 min/waking day: -MVPA: .97; > **p=0.1** -sedentary: -11; **p=0.014** **Weight: Ø** Measured BMI: .064; p=0.41 -% body fat: 0.21; p=0.32
De Bock et al., 2011 **Study Design:** RCT **Intx Category:** Nutrition **Setting:** Centers, Preschools n=18 (8 intx, 10 ctrl) Southern Germany	**Age:** 3-6y mean=4.26y **Size:** n=377 (intx, ctrl NR) **Race/Ethnicity:** Roughly one-third of children came from an immigrant background **SES:** NR	**Intx Name:** NA **Intx Description:** ***Nut Ed*:** 15x2-hr sessions delivered by trained nutrition experts over 6 months ***Parents*:** attended 5 of the nut ed. sessions provided to children ***FBs Outside Meals*:** offered healthy snacks (e.g., FVs and water) **Duration**: 12 months **Follow-up:** 6 and 12 months	**Diet: +/Ø** Caregiver reported child's intake (portions/day) via questionnaire: -Fruit: 0.23, **p=0.001** -Veg: 0.15, p=0.27 -SSB: NS **Weight: Ø** -BMI: NS -Skinfold: NS -Waist-to-height ratio: NS **PA**: NA
De Coen et al., 2012 **Study Design:** RCT **Intx Category:** Nutrition & PA	**Age:** 3-6y **Size:** n=1102 for BMI outcomes n=694 for diet outcomes	**Intx Name:** Prevention of Overweight among Pre-school and school children project (POP) **Intx Description:** ***PA*:** developed active playgrounds and implemented health-focused PE	**Diet: Ø** Parents reported children's daily intake via FFQ: -Fruit; p>0.05 -Veg; p>0.05 -Soft drinks; p>0.05

First Author et al., Year Study Design Intervention Focus Setting	Sample Characteristics	Intervention Description	Outcomes Measured Results (effect size)
Setting: Primary and Pre-Primary Schools n=31 Flanders, Belgium	**Race/Ethnicity:** NR **SES:** High, medium and low SES communities	***Meal FBs & FBs Outside Meals*:** environ and policy changes to increase water (e.g., drinking fountains) and FV availability. ***Policy*:** availability of water and FVs ***Parents*:** Education, letters, posters ***Other*:** Community meetings; distributed brochures and posters to practitioners, pharmacists, social services and community events; Regional Health Boards assisted with implementation at community and school levels **Duration**: 2 years **Follow-up:** 2 years	-Sweet and savory snacks: p>0.05 **PA: Ø** Parents reported children's PA (hours/wk) via questionnaire: -Participation in sports club: p>0.05 -Participation in after-school sports activities: p>0.05 **Weight: +/ Ø** BMI z-score by SES: -Total group: p>0.05 -High SES: p>0.05 -Medium SES: p>0.05 -Low SES: **p<0.001**
De Craemer et al., 2014 **Study Design:** RCT **Intx Category:** PA **Setting:** Centers, Kindergartens, Daycare centers, and Preschools (all referred to as Kindergartens in the paper) n=27 (15 intx, 12 ctrl) Flanders, Belgium	**Age:** 4-6y mean=4.43y **Size:** n=472 (301 intx, 171 ctrl) **Race/Ethnicity:** NR **SES:** High, medium and low SES Communities	**Intx Name:** ToyBox Study **Intx Description:** ***PA Environ*:** classroom environment changes for PA, implemented throughout the whole school year. ***Staff:*** 3 teacher training sessions; provided with the "ToyBox", a box containing a teachers' guide (info on importance of PA), classroom activity guides, newsletters, tip-cards, posters and a kangaroo hand puppet. ***PA*:** Teachers were asked to allocate ≥1 hour/week to use the ToyBox-materials and to implement the ToyBox-intervention in the classroom. The PA part of the intx was implemented in weeks 5-8, and had a 2-week repetition period in weeks 19 and 20. ***Parents*:** newsletters and tip-cards with strategies to increase preschoolers' PA levels and 1 poster (with key messages on PA that could be colored at kindergarten or at home) to take home for their parents/caregivers. ***Control*:** standard curriculum **Duration**: 24 weeks for PA environment changes;	**PA: +/Ø** Children's PA levels measured via accelerometer: **Total day:** -light PA: -0.06; NS -MPA: 1.06; NS -VPA: 1.11; NS -Total PA: 0.48; NS -MVPA: 1.07; NS **Weekday:** -light PA: -0.11; NS -MPA: 1.05; NS -VPA: 1.14; NS -Total PA: 0.65; NS -MVPA: 1.07; NS **Weekend day:** -light PA: -0.09; NS -MPA: 1.02; NS -VPA: 1.08; NS -Total PA: -0.09; NS -MVPA: 1.04; NS **School hours:**

First Author et al., Year Study Design Intervention Focus Setting	Sample Characteristics	Intervention Description	Outcomes Measured Results (effect size)
		6 weeks total (4 weeks on, 11 weeks off, 2 weeks on, 4 weeks off) for the in-class intx activities	-light PA: -1.02; NS -MPA: 0.45; NS -VPA: 1.02; NS -Total PA: 1.03; NS -MVPA: 1.05; NS **After school hours:** -light PA: -1.18; NS -MPA: 1.11; NS -VPA: 1.31; **p<0.05** -Total PA: 1.93; NS -MVPA: 1.18; **p<0.05** **Diet:** NA **Weight:** NA
Eliakim et al., 2007 **Study Design:** RCT **Intx Category:** Nutrition & PA **Setting:** Center, Preschool n=1 (2 intx classrooms, 2 ctrl classrooms) Oranit, Israel	**Age:** 5-6y **Size:** n=101 (54 intx, 47 ctrl) **Race/Ethnicity:** NR **SES:** Middle-high SES	**Intx Name:** NA **Intx Description:** ***Nut Ed*:** Integrated nut into the curriculum via lectures/talks, games, books and workshops. ***PA*:** 3x15-min PA sessions (45 min/day) 6 days/week, directed by a professional youth coach 2x/wk and by the teacher and/or assistant other times, indoors and/or outdoors, based on circuit training, designed to mimic the type and intensity of PA preschool children normally perform, primarily as games, mainly endurance activities, as well as coordination and flexibility. ***Screen Time*:** study staff encouraged children to reduce sedentary activities (e.g., tv, video games) ***Control*:** regular schedule **Duration**: 4 months	**PA: +** Children's steps taken 9am-3pm measured via pedometer (average of two 3-day periods, 6 days total): -Steps/day: <0.003 -Steps/school day: <0.001 -Steps/afterschool day: <0.04 **Weight: +** -BMI: **p<0.05** -BMI percentile: **p<0.05** -% body fat (triceps and subscapular skinfold thickness): **p<0.05** **Diet:** NA
Finch et al., 2010 Finch et al., 2014 **Study Design:** RCT	**Age:** 3-5 years **Size:** n=245 (120 ctrl, 125 intx)	**Intx Name:** NA **Intx Description:** ***PA Offered***: 20 min, 5 day/wk sessions of structured PA sessions. Opportunities for children to participate in PA	**Diet:** NA **PA: Ø** Step count using pedometer: -steps/min: 1.39; p=0.12

First Author et al., Year Study Design Intervention Focus Setting	Sample Characteristics	Intervention Description	Outcomes Measured Results (effect size)
Intx Category: PA **Setting:** Center, long day care services n=20 (10 intx, 10 ctrl) New South Wales, Australia	**Race/ethnicity:** NR **SES:** NR	over the course of the day. ***PA Environ***: Portable equipment to children in indoor and outdoor areas ***Screen time***: fewer mins/day spent watching TV or using electronic media ***Staff*:** Staff role modelling. Staff were asked to participate during active play Duration: 6 months	**Weight:** NA
Fitzgibbon et al., 2005 **Study Design:** cluster RCT **Intx Category:** Nut+PA/Screentime **Setting:** Center, Head Start preschool programs n=12 (6 intx, 6 ctrl) Chicago, Illinois USA	**Age:** 3-5y **Size:** **BMI (and BMI z-score):** n=362 (179 intx, 183 ctrl) (14 weeks) n=289 (143 intx, 146 ctrl) (1 year) n=300 (146 intx, 154 ctrl) (2 years) **Exercise frequency, Exercise intensity:** n=297 (143 intx, 154 ctrl) (14 weeks) n=274 (132 intx, 142 ctrl) (1 year) n=261 (129 intx, 132 ctrl) (2 years) **Race/ethnicity:** predominantly Black **SES**: NR	**Intx Name:** Hip-Hop to Healthy Jr. **Intx Description:** ***Nutrition Education:*** curriculum (14-week (20 min, 3x/week)) ***PA Education:*** curriculum (14-week (20 min, 3x/week)) ***PA Offered:*** offered in curriculum (14-week (20 min, 3x/week)) ***Screen Time:*** lesson in curriculum ***Parent Engagement:*** newsletters (weekly), homework assignments (12) ***Staff Engagement:*** administered curriculum lessons (14-week (40 min, 3x/week)) **Control Description:** general health curriculum (14-week (20 min, 1x/week)), parent newsletters (weekly) **Intx Duration:** 14 weeks **Follow-up Times:** 14 weeks, 1 year, 2 years	**PA:** Ø Caregiver reported exercise frequency via questionnaire: -% that exercised ≥7 times/week at 14 weeks: 0.59; p>0.05 -% that exercised ≥7 times/week at 1 year: -10.55; p>0.05 -% that exercised ≥7 times/week at 2 years: 0.79; p>0.05 Caregiver reported exercise intensity on questionnaire: -Exercise intensity on Borg scale at 14 weeks: 0.14; p>0.05 -Exercise intensity on Borg scale at 1 year: -0.29; p>0.05 -Exercise intensity on Borg scale at 2 years: -0.62; p>0.05 **Weight:** +/Ø -BMI at14 weeks): -0.07; p=0.373 -BMI z-score at 14 weeks: -0.03; p=0.606 -BMI at1 year: -0.53; **p=0.012** -BMI z-score at1 year: -0.23; **p=0.006** -BMI at2 years: -0.54; **p=0.022** -BMI z-score at2 years: -0.18; **p=0.015** Effect size=-0.16

First Author et al., Year Study Design Intervention Focus Setting	Sample Characteristics	Intervention Description	Outcomes Measured Results (effect size)
			Diet: NA
Fitzgibbon et al., 2006 **Study Design:** cluster RCT **Intx Category:** Nut+PA/Screentime **Setting:** Center, Head Start preschool programs n=12 (6 intx, 6 ctrl) Chicago, Illinois, USA	**Age:** 3-5y **Size:** **BMI (and BMI z-score):** n=383 (196 intx, 187 ctrl) (14 weeks) n=336 (176 intx, 160 ctrl) (1 year) n=331 (171 intx,l 160 ctrl) (2 years) **Exercise frequency:** n=323 (171 intx, 152 ctrl) (14 weeks) n=293 (154 intx, 139 ctrl) (2 years) **Exercise intensity:** n=322 (171 intx, 151 ctrl) (14 weeks) n=293 (154 intx, 139 ctrl) (2 years) **Race/ethnicity:** predominantly Latino **SES:** NR	**Intx Name:** Hip-Hop to Health Jr. **Intx Description:** ***Nutrition Education:*** curriculum (14-week (20 min, 3x/week)) ***PA Education:*** curriculum (14-week (20 min, 3x/week)) ***PA Offered:*** offered in curriculum (14-week (20 min, 3x/week)) ***Screen Time:*** lesson in curriculum **Intx Name:** NA ***Parent Engagement:*** newsletters (weekly), homework assignments (12) ***Staff Engagement:*** administered curriculum lessons (14-week (40 min, 3x/week)) **Control Description:** general health curriculum (14-week (20 min, 1x/week)), parent newsletters (weekly) **Intx Duration:** 14 weeks **Follow-up Times:** **BMI and BMI z-score:** 14 weeks, 1 year, 2 years **Exercise frequency and exercise intensity**: 14 weeks, 2 years	**PA:** Ø Caregiver reported exercise frequency via questionnaire: -% that exercised ≥7 times/week at14 weeks: 0.28; p>0.05 -% that exercised ≥7 times/week at2 years: 10.8; p>0.05 Caregiver reported exercise intensity via questionnaire: -Exercise intensity on Borg scale at14 weeks): -0.18; p>0.05 -Exercise intensity on Borg scale at2 years): -0.30; p>0.05 **Weight:** Ø -BMI at 14 weeks: 0.00; p=1.0 -BMI z-score at 14 weeks: 0.01; p=0.94 -BMI at 1 year: -0.13; p=0.60 -BMI z-score at 1 year: -0.11; p=0.29 -BMI at 2 years: -0.20; p=0.49 -BMI z-score at 2 years: -0.15; p=0.19 **Diet:** NA
Fitzgibbon et al., 2011 **Study Design:** cluster RCT **Intx Category:** Nut+PA/Screentime **Setting:**	**Age:** 3-5y **Size:** **BMI:** n=589 (309 intx, 280 ctrl) **Physical activity:** n=190 (96 intx, 94 ctrl) **Diet:**	**Intx Name:** Hip-Hop to Health Jr. **Intx Description:** ***Nutrition Education:*** curriculum (14-week (20 min, 2x/week)) ***PA Education***: curriculum (14-week (20 min, 2x/week)) ***PA Offered:*** offered in curriculum (14-week (20 min, 2x/week))	**Diet:** Ø Caregiver reported on foods consumed out of school on a 24-hour recall and researcher measured plate waste in school: -Kcals: 79.9; p=0.35 -Servings of fruit per day: 0.08; p=0.69 -Servings of 100% fruit juice per day: 0.32; p=0.15 -Servings of vegetables per day: 0.06; p=0.58

First Author et al., Year Study Design Intervention Focus Setting	Sample Characteristics	Intervention Description	Outcomes Measured Results (effect size)
Center, Head Start preschools =18 (9 intx, 9 ctrl) Chicago, Illinois, USA	n=440 (238 intx, 202 ctrl) **Race/ethnicity:** predominantly Black **SES:** NR	***Screen Time:*** lesson in curriculum ***Parent Engagement:*** newsletters (weekly), homework assignments ***Staff Engagement***: training, administered curriculum lessons (14-week (40 min, 2x/week)) **Control Description:** teacher training, general health curriculum (14-week (20 min, 1x/week)), parent newsletters (weekly) **Intx Duration:** 14 weeks **Follow-up Times:** 14 weeks	**PA:** + Time in PA measured by accelerometer: -Minutes of MVPA per day: 7.46; **p=0.02** -Minutes of moderate activity per day: 4.78; **p=0.05** -Minutes of vigorous activity per day: 2.83; **p=0.03** -Minutes of MVPA per hours wore accelerometer: 0.53; **p=0.02** **Weight:** Ø -BMI: -0.08; p=0.28 -BMI z-score: -0.05; p=0.23
Fitzgibbon et al., 2013 **Study Design:** cluster RCT **Intx Category:** Nut+PA/Screentime **Setting:** Center, Head Start preschools n=4 (2 intx, 2 ctrl) Chicago, Illinois, USA	**Age:** 3-5y **Size:** **BMI**: n=143 (71 intx, 72 ctrl) (14 weeks) n=128 (61 intx, 67 ctrl) (1 year) **PA:** n=46 (23 intx, 23 ctrl) (14 weeks) **Diet:** n=106 (50 intx, 56 ctrl) (14 weeks) **Race/ethnicity:** predominantly Latino **SES:** low SES - median income of $15,000	**Intx Name:** Family-Based Hip-Hop to Health **Intx Description:** ***Nutrition Education***: curriculum (14-week (20 min, 3x/week)) ***PA Education***: curriculum (14-week (20 min, 3x/week)) ***Screen Time***: lesson in curriculum ***Parent Engagement***: 6 90min classes (60 min education curriculum (nutrition and PA) + exercise session (30min)), newsletters (weekly) **Control Description:** general health curriculum (14-week (20 min, 1x/wk)), parent newsletters (weekly) **Intx Duration:** 14 weeks **Follow-up Times:** **BMI:** 14 weeks and 1 year **PA:** 14 weeks **Diet:** 14 weeks	**Diet:** Ø Caregiver reported on foods consumed out of school on a 24-hour recall and researcher measured plate waste in school: -Kcals: -26.3; p>0.05 -Servings of fruit per day: 0.28; p>0.05 -Servings of 100% fruit juice per day: -0.83; p>0.05 -Servings of vegetables per day: -0.18; p>0.05 **PA:** Ø Time in PA measured by accelerometer: -Minutes of MVPA per day: 9.02; p>0.05 -Minutes of moderate activity per day: 2.78; p>0.05 -Minutes of vigorous activity per day: 1.81; p>0.05 -Minutes of MVPA per hours wore accelerometer: 0.07; p>0.05 **Weight:** -/ Ø -BMI at14 weeks): -0.04; p>0.05 -BMI z-score at14 weeks): -0.03; p>0.05 -BMI at1 year): 0.22; **p<0.05**

First Author et al., Year Study Design Intervention Focus Setting	Sample Characteristics	Intervention Description	Outcomes Measured Results (effect size)
			-BMI z-score at1 year): 0.07; p>0.05
Goldfield et al., 2016 **Study Design:** cluster RCT **Intx Category:** PA **Setting:** Center, child care n=6 (3 intx, 3 ctrl) Canada	**Age:** 3-5y **Size:** **PA outcomes:** n=88 (40 intx, 48 ctrl) **Body composition/wt status outcomes:** n=77 (35 intx, 42 ctrl) **Race/ethnicity:** NR **SES:** Mostly high income	**Intx Name:** NA **Intx Description:** ***Staff Engagement:*** workshops (2 3-hr sessions), training manual aimed at increasing PA through active play, booster sessions (12, 1-hr, biweekly) **Intx Duration:** 6 months **Follow-Up Times:** 6 months	**PA:** +/Ø Measured number of children spending ≥4 hours in PA level for ≥2 days per week by accelerometer: -Total PA: 22.5; **p=0.002** -MVPA: 6.5; p=0.085 -Light intensity PA: 16.1; **p=0.004** **Weight:** +/Ø **-**BMI: -0.2; p=0.255 **-**BMI z-score: -0.12; p=0.225 -% body fat: -1.9; **p=0.023** Effect size=-0.33 -Kg of fat mass: -0.3; **p=0.018** Effect size=-0.15 **-**Kg of fat free mass: 0.2; p=0.126 **Diet:** NA
Gripshover et al., 2013 **Study Design:** RCT **Intx Category:** Nutrition **Setting:** Center, Preschool n=1 Palo Alto, CA US	**Age:** 4-5y **Size:** n=40 (intx NR, ctrl NR) experiment 1 n=100 (intx NR, ctrl NR) experiment 2 **SES:** High SES families	**Intx Name:** NA **Intx Description:** ***Nut Ed*:** An "intuitive theory-based intervention" in which teachers read 5 story books during snack time and asked interactive questions (up to 2x/wk) that addressed 5 key concepts: dietary variety, digestion, food categories, nutrients and nutrient functions. ***Control*:** The intx was tested vs 2 different control groups: 1) no-treatment and 2) an alternative treatment control group read books from USDA's Team Nutrition website on enjoying healthy eating and encouraging trying new foods, especially vegetables. **Duration**: 10-12 weeks	**Diet: +** Researchers observed children's vegetable intake during snack: -Experiment 1: **p=0.03** -Experiment 2: **p=0.04** **PA**: NA **Weight**: NA
Hardy et al., 2010	**Age:** 3-5 years	**Intx Name:** Munch and Move	**Diet: +/Ø**

First Author et al., Year Study Design Intervention Focus Setting	Sample Characteristics	Intervention Description	Outcomes Measured Results (effect size)
Study Design: RCT **Intx Category:** Nut+PA **Setting:** Center, Preschool n=15 New South Wales, Australia	**Size:** n=430 (167 ctrl; 263 intx) **Race/ethnicity:** NR **SES:** 47.5% low SES	**Intx Description:** **Munch and Move** ***Staff engagement****:* Increase staff confidence and knowledge to promote strategies within their centers that encourage children's healthy eating, active play, and fundamental movement skills. Duration: 16 months	Researchers audited foods served during lunch: -Servings of SSB: -0.13; **p=0.05** - Servings of fruit: -0.05; p=0.75 - Servings of vegetables: 0.12; p=0.16 - Servings of snacks: 0.06; p=0.75 %: -Balanced lunchbox: 0.85; p=0.72 -Unbalanced lunchbox: 1.18; p=0.72 **PA:** NA **Weight:** NA
Harnack et al., 2012a (same paper as 2012b) **Study Design:** cross-over trial **Intx Category:** Nutrition **Setting:** Center, Head Start n=1 Minneapolis, MN US	**Age:** 2-5y **Size:** n=53 (intx, ctrl NA bc cross-over design) **Race/Ethnicity:** Predominately Black (75.5%) **SES:** NR	**Intx Name:** NA **Intx Description:** ***Meal FB*:** Provided FVs before serving other items via family style during lunch ***Control*:** traditional family style lunch service **Duration**:2 weeks per condition	**Diet: +/Ø** Researchers observed children's lunch intake: -Fruit: 0.40; **p<0.01** -Vegetable: 0.16; p>0.05 -Energy: 237.4; p>0.05 **PA:** NA **Weight:** NA
Hu et al., 2009 **Study Design**: RCT **Intx Category:** Nutrition **Setting:** Centers, Kindergartens n=7 (4intx, 3 ctrl) Hefei, the capital city of Anhui Province, Eastern China	**Age:** 4-6y **Size:** n=1,755 (1042 intx, 713 ctrl) parent-child pairs **Race/Ethnicity:** NR **SES:** NR	**Intx Name:** NR **Intx Description:** ***Nut Ed*:** children received education sessions and nutrition-themed books ***Parent*:** education sessions, pamphlets, and posters displayed in kindergartens ***Control:*** children received a book of general picture stories. **Duration**: 10 months **Follow-up:** 12 months	**Diet: +/Ø** Parents reported intake during previous week via FFQ: Children: -Unhealthy snack intake: p<0.05 -Western style high energy food intake: **p>0.05** Adults: -Fast food intake: p<0.001 -Western style high energy food intake: **p>0.05** **PA:** NA **Weight:** NA

First Author et al., Year Study Design Intervention Focus Setting	Sample Characteristics	Intervention Description	Outcomes Measured Results (effect size)
Harnack et al., 2012b **(same paper as 2012a)** **Study Design:** cross-over trial **Intx Category:** Nutrition **Setting:** Center, Head Start n=1 Minneapolis, MN US	**Age:** 2-5y **Size:** n=53 (intx, ctrl NA bc cross-over design) **Race/Ethnicity:** Predominately Black (75.5%) **SES:** NR	**Intx Name: NA** **Intx Description:** ***Meal FB*:** Provider-portioned lunch service style ***Control*:** traditional family style lunch service **Duration**: 2 weeks per condition	**Diet: -** **Researcher-observed lunch intake:** -Fruit: 0.25; **p<0.001** -Vegetable: 0.11; **p<0.01** -Energy: 284.5; **p<0.001** *All statistically significant in a non-desirable direction **PA:** NA **Weight:** NA
Huss et al., 2013a **(same paper as 2013b)** **Study Design:** Cross-over trial **Intx Category:** Nutrition **Setting:** Center, CCC n=1 (with 4 classrooms) West Lafayette, IN US	**Age:** 2-5y **Size:** n=23 (intx, ctrl NA bc cross-over design) **Race/Ethnicity:** White (56.5%) and Asian (30.4%) **SES:** NR **Other:** Predominately male (74%)	**Intx Name:** NA **Intx Description:** ***Meal FB*:** Manipulated entree portion size (std vs 50% larger). Two meals (fish and pasta) were each served once/wk for 8 weeks in the various combinations (two 4-wk menu rotations). **Duration**: 8 weeks **Follow-up:** 12 weeks	**Diet: Ø** Researchers measured children's plate waste during the lunch meal and estimated kcal intake from: kcal intake from: -Main course: NS -Dessert: NS -Total meal: NS **PA:** NA **Weight:** NA
Huss et al., 2013b **(same paper as 2013a)** **Study Design:** Cross-over trial **Intx Category:** Nutrition **Setting:** Center, CCC n=1 (with 4 classrooms)	**Age:** 2-5y **Size:** n=23 (intx, ctrl NA bc cross-over design) **Race/Ethnicity:** White (56.5%) and Asian (30.4%) **SES:** NR	**Intx Name:** NA **Intx Description:** ***Meal FB*:** Changed timing of dessert (after meal as opposed to with meal). Two meals (fish and pasta) were each served once/wk for 8 weeks in the various combinations (two 4-wk menu rotations). When dessert was served immediately after the main course, the main course was removed from the table leaving the desert as the only food in front of the child. **Duration**: 8 weeks	**Diet: +/Ø** Researchers measured plate waste during the lunch meal to estimate kcal intake from: -Total meal: 9% greater; p**<0.01** -Dessert: 7% greater; 0.05 -Main course: 14% greater; **p<0.04** **PA:** NA **Weight:** NA

First Author et al., Year Study Design Intervention Focus Setting	Sample Characteristics	Intervention Description	Outcomes Measured Results (effect size)
West Lafayette, IN US	**Other:** Predominately male (74%)	**Follow-up:** 12 weeks	
Jones et al., 2011 **Study Design:** cluster RCT **Intx Category:** PA **Setting:** Center, CCCs n=2 (1 intx, 1 ctrl) Australia	**Mean Age:** 4.13y **Size:** n=86 (46 intx, 40 ctrl) **Race/ethnicity:** NR **SES:** NR	**Intx Name:** Jump Start **Intx Description:** ***PA offered*:** structured PA during AM lessons, unstructured PM PA time ***PA environment*:** supports skills being taught ***PA education**:* movement skills development (3 20 min lessons/week for 20 weeks) ***Staff Engagement*:** in-person training/lessons (4 30min workshops) **Intx Duration:** 20 weeks **Follow-up Times:** **PA**: 19 weeks and 6 months **BMI**: 6 months	**PA:** +/Ø Counts per minute during the school day measured by accelerometer: -Counts/min at 19 weeks: 110.48; **p=0.01** Effect size: 0.40 -Counts/min at 6 months: -38,31; p=0.25 % time spent in PA level during the school day measured by accelerometer: -light PA at 19 weeks: -0.06; p=0.97 -MPA at 19 weeks: -0.24; p=0.74 -VPA at 19 weeks: 0.56; p=0.16 -MVPA at 19 weeks: 0.26; p=0.82 -light PA at 6 months: -2.01; p=0.19 -MPA at 6 months: -1.06; p=0.14 -VPA at 6 months: -0.71; p=0.16 -MVPA at 6 months: -1.86; p=0.73 **Weight:** Ø -BMI: -0.8; p=0.53 **Diet:** NA
Kirk et al., 2016 **Study Design:** QE **Intx Category:** PA **Setting:** Center, Head Start preschools n=2 preschools, =4 classrooms total (1 preschool (2 classrooms) intx, 1 preschool (2 classrooms) ctrl)	**Mean Age:** 4.1y **Size:** n=54 (39 intx, 15 ctrl) **Race/ethnicity:** African American **SES:** low SES	**Intx Name:** NA **Intx Description:** ***PA Offered*:** activity lessons (2x/day, 30 min) ***Staff Engagement*:** teacher led lessons, training **Intx Duration:** 8 months **Follow-Up Times:** 4 months and 8 months	**PA:** + Researchers observed PA 2 times per day during activity lessons using SOFIT: -PA score at4 months): **p<0.05** -PA score at8 months): **p<0.05** **Diet:** NA **Weight:** NA

First Author et al., Year Study Design Intervention Focus Setting	Sample Characteristics	Intervention Description	Outcomes Measured Results (effect size)
Location NR			
Krombholz, 2012 **Study Design:** QE **Intx Category:** PA **Setting:** Centers, CCCs n=22 (11 intx, 11 ctrl) Munich, Germany	**Age:** 4.6y=mean **Size:** n=428 (211 intx, 217 ctrl) **Race/Ethnicity:** NR **SES:** NR	**Intx Name:** NA **Intx Description:** ***PA Offered*:** At least one weekly 45-min PE session and other sessions of PA (mainly organized games as well as running, jumping, climbing, kicking, throwing and catching, at least 20 min. per day) on the other days. Indoor or outdoor environments were rearranged to be more activity friendly if necessary. ***Staff:*** received education on benefits of PA for children, educational materials for implementing the PA, training to organize structured PA **Control***: regular curriculum consisting of one* 45-min PA session/wk **Duration**: 20 months **Follow-ups:** 11 and 20 months	**Weight: Ø** -BMI percentile: NS -Skinfold thickness: NS **Diet:** NA **PA:** NA
Korwanich et al., 2008 **Study Design:** RCT **Intx Category:** Nutrition **Setting:** Centers, Nursery Schools n=16 (8 intx, 8 ctrl) Muang District, Phrae Province Thailand	**Age:** 4-5y **Size:** n=219 (135 intx, 84 ctrl) **Race/Ethnicity:** **SES:** low-income **Other:** mainly rural population	**Intx Name:** NA **Intx Description:** ***Policy*:** nut policy for nursery schools created via a 4-step process: selection, advocacy, adoption and implementation. Policy-based activities included: nut guidelines, snack and beverage advising, changing availability of snacks at school shops and home, nut ed and activities, and focus groups with parents, teachers, local health officers, school board members and the public. ***Parent*:** education on Thai RDA, involvement in policy development process, newsletters ***Staff***: teacher education on Thai RDA, involvement in policy development process, newsletters **Control:** no intx **Duration**: 9 months	**Diet: +/ Ø/ -** Researchers observed children's snack intake: -Cariogenic snacks: **p=0.00** -Fresh fruit: p=0.13 -Thai desserts: negative outcome; **p=0.01** -Crispy snacks: **p=0.00** -Sugary drinks: p=0.17 **PA:** NA **Weight:** NA
Kling et al., 2016	**Age:** 3-5y mean=4.4y	**Intx Name:** NA **Intx Description:**	**Diet: +**

First Author et al., Year Study Design Intervention Focus Setting	Sample Characteristics	Intervention Description	Outcomes Measured Results (effect size)
Study Design: Cross-over trial **Intx Category:** Nutrition **Setting:** Centers, CCCs n=3 (11 classrooms) University Park, PA US	**Size:** n=120 (intx, ctrl NA bc cross-over design) **Race/Ethnicity:** Predominately White **SES:** Middle-high income	**Meal FB:** Lunch was served once a week for 6 weeks. Across the 6 meals, all items (food and milk) were served at 3 levels of portion size (100%, 150%, or 200%) and 2 levels of energy density (100% or 142%). *100% is the baseline condition **Duration**: 6 weeks	Researchers measured children's plate waste at lunch: -Total energy intake at lunch: p<0.0001 -Both levels of portion size increase (150% and 200%) had a sig effect on energy intake (+49 and +66 kcal respectively; there was not a sig diff btwn the 150 and 200% conditions). -Increasing meal energy density by 42% also had a sig effect on energy intake (+103 kcal). -Increasing both portion size and energy density had a synergistic effect (+175 kcal in the largest portion + highest energy condition)
Morshed et al., 2016 **Study Design:** RCT **Intx Category:** Nut+PA **Setting:** Rural New Mexico US	**Age:** NA **Size:** Center, Head Start n=16 (8 intx, 8 ctrl)* **Race/ethnicity:** ~40% American Indian centers ~60% Hispanic centers **SES:** NR *unit of analysis was the Center itself	**Intx Name:** Child Health Initiative for Lifelong Eating and Exercise (CHILE) **Intx Description:** ***Nutrition Education:*** curriculum, taste tests ***Meal FB:*** food purchasing, preparation, and serving by HS food service staff ***FB Outside Meals:*** food service component ***PA Education:*** curriculum ***PA Offered:*** add 30 min of PA to class activities (daily) ***Staff Engagement:*** professional development training (quarterly) ***Parent Engagement:*** take-home materials, family events (2x/school year) ***Other - Community:*** local grocery store component, health care provider component **Intx Duration:** 2 academic years **Follow-Up Times:** 2 academic years	**Diet:** Ø Researchers observed food service offerings: -Servings of fruit: 1.02; p>0.05 -Servings of vegetables: 1.07; p>0.05 -Servings of added sugar: 0.94; p>0.05 **PA:** NA **Weight:** NA
Mo-Suwan et al., 1998 **Study Design:** RCT	**Age:** mean = 4.5y n=292 (147 intx, 145 ctrl)	**Intx Name:** NA **Intx Description:**	**Weight: +/Ø** Measured BMI -Triceps Skinfold Thickness (TSF): -0.17; NR

First Author et al., Year Study Design Intervention Focus Setting	Sample Characteristics	Intervention Description	Outcomes Measured Results (effect size)
Intx Category: PA **Setting:** Center, Kindergartens 2 Kindergartens n=10 classes (5 intx, 5 ctrl) Hat Yai, Songkhla, Thailand	**Race/ethnicity:** NR **SES:** Middle SES	***PA offered:*** morning walk (15 min) and afternoon aerobic dance (20 min) (3x/week) Duration: 30 weeks	change over multiple time points - 0-30 wks: -WHCU slope: .86; NR -TSF slope: 1.31; NR girls: -BMI: -0.28; NR -WCHU: -0.26; NR change over multiple time points - 0-30 wks: -BMI slope: .32; NR boys: -BMI: 0.11; NR -WHCU: 0.1; NR change over multiple time points - 0-30 wks: -BMI slope: 1.08; NR **Diet:** NA **PA:** NA
Natale et al., 2013, Natale et al., 2014b, Natale et al., 2017* **Study Design:** cluster RCT **Intx Category:** Nut+PA/Screentime **Setting:** Center, CCCs n=28 (12 intx, 16 ctrl) Miami-Dade City, FL, US	**Age:** 47 months **Size:** n=1211 (NR) **Race/ethnicity:** 56% Hispanic, 33% Black, 7% White, 4% other **SES:** low	**Intx Name:** HC2 - Healthy Caregivers, Healthy Children **Intx Description:** ***Nutrition Education:*** curriculum (daily) ***Meal FB****:* part of policy ***FB Outside Meals:*** part of policy ***PA Offered:*** not clear if offered ***PA Education*****:** curriculum (daily) ***Screentime:*** part of policy ***Parent Engagement:*** training/nutrition education (1x/month for 6 months + 4 booster trainings/year for year 2 and 3) ***Policy:*** healthy beverages, snacks, meals; encourage PA, limit TV/computer use ***Staff Engagement:*** training/nutrition education (1x/month for 6 months + 4 booster trainings/year for year 2 and 3), delivered intx, visits with specialists (20 weekly)	**Diet:** +/Ø Parent reported child intake on the Healthy Kids Checklist: -Child FV intake score at1 year): 0.22; **p=0.04** -Child FV intake score adjusted for parent intake at 1 year: 0.11; p=0.07 -Child FV intake score adjusted for parent & teacher intake at 1 year: -0.21; p=0.34 -Child junk food intake score at 1 year: -0.13; **p=0.01** -Child junk food intake score adjusted for parent intake at 1 year: -0.08; p=0.13 -Child junk food intake score adjusted for parent & teacher at 1 year: -0.13; p=0.26 -Child FV intake score at 2 years: p>0.05 -Child junk food intake score at 2 years): p>0.05 **Weight:** + -BMI in model of trajectory over time at 2 years: -1.95; **p=0.04**

First Author et al., Year Study Design Intervention Focus Setting	Sample Characteristics	Intervention Description	Outcomes Measured Results (effect size)
		Control Description: attention control safety curriculum (3x/year) **Intx Duration:** 1 school year (main intx), booster activities in 2nd year **Follow-up Times:** **Diet**: 1 year and 2 year **BMI**: 2 year	**PA:** NA
Natale et al., 2014a **Study Design:** RCT **Intx Category:** Nut+PA/Screentime **Setting:** Center, childcare n=8 (6 intx, 2 ctrl) Miami-Dade County, FL USA	**Age:** 2-5y **Size:** n=307 (238 intx, 69 ctrl) **Race/ethnicity:** multiple race/ethnicities **SES:** low SES	**Intx Name:** Healthy Inside-Healthy Outside (HI-HO) (modified) **Intx Description:** ***Parent Engagement:*** dinners (monthly), newsletters (monthly), at-home activities ***Policy:*** modify menus, increase water availability, drink policy (substitutions/restrict access to unhealthy), snack policy (substitute), PA policy (increase PA, decrease TV viewing) ***Staff Engagement:*** training (2/center), curriculum*, technical assistance(weekly) **Intx Duration:** 6 months **Follow-up Times:** 3, 6, and 12 months	**PA:** Ø Caregiver reported frequency over the past month on questionnaire using questions extracted from NHANES: -PA at6 months): p>0.05 **Weight:** Ø -BMI z-score at 3 months: p>0.05 -BMI z-score at6 months: 0.32; p>0.05 -BMI z-score at12 months: -0.04; p=0.81 **Diet:** NA
O'Dwyer et al., 2013 **Study Design:** RCT **Intx Category:** PA **Setting:** Center, Preschool n=12 England	**Age:** 3-4.9 years **Size:** n=218 (115 ctrl, 103 intx) **Race/ethnicity:** NR **SES:** Low-income neighborhoods	**Intx Name:** NA **Intx Description:** ***PA Offered***: 60-min session 1 day/week with warm up, dance, gym, games and cool down led by active play professionals and teachers. ***PA Edu***: Posters displayed promoting PA ***Staff*****:** provide staff development and on-going support for teachers who are not PE specialists. ***Control*****:** delivered their usual PA provision.	**Diet:** NA **PA: Ø** Total day PA via accelerometer: -Light PA: 0.1; NS -MVPA: -0.1; NS **Weight:** NA

First Author et al., Year Study Design Intervention Focus Setting	Sample Characteristics	Intervention Description	Outcomes Measured Results (effect size)
		Duration: 6 weeks Follow-up: 6 weeks, 6 months	
Pate et al., 2016 **Study Design:** RCT **Intx Category:** PA **Setting:** Centers, Preschools n=16; 8 intx and 8 ctrl (4 public and 4 private in each group) Austin, TX US	**Age:** 3-5y **Size:** n=379 (191 intx, 188 ctrl) **Race/Ethnicity:** White: 39% ctrl; 44% intx Black: 42% ctrl; 47% intx Other: 18.9% ctrl; 9% intx **SES:** NR	**Intx Name:** SHAPES (Study of Health and Activity in Preschool Environments) **Intx Description:** ***PA*:** (1) teacher-led structured in-class PA opps; (2) structured and unstructured PA opps at recess; and (3) PA integrated into pre-academic lessons. ***PA Environ*:** Social environment modifications included teacher verbal encouragement of PA, teacher participation in PA, and inclusion of MVPA that children enjoy (e.g., dancing, chase games, ball games). Physical environment changes included supplies (e.g., balls, music, scarves), use of space, materials, and existing equipment to engage all children in PA ***Staff:*** Researchers trained teachers to engage children in PA and encouraged teachers to adopt the intx **Duration**: 9 months	**PA: +/Ø** PA time (mins/hr) during the preschool day measured via accelerometer: -MVPA: **p=0.01** -Light PA: p=0.34 -Total PA: p=0.79
Peñalvo et al., 2013a; Peñalvo et al., 2013b; Peñalvo et al., 2015 **Study Design:** RCT **Setting:** Center, public schools n=24 (12 intx, 12 ctrl) Madrid, Spain	**Age:** 3-5 years **Size:** n=2062 **Race/ethnicity:** NR **SES:** NR	**Intx Name:** SI! **Intx Description:** ***Nut Ed*:** curriculum based, audiovisuals, books, games and cooking workshops ***Staff*:** 1 teacher for each school received a 30hr government-certified training on the program. Training booklet and audiovisual material. ***Parents*:** informative letters and leaflets, Program SI! Website, Duration: 3 years	**Diet:** NA **PA:** NA **Weight: +/Ø** Measured -BMI: ANR; p>0.05 -3-year intervention subscapular skinfold z-score: -0.22; **p=0.039** -2-year intervention subscapular skinfold z-score: ANR; p>0.05 -1-year intervention subscapular skinfold z-score: ANR; p>0.05 -WC: -0.1; p=0.179
Reilly et al., 2006 **Study Design:** cluster RCT	**Mean Age:** 4.2y **Size for BMI outcome:**	**Intx Name:** MAGIC **Intx Description:**	**PA:** -/Ø Counts per minute during the whole day measured by accelerometer:

First Author et al., Year Study Design Intervention Focus Setting	Sample Characteristics	Intervention Description	Outcomes Measured Results (effect size)
Intx Category: PA **Setting:** Center, nurseries n=36 (18 intx, 18 ctrl) Glasgow, Scotland	n= 481 (231 intx, 250 ctrl) (6months) n=504 (245 intx, 259 ctrl) (12 months) **Size for PA outcome:** n=285 (NR) (6 months) **Race/ethnicity:** NR **SES:** NR	***PA offered:*** increase levels of PA, teach movement skills (3 30 min sessions/week for 24 weeks) ***PA environment:*** posters about increasing PA (walking & play) (6 weeks) ***Parent engagement:*** written PA education/screen time materials ***Staff Engagement:*** train 2 staff/site (3 sessions) **Control Description:** usual curriculum **Intx Duration:** 24 weeks **Follow-up Times:** **BMI**: 6 months and 12 months **PA**: 6 months	-Counts per min: p=0.18 % waking hours during the whole day spent in PA level measured by accelerometer: **-**MVPA**: p=0.05**, undesired effect **Weight:** Ø -zBMI at 6 months: p= 0.87 -zBMI at 12 months: p=0.90 **Diet:** NA
Roberts-Gray et al., 2016 **Study Design:** RCT **Intx Category:** Nutrition **Setting:** Centers, CCCs n=30 (15 intx, 15 ctrl) Austin, San Antonio and Houston, TX US	**Age:** 3-5 y **Size:** n=646 (349 intx, 279 ctrl) analyzed n=633 (341, 282) at baseline n=608 (340, 268) at 6 weeks n=586 (330, 356) at 22 weeks n=578 (325, 253) at 28 weeks **Race/Ethnicity:** Predominately white (72%) **SES:** Middle-high income (57% of families had annual income >$100,000)	**Intx Name:** Lunch is in the Bag **Intx Description:** ***Nut Ed*:** Lesson plan for: 1. daily teacher-guided lunch unpacking activity to facilitate teacher–child communication about food groups, and 2. activities requiring parents to send materials ***Parents*:** 5 weekly nut handouts and homework activities to inspire dialogue and assist parents in packing a serving from all 5 food groups; 5 weekly activity stations displayed in ECE facility to spark parent–child communication ***Staff:*** session for teachers, materials to facilitate teacher–parent communication about lunches *This study amended the original intervention by creating a classroom activity in which children could earn a gold star certificate, branding the intervention with a squirrel character, and adding a booster week **Duration**: 6 weeks + 1 week booster 22 weeks later **Follow-ups:** 6 weeks, 22 weeks, 28 weeks	**Diet: +/Ø** Researchers observed servings packed in lunches brought from home on 3 random, non-consecutive days: -Vegetables at 6 weeks: **p<0.001** -Vegetables at 22 weeks: NS -Vegetables at 28 weeks: NS -Fruit: p>0.001 at all 3 follow-ups -Sweets at 22 weeks: **p<0.01** **PA:** NA **Weight**: NA

First Author et al., Year Study Design Intervention Focus Setting	Sample Characteristics	Intervention Description	Outcomes Measured Results (effect size)
Roth et al., 2015 **Study Design:** RCT **Intx Category:** Physical Activity **Setting:** Centers, Preschools n=41 (21 intx, 20 ctrl) Urban and rural areas outside 2 cities in Southern Germany	**Age:** 4-5y (mean: 4.7y) **Size:** n=474-666 depending on outcome and f/u (too many figures to report) For main outcome of MVPA, n=598, 474, and 477 for 1st, 2nd and 3rd f/u respectively **Race/Ethnicity:** NR **SES:** Predominately middle and upper SES (75-80%)	**Intx Name:** PAKT (Prevention through Activity in Kindergarten Trial) **Intx Description:** ***PA Offered*:** 30 min/day of teacher-led PA which included instruction for developing specific motor skills; children received PA homework and games to play with family ***Parents*:** 3 interactive lectures on healthy development, flyers ***Control:*** regular PA (no formal motor skill training and no PA promotion) **Duration**:11 months **Follow-ups:** 5-6 mos, 11 mos (end of intx) and 13-15 months post baseline	**PA: +** Time (% total day) spent in MVPA measured via accelerometer: -Average over one week: 0.005; **p=0.049** -Weekday-specific MVPA: 0.011; **p=0.003** **Weight: Ø** -BMI post intx: 0.244; p=0.857 -BMI 2-4 post intx: 0.103; p=0.949 -Skinfold post intx: -1.548; p=0.272 -Skinfold 2-4 post intx: 0.305; p=0.846
Salazar et al., 2014 **Study Design:** cluster RCT **Intx Category:** Nut+PA **Setting:** Center, national day care centers n=4 (2 intx, 2 ctrl) Santiago, Chile	**Age:** 4-5y **Size:** n=265 (120 intx, 145 ctrl) **Race/Ethnicity:** NR **SES:** low	**Intx Name:** NA **Intx Description:** ***Nutrition education:*** no details ***PA education*:** no details ***Parent engagement*:** training, workshops, written materials (screen time and energy-dense foods) ***Staff engagement:*** training and curriculum materials **Intx Duration:** 12 months **Follow-up:** NR	**Weight:** +/Ø Among obese: -zBMI: p=0.64 -skinfold thickness: **p<0.01** -% body fat: **p<0.01** -FMI: **p<0.01** -FFMI: **p<0.01** Among normal wt: -zBMI: p=0.56 -skinfold thickness: **p<0.01** -% body fat: **p<0.01** -FMI: **p<0.01** -FFMI: **p<0.01** **Diet:** NA **PA:** NA
Sweitzer et al., 2010	**Age:** 3-5y	**Intx Name:** Lunch is in the Bag **Intx Description:**	**Diet: +/Ø**

First Author et al., Year Study Design Intervention Focus Setting	Sample Characteristics	Intervention Description	Outcomes Measured Results (effect size)
Study Design: RCT **Intx Category:** Nutrition **Setting:** Centers, CCCs n=6 (3 intx, 3 ctrl) Austin, Texas US	**Size:** n=132 (81 intx, 51 ctrl) parent-child dyads **Race/Ethnicity:** Predominately white (~60%) followed by Asian (28%) **SES:** Middle-high income	***Parents:*** handouts, menu and recipe suggestions, goal-setting activities, social references, and education stations ***Nut Ed:*** arts, crafts, books, games, discussion, and educational stations ***Staff*:** Teacher training **Duration**: 5 weeks **Follow-up:** 6weeks	Researchers observed servings in children's lunches brought from home: Veg: 0.344**; p=0.001** Fruit: 0.065; p=0.60 **PA:** NA **Weight:** NA
Sweitzer et al., 2016 **Study Design:** RCT **Intx Category:** Nutrition **Setting:** Centers, CCCs n=3 (2 intx, 1 ctrl) Austin, TX US	**Age:** 3-5y **Size:** n=107 (59 intx, 48 ctrl) parent-child dyads **Race/Ethnicity:** Predominately white (73%) **SES:** Middle-high	**Intx Name:** Lunch is in the Bag **Intx Description:** ***Nut Ed*:** Lesson plan for: 1. daily teacher-guided lunch sack unpacking activity to facilitate teacher–child communication about food groups, and 2. activities requiring parents to send materials (e.g., empty boxes to build a great "grain train" around the classroom walls) ***Staff:*** session for teachers, materials to facilitate teacher–parent communication about lunches ***Parents*:** 5 weekly nut handouts and homework activities to inspire dialogue and assist parents in packing a serving from all 5 food groups; 5 weekly activity stations displayed in ECE facility to spark parent–child communication ***A booster week was added to the pilot intx activities **Duration**: 5 wks+1 wk booster 20 weeks later **Follow-ups:** 6 weeks and 26 weeks	**Diet: +/Ø** Researchers observed FV servings packed in lunches children brought from home on 3 random, non-consecutive days: -Vegetables at 6 weeks: **p<0.001** -Vegetables at 26 weeks: **p<0.001** -Fruit at 6 weeks: p>0.001 -Fruit at 26 weeks: p>0.001
Trost et al., 2008 **Study Design:** RCT **Intx Category:** PA **Setting:**	**Age:** 3-5 years **Size:** n=42 (20 intx; 22 ctrl) **Race/ethnicity:** NR **SES:** NR	**Intx Name:** NA ***PA Education**:* Opportunities for PA were integrated in curriculum, including math, science, language arts, and nutrition education. ***PA Offered***: ≥2 PA activities lasting ≥10 min. offered 4 days/week. ***Staff engagement***: 3-hr training for teachers and staff.	**Diet:** NA **PA: +** Classroom PA measured via accelerometer. -MVPA: +2 mins; **p<0.05** -VPA: +1.5 mins; **p<0.05** PA- Classroom + outside: -MVPA: +2 mins; **p<0.05**

First Author et al., Year Study Design Intervention Focus Setting	Sample Characteristics	Intervention Description	Outcomes Measured Results (effect size)
Center, Preschool- Half-day n=1 Manhattan, KS, USA		Duration: 8 weeks Follow-up: 10 weeks	-VPA: +1 min; **p<0.05** **Weight:** NA
Vereecken et al., 2009 **Study Design:** RCT **Intx Category:** Nutrition **Setting:** Centers, Preschools n=16 (8 intx, 8 ctrl) Flanders, Belgium	**Age:** 3-4+y **Size:** n=1063 (618 intx, 445 control) FBs avail during morning and afternoon breaks n=476 (308 intx, 168 ctrl) FB intake **Race/Ethnicity:** NR **SES:** NR	**Intx Name:** Beastly Healthy at School **Intx Description:** ***Nut Ed*:** experiential (e.g., tasting), didactic, role modeling, feedback and reinforcement by teachers via stories and characters ***FBs Outside Meals*:** increased availability of healthy foods at snacks and improved cooking equipment ***Parent*:** Newsletters, worksheets for children, evening and other school activities ***Staff***: Teacher trainings, manuals, digital learning environment, newsletters, group discussions; trainings for principals and cafeteria staff, on-demand help via e-mail, feedback to schools **Duration**: 6 months	**Diet: +/ Ø** Teachers observed FBs available during morning and afternoon breaks: -Fruit Juice: 0.04, p=0.629 -Sugary milk drinks: -0.07, p=0.391 -Fresh fruit: 0.09, p=0.161 Caregivers reported children's intake during the last year via FFQ: -Fruit Juice: -10, p=0.594 -Sugary soft drinks: -2; 0.822 -Sugary milk drinks: 9, p=0.458 -Fresh fruit: 9, **p=0.039** -Vegetables: 3, p=0.485 (Units are ml for beverages and g for foods) **PA:** NA **Weight:** NA
Williams et al., 2002 **Study Design:** QE **Intx Category:** Nutrition **Setting:** Centers, Head Start n=9 (6 intx (3 in each of 2 intx conditions), 3 ctrl) Upstate New York, NY US	**Age:** 2-5y **Size:** n=567 at 12 months n=144 at 24 months **Race/Ethnicity:** predominately minority (41% black, 33% Latino) **SES:** Low-income	**Intx Name:** Healthy Start **Intx Description:** ***Meal FBs:*** food service modified to provide ≤30% kcal from total fat and ≤10% kcal from sat fat, while meeting USDA's reimbursable meal pattern, including for kcal. ***FB Outside Meals:*** see Meal FBs ***Nut. Ed*.:** Three intervention centers had nut education and 3 did not, but for the analysis, all 6 centers were grouped together. ***Parent*:** Newsletters, meetings, take-home activities ***Staff***: cooks had 1-day training on menu planning, recipe development, food purchasing and prep; teacher workshop and booster sessions; in centers assigned to	**Diet: +/ Ø** Researchers observed children's plate waste during the school day: -Kcal intake at 12 months: -0.42; **p<0.001** -Kcal intake at 24 months: p>0.05 **PA**: NA **Weight**: NA

First Author et al., Year Study Design Intervention Focus Setting	Sample Characteristics	Intervention Description	Outcomes Measured Results (effect size)
		nut ed, dieticians worked with teachers to improve their knowledge, confidence and motivation. ***Control:*** Food service change-only intx centers and control centers received additional safety ed. All groups received the nut ed in place prior to the study. **Duration**: 2 years **Follow-up:** 1 and 2 years	
Williams et al., 2004 **Study Design:** QE **Intx Category:** Nutrition **Setting:** Centers, Head Start Centers n=9 (6 intx (3 in each of 2 intx conditions), 3 ctrl) Upstate New York, NY US	**Age:** 2-5y **Size:** n=676 (383 intx, 293 ctrl) **Race/Ethnicity:** The majority of the Food Service-Only group was White The majority of the Food Service + Nut. Ed. group was Black. The majority of the control group was Hispanic. **SES:** Low-income	**Intx Name:** Healthy Start **Intx Description:** ***Meal FBs*:** food service modified to provide ≤30% kcal from total fat and ≤10% kcal from sat fat, while meeting USDA's reimbursable meal pattern including adequate kcal intake. ***FBs Outside Meals*:** see Meal FBs ***Nut. Ed*:** Three intervention centers had nut education and 3 did not, but for the analysis, all 6 centers were grouped together. ***Parent Engagement*:** Newsletters, meetings, take-home activities ***Staff*:** cooks had 1-day training on menu planning, recipe development, food purchasing and prep, and changing offerings; teachers attended a training workshop and booster sessions (in centers assigned to nut ed, dieticians worked with teachers to improve their knowledge, confidence and motivation) ***Control*:** Food service change-only intx centers and control centers received additional safety ed. All groups received the usual nut ed. **Duration**: 9 months	**Weight: Ø** -BMI: NS **Diet:** NA **PA:** NA
Williams et al., 2014 **Study Design:** RCT **Intx Category:** Nutrition	**Age:** 4.4y=mean **Size:** n=902 parents (440 intx, 462 ctrl)	**Intx Name:** Eat Well Play Hard Child Care Settings **Intx Description:** ***Nut Ed*:** lesson plans and activities	**Diet: +/Ø** **Parent reported (Questionnaire):** -Cups of vegetables consumed at home: 0.12; **p<0.05**

First Author et al., Year Study Design Intervention Focus Setting	Sample Characteristics	Intervention Description	Outcomes Measured Results (effect size)
Setting: Centers, CCCs n=24 (12 intx, 12 ctrl) New York City, NY USA	child sample NR? **Race/Ethnicity:** Mixed race/ethnicity **SES:** Low	***Parents:*** lesson plans and activities; each module included take-home materials and activities for parents to do with children. ***Policy*:** center directors identified areas of policy improvement for enhancing nutrition. ***Staff***: RDNs taught ≥2 classes for staff to help them integrate the program's messages into classroom activities **Duration**: 6-10 weeks **Follow-up:** 17 weeks	-Cups of fruit consumed at home: 0.06; p>0.05 -Cups of FVs consumed at home: 0.19p>0.05 -# days in the past week child helped self/requested vegetable as snack: 0.34; **p<0.05** -# days in the past week child helped self/requested fruit as snack: 0.24p>0.05 -# days in the past week parent offered vegetable as snack: 0.25p>0.05 -# days in past week parent offered fruit as snack: 0.00p>0.05 **PA:** NA **Weight:** NA
Winter and Sass, 2011 **Study Design:** QE **Intx Category:** Nutrition & PA **Setting:** Centers, Head Starts n=4 Large city in South Texas, US	**Age:** 3-5y **Size:** n=405 (206 intx, 199 ctrl) n=131 (intx, ctrl NR) for PA **SES:** Low-income **Race/Ethnicity:** Predominately Latino (95%)	**Intx Name:** Healthy & Ready to Learn **Intx Description:** ***Nut Ed*:** health-themed storybooks ***PA Ed*:** health-themed storybooks ***PA Offered*:** activities with materials ***Parent*:** monthly sessions focused on motivating parents to engage in healthy behaviors, including increasing FVs and PA and reducing use of sweets as rewards. Promotoras assisted in trainings. ***Control*:** standard curriculum **Duration**: 24 weeks	**PA: Ø** Researchers observed children's PA during teacher-led sessions using SOFIT: -SOFIT PA score: 3.42; p>0.05 **Weight: Ø** -BMI: B=-0.06; p>0.05
Witt and Dunn, 2012 **Study Design:** RCT **Intx Category:** Nutrition & PA **Setting:** Centers, CCCs n=17 (10 intx, 7 ctrl) Boise, ID US	**Age:** 4-5y **Size:** n=263 (165 intx, 98 ctrl) n=153 (83 intx, 70 ctrl) fruit intake n=122 (70 intx, 52 ctrl) veg intake **Race/Ethnicity:** NR **SES:** NR	**Intx Name:** Color Me Healthy **Intx Description:** ***Nut Ed*:** interactive lessons (3x15-30 min/week), with focus on FVs ***PA Ed*:** interactive lessons (3x15-30 min/week), combined with nut ed. ***Parents*:** newsletters **Duration**: 6 weeks **Follow-up:** 3 months	**Diet: +** Researchers measured children's plate waste (% of total served remaining) at snack: -Fruit intake at 1 week: d=1.29; **p<0.001** -Fruit intake at 3 months: d=0.68; **p<0.001** - Veg intake at 1 week: d=0.90; **p<0.001** - Veg intake at 3 months: d=1.20; **p<0.001**

First Author et al., Year Study Design Intervention Focus Setting	Sample Characteristics	Intervention Description	Outcomes Measured Results (effect size)
Yin et al., 2012 **Study Design:** QE **Intx Category:** **Setting:** Centers, Head Start n=3 (2 intx, 1 ctrl) San Antonio, TX US	**Age:** 3-5 y mean=4.1y **Size:** n=276 (179 center-based intx, 97 ctrl) **Race/Ethnicity:** Predominately Hispanic (Mexican-American)-90% **SES:** low	**Intx Name:** Miranos! Look at Us, We Are Healthy! **Intx Description:** ***PA*:** Teachers implemented a structured gross motor skills program during daily outdoor play time (30–45 min: 15-20 min structured and remaining time engaged with children in free play) using Activity Cards with lesson plans and equipment supplied by the study. Before the intx children had unstructured, free play while teachers monitored. ***PA Ed*:** Sesame Street Workshop Healthy Habits for Life (HHL) resource kit, a bilingual health education program with 9 activity modules with physical activities, hands-on games, and interactive DVD activities that can be integrated into daily routines. Supplemented HHL with movement music CDs and storybooks with PA themes. ***Nut Ed*:** storybooks with nut the mess; tasting activities and contests to promote healthy eating (water, low-fat or skim milk, fruits, vegetables, and healthy snacks) during lunch and snacks. ***Staff*:** research team trained teachers and staff to implement a gross motor skills program during daily outdoor play and nut activities **Duration:** 18 weeks	**PA: +** Step score (total step count/duration of observed) during play period measured via pedometer: **p<0.05** **Weight: Ø** -Weight: -0.02 kg; p>0.05 -Weight z-score for age and gender: -0.01; p>0.05 -BMI z-score: -0.04; p>0.05 **Diet:** NA
Yin et al., 2012 **Study Design:** QE **Intx Category:** PA+ Nut **Setting:** Centers, Head Start n=2 (1 intx, 1 ctrl) San Antonio, TX US	**Age:** 3-5 y mean=4.1y **Size:** n=177 (80 center + home intx, 97 ctrl) **Race/Ethnicity:** Predominately Hispanic (Mexican-American)-90% **SES:** low	**Intx Name:** Miranos! Look at Us, We Are Healthy! **Intx Description:** ***PA*:** Teachers implemented a structured gross motor skills program during daily outdoor play time (30–45 min: 15-20 min structured and remaining time engaged with children in free play) using Activity Cards with lesson plans and equipment supplied by the study. Before the intx children had unstructured, free play while teachers monitored. ***PA Ed*:** Sesame Street Workshop Healthy Habits for Life (HHL) resource kit, a bilingual health education program with 9 activity modules with physical	**Diet: +** Researchers measured plate-waste of FVs at lunch on 3 consecutive days: 0.19 servings; **p<0.05** **PA: +** Step score (total step count/duration of observed) during play period measured via pedometer: **p<0.05** **Weight: +/Ø** -Weight: -0.13kg; p<0.08 -Weight z-score for age and gender: -0.06; **p<0.04**

First Author et al., Year Study Design Intervention Focus Setting	Sample Characteristics	Intervention Description	Outcomes Measured Results (effect size)
		activities, hands-on games, and interactive DVD activities that can be integrated into daily routines. Supplemented HHL with movement music CDs and storybooks with PA themes. ***Nut Ed*:** storybooks with nut the mess; tasting activities and contests to promote healthy eating (water, low-fat or skim milk, fruits, vegetables, and healthy snacks) during lunch and snacks. ***Staff*:** research team trained teachers and staff to implement a gross motor skills program during daily outdoor play and nut activities ***Parents*:** 7 parent peer educators were trained to engage other parents during school dismissal period and hold poster education sessions; 14 newsletters; take-home activity bags **Duration**: 18 weeks	-BMI z-score: -0.09; p<0.09
Zhou et al., 2014 **Study Design:** QE-pre-post with control group. **Intx Category:** Nut+PA **Setting:** Center, public childcare (n=2) Beijing, China	**Age:** 3-5 years **Size:** n=357 (139 ctrl, 218 intx) **Race/ethnicity:** NR **SES:** NR	**Intx Name:** NA **Intx Description:** ***PA*:** 60 mins/day sessions for outdoor play for 3-years-old. 90 mins/day of outdoor play for 4 and 5 years-old. All received 10 min exercise routine during recess. ***PA Edu*:** PA curriculum for outdoor play ***PA Env***: portable play equipment to implement PE curriculum ***Meal FB***: planed menus to meet the nutrition regulations and standards and to increase healthy eating choices ***Staff*:** teachers, 20 hour training on child growth and PA. Food services workers, 6 hr training by dietitians about nutrition, menu design, nutrition standards. ***Parents*:** Monthly health education seminars on PA and nutrition, monthly newsletters, interactive internet website for parents, family events. Duration: 12 months	**Diet:** NA **PA:** NA **Weight: +/Ø** Bioelectrical impedance -Body fat %: -1.2%; **p<0.0001** -Fat mass (kg): -0.55; **p<0.0001** -Muscle mass (kg): +0.48; **p<0.0001** -BMI: 0.19; NS -BMI z-score: 0.15; NS

First Author et al., Year Study Design Intervention Focus Setting	Sample Characteristics	Intervention Description	Outcomes Measured Results (effect size)

*All measures of association reported in the intervention results papers are included in this table.

** Multiple papers are cited in the same row when they report on the same study

Intx: Intervention

NS: Not significant, p-value not reported

NR: Not reported, by the study authors

+ : positive/desired/favorable result based on statistical significance.

Ø: null result based on statistical significance.

-: negative/undesired/unfavorable result based on statistical significance.

+/Ø: mix of positive and null results based on statistical significance.

Appendix 2. PubMed Boolean Operator Search Strategy

Setting and Population Words:

child care[tiab] OR childcare[tiab] OR day care[tiab] OR daycare[tiab] OR head start[tiab] OR early care[tiab] OR early education[tiab] OR early childhood education[tiab] OR early childhood program[tiab] OR preschool[tiab] OR preschools[tiab] OR nursery school[tiab] OR nursery schools[tiab] OR prekindergarten[tiab] OR toddler[tiab] OR child[tiab] OR early childhood[tiab]

Intervention and Outcome Words:

healthy eating index[tiab] OR energy intake[tiab] OR consumption[tiab] OR intake[tiab] OR feeding [tiab] OR eat*[tiab] OR calorie[tiab] OR diet[tiab] OR nutrition[tiab] OR dietary sugars[tiab] OR sweetened[tiab] OR sugar[tiab] OR carbonated beverages[tiab] OR soda pop[tiab] OR sugar sweetened beverages[tiab] OR water[tiab] OR junk food[tiab] OR snack[tiab] OR meal[tiab] OR breakfast[tiab] OR lunch[tiab] OR dinner[tiab] OR food[tiab] OR beverages[tiab] OR fruits[tiab] OR vegetables[tiab] OR healthy food[tiab] OR menus[tiab] OR physical activity[tiab] OR exercise[tiab] OR play[tiab] OR activity level[tiab] OR motor activity[tiab] OR vigorous[tiab] OR mvpa[tiab] OR physically active[tiab] OR energy expenditure[tiab] OR motor activity[tiab] OR fitness[tiab] OR physical fitness[tiab] OR physical exertion[tiab] OR sedentary[tiab] OR inactive*[tiab] OR body composition[tiab] OR body weight[tiab] OR body weight change[tiab] OR body mass index[tiab] OR bmi[tiab] OR body fat[tiab] OR adiposity[tiab] OR growth[tiab] OR height[tiab] OR weight[tiab] OR weight gain[tiab] OR overweight[tiab] OR obese[tiab] OR obesity[tiab] OR waist circumference[tiab] OR skin fold[tiab] OR food security[tiab] OR food insecurity[tiab] OR hunger[tiab]

Review Paper Search:

- Yield: **3329** references on 2-12-16
- Date restriction: 01-01-05 to 12-31-16

Primary Paper Search:

- Yield: **280** references on 10-26-16
- Date restriction: 12-01-15 to 12-31-16

Five papers were included that were published prior to 2005 that were either seminal studies in the field[22, 29, 54] and deemed relevant to this literature review or prior studies of more recent interventions[72, 73].

Appendix 3. Outcomes included in the literature review

- Dietary intake
  - Fruits and vegetables
  - Food/beverage categories characterized by added sugar
  - Meal quality
  - Snack quality
  - Energy intake

- Physical Activity
  - Light PA
  - Moderate PA
  - Moderate-vigorous PA
  - Vigorous PA
  - Total PA

- Weight-related/body composition:
  - BMI
  - BMI z-score
  - % Overweight/Obese
  - Skinfold Thickness
  - % Body Fat
  - Waist Circumference

Appendix 4. Definitions of Intervention Components

1. **Nutrition education for children (*Nut. Ed.*)** generally entailed teachers or other trained professionals delivering activity-based curriculum (e.g., games, story books, songs, puppets, videos, etc.) to children in designated, regularly occurring time sessions (i.e., lessons). Teachers or other trained professionals covered topics such as food groups, the human body and digestion, nutrients, and the importance of healthy eating and active living. Some interventions included interactive activities such as food preparation and taste tests. Promotional posters and characters were frequently included.

2. **Foods and/or beverages served during meals (*Meal FB*)** were modified by changing the quantity or frequency of healthy or unhealthy foods and beverages provided to children at meals during the ECE day. Changes often were made to food purchasing, menu planning, food preparation and/or serving practices. Interventions modified water access, portion sizes, energy density, fat or calorie content of meals, nutrition standards, or food service style.

3. **Foods and/or beverages served outside of meals (*FB Outside Meals*)** were modified by changing quantity or frequency of healthy or unhealthy foods and beverages provided to children at snacks or other times during the ECE day. Examples include serving only unsweetened beverages, increasing water access, training food service staff, improving cooking equipment and increasing the availability of healthy items.

4. **Physical activity offered to children (*PA Offered*)** included changes in the quantity or quality of PA opportunities provided to children during the ECE day, including additional indoor or outdoor play time, structured exercise sessions led by teachers or other trained professionals, integration of PA into the academic curriculum, and/or classroom breaks. Activities included running, jumping, climbing, kicking, throwing and catching, and dancing, among others. Most of the interventions with this component included 20-30-minute daily PA sessions.

5. **Changed made to the physical activity environment (*PA Env.*)** changes involved enhancing fixed play structures (e.g., climbing walls, hammocks, tree houses) and/or portable (e.g., balls, cords or stilts) equipment and/or adding markings for activities on the playground and/or classroom.

6. **Physical activity education for children (*PA Ed.*)** generally entailed activity-based curriculum (e.g., games, story books, songs, puppets, etc.) aimed at teaching children about the importance of PA and fun ways to be active. Some interventions emphasized behavioral skills, goal setting and self-monitoring and some included promotional posters displayed at the ECE site.

7. **Screen time regulations (*Screen Time*)** components included education or time limits aimed at reducing watching television, playing videogames, computer and overall electronic media use.

    - ***Parent Engagement*** activities included the distribution of print educational materials (newsletters, pamphlets, recipes, posters, handouts, etc.), activities to promote PA and/or nutrition at home (e.g., PA activity cards, music CDs, DVDs), participation in workshops or

educational sessions and/or attendance at health festivals. Many interventions offered integrated child and parent educational opportunities. Active parent engagement is defined as including in-person educational sessions or meetings and passive parent engagement is defined as exposure to print-based educational materials. Comprehensive parent engagement includes a variety of activities such as interactive education seminars and workshops on PA and nutrition, family events, engagement in project management committees, and at-home activities.

8. **Wellness-Related Policy (*Policy*)** were organization or statewide policies governing nutrition and/or physical activity offerings at ECE sites. Some policies included provisions for teacher and/or staff education.

Appendix 5. Effective Intervention Criteria

- **Effective** interventions demonstrated statistical significance ($p<.05$) for ≥1 SO-related outcome, and had no negative or undesirable outcomes.
- **Ineffective or Null** interventions did not demonstrate statistical significance for ≥1 SO-related outcome. Any studies which had combinations of null or any negative results were also included in this category.

Appendix 6. Magnitude of Effects for Weight Status Outcomes

- Among interventions that reported significant positive weight status outcomes, the following range of magnitudes was observed:

Any Weight Outcomes	All results
BMI	-0.57 (among obese), -0.54, -0.53, -0.53, -0.31, -0.19, -0.06,
BMI z-score	-0.26, , -0.23, -0.23, -0.18, -0.15, -0.14
% Body fat	-1.9, -1.2, -0.07
Subscapular z-score	-0.22
Sum of 4 skinfolds	-2.78mm
WC	-1.0, -0.8

Appendix 7. Definitions and Acronyms

BMI Z-Score: also called BMI standard deviation (s.d.) scores, is the number of standard deviations from the mean and area measures of relative weight adjusted for child age and sex[79]

Body Mass Index (BMI): a person's weight in kilograms divided by their height squared in meters

CACFP: Child and Adult Care Food Program

CCC(s): Childcare center(s)

Duration: The length of time the intervention was implemented

Early Care and Education (ECE): Early Care and Education interventions focused on infants and children aged 0-5; intervention locations may include centers, preschools, Head Start, and/or family child care homes. Interventions in ECE may also focus on adults as appropriate for the setting, e.g. childcare providers, pre-school teachers, aides, afterschool program leads, etc.)[80]

FB: Food and/or Beverage

Follow-up(s): Length of time between the baseline and follow-up measurement(s)

FVs: Fruits and Vegetables

Intervention (Intx): A change in an exposure, either assigned by an investigator or naturally occurring

MPA: Moderate PA

MVPA: Moderate to vigorous PA

NA: Not applicable

NR: Not reported

Overweight: BMI at or above the 85th percentile for weight and height, and below the 95th percentile for children of the same age and sex[81]

Obese: BMI at or above the 95th percentile for weight and height for children of the same age and sex[81]

PA: Physical activity

Percent (%) Body Fat: Total mass of fat (adipose tissue) divided by the total body mass, multiplied by 100

RCT: Randomized-controlled trial

Subscapular skinfold z-score: Z-score for measure of body fat, specifically the thickness of a skinfold in the subscapular area

Sugar-sweetened beverages (SSBs): Drinks with added sugar, including non-diet soft drinks/sodas, flavored juice drinks, sports drinks, sweetened tea and coffee, energy drinks and sweetened milks or milk alternatives.[4]

Sum of four (4) skinfolds: Measure of body fat based on the thickness of a skinfold in four different locations on the body (locations vary by study)

VPA: Vigorous PA

WC: Waist circumference, a measure of abdominal adiposity

Weight Status: Any body weight or body composition measure; including BMI, WC, skinfold, etc.

WG(s): Whole grain(s)