

Effectiveness of Physical Activity Interventions for Preschoolers: A Meta-Analysis

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Purpose: The purpose of the meta-analysis was to examine the effectiveness of physical activity interventions on physical activity participation among preschoolers. A secondary purpose was to investigate the influence of several possible moderator variables (e.g., intervention length, location, leadership, type) on moderate-to-vigorous physical activity (MVPA). **Method:** Nine databases were systematically searched for physical activity interventions. Studies were included if they contained statistics necessary to compute an effect size (ES), were written in or translated into English, examined physical activity in preschoolers, incorporated a physical activity intervention, and targeted preschool-aged children. Fifteen studies satisfied these criteria. ESs were calculated using a random-effects model. **Results:** Results indicated that overall, interventions had a small-to-moderate effect on general physical activity (Hedges $g = 0.44$, $p < .05$, $n = 73$ ESs) and a moderate effect on MVPA (Hedges $g = 0.51$, $p < .05$, $n = 39$ ESs). The greatest effects for MVPA were identified for interventions that were less than 4 weeks in duration, were offered in an early-learning environment, were led by teachers, involved outdoor activity, and incorporated unstructured activity. **Conclusions:** This meta-analysis provides an overview and synthesis of physical activity interventions and highlights effective strategies for future interventions aimed at increasing physical activity levels among preschoolers.

Keywords: efficacy, exercise, meta-analysis, young children

Inactivity may predispose children and youth to developing preventable chronic conditions (Hinkley, Crawford, Salmon, Okely, & Hesketh, 2008) including type 2 diabetes, cardiovascular disease, hypertension, dyslipidemia, sleep apnea, gastrointestinal problems, depression (Daniels, 2006; Reilly, 2005; Strong et al., 2005), and obesity (Marcus et al., 2000; Sturm, 2005). It is therefore recommended that young children engage in sufficient physical activity.

Although a recent Canadian investigation reported that preschoolers are engaging in sufficient levels of physical activity (Obeid, Nguyen, Gabel, & Timmons, 2011), the

majority of the literature on preschool-aged children has contradicted this finding. A systematic review of 39 studies (Tucker, 2008) revealed that the majority reported activity levels below the American Alliance for Health, Physical Education, Recreation and Dance (AAHPERD) guideline (i.e., 60 min of structured and a minimum of 60 min of unstructured physical activity per day; National Association for Sport and Physical Education, 2002). Specifically, Tucker's (2008) review showed that preschoolers engaged in 120 min of physical activity per day in only 23% of the studies. New physical activity guidelines were recently released in Australia (Australian Government, Department of Health & Ageing, 2010), the United Kingdom (*Start Active, Stay Active*, 2011), and Canada (Tremblay et al., 2012). These guidelines now recommend that preschool-aged children participate in 180 min of physical activity (at any intensity) per day. The low activity rates identified in

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Tucker's systematic review, coupled with the new physical activity prescription of 180 min per day, and the many health benefits associated with physical activity engagement highlight the need for interventions targeting the low levels of physical activity participation among preschoolers.

The primary purpose of the present study was to conduct a meta-analysis to examine the effectiveness of interventions that target physical activity participation among preschool-aged children. The secondary purpose was to examine the extent to which intervention characteristics (i.e., moderator variables), including intervention length, location, leadership, type, activity-reporting method, location of play (i.e., indoor vs. outdoor), and nature of physical activity (i.e., unstructured vs. structured), influence moderate-to-vigorous physical activity (MVPA).

METHODS

Data Collection

Nine databases were systematically searched for articles that included a physical activity intervention and provided physical activity participation outcome data. These databases included: Scopus, CINAHL, Embase, PubMed, ProQuest, Medline, PsycINFO, SPORTDiscus, and the Physical Activity Index. Each database was searched using the following keywords: preschool, preschooler, exercise, physical activity, obesity, young child, daycare, child care, childhood obesity intervention, and toddler. Several combinations of these keywords were also used, including, but not limited to¹ physical activity and preschooler, exercise and preschooler, young child and physical activity, toddler and daycare and exercise, and daycare and physical activity.

The reference lists of studies that met the inclusion criteria were also examined. Journal searches were undertaken focusing on those journals that were most likely to publish research pertinent to physical activity in preschoolers. These journals included the *American Journal of Health Behavior*, *Obesity*, *British Medical Journal*, *Research Quarterly for Exercise and Sport*, *Preventive Medicine*, *Pediatric Exercise Science*, and *International Journal of Pediatric Obesity*. Lastly, 30 researchers (i.e., individuals who had published studies in the area of physical activity among preschoolers) were contacted to inquire about unpublished data.

Inclusion Criteria

To be considered for inclusion, studies had to: contain statistics necessary (e.g., means, standard deviations, and sample size; percentages and sample size) to compute an

effect size (ES), be written in or translated into English, provide physical activity data for preschoolers, incorporate a physical activity intervention, and target preschool-aged children. For the purpose of the present study, "preschool-aged" was defined as children aged 2.0 to 5.9 years at the onset of the intervention.

Variables

The dependent variables were general physical activity levels (i.e., all types and intensities of physical activity) and MVPA (moderate- to vigorous-intensity physical activity only). Both of these dependent variables were assessed with a variety of measurement tools including accelerometers, heart rate monitors, pedometers, direct observation, and parent report. Also, a wide variety of metrics was used including activity counts per minute, percent of time spent in physical activity, and minutes of moderate and/or vigorous activity. Table 1 presents a comprehensive list of the general physical activity and MVPA outcome metrics from the original studies. The independent variable was interventions targeting preschoolers' physical activity behaviors. Different conditions of these interventions (i.e., intervention length, intervention location, intervention leadership, intervention type, activity-reporting method, location of play, and nature of physical activity) were identified and examined in relation to MVPA.

Overall Data Analysis

Initially, data were coded by the primary investigator into a database. Subsequently, all of the entries were discussed and double-checked for accuracy by a team of four researchers. The data were then transferred into Comprehensive Meta-Analysis (Borenstein, Hedges, Higgins, & Rothstein, 2005). The ES used was Hedges *g* because it estimates the population ES while statistically adjusting for both sample size and variance (Hedges, 1981, 1982; Hedges & Olkin, 1985). For the purposes of discussion, Cohen's (1988) prescriptions for the interpretation of ESs were used where "small," "medium," and "large" represented Hedges *g* values of 0.20 to 0.49, 0.50 to 0.79, and 0.80 and greater, respectively.

A random-effects model was used because with this protocol, ES calculations are weighted using both within- and between-study variance; a random-effects approach allows for generalizability beyond the studies included (Field, 2001; Hunter & Schmidt, 2000). Statistically significant ESs were those with 95% confidence intervals that did not include, or pass through, 0 (Hedges & Olkin, 1985).

Moderator Analyses

A moderator variable is a factor that can change the basic nature and/or strength of the relationship between an independent variable and the dependent variable (Baron &

¹ For a complete list of the combinations of keywords used in the database searches, please contact the corresponding author.

TABLE 1
Categorization of Dependent Variables

Variable	Variables Included Under Label
General physical activity	Percent time in light physical activity, activity counts per minute (pedometer or accelerometer), physical activity level based on pedometer counts, steps per day (pedometer), parent reporting ("more than enough [activity]," "about the right amount [of activity]," "not enough [activity]"), researcher-observed total physical activity (Environment and Policy Assessment and Observation), researcher reporting ("active play item," "family activity item"), teacher-observed physical activity, exercise frequency, and all variables categorized within the moderate-to-vigorous physical activity variable.
Moderate-to-vigorous physical activity (MVPA)	Moderate-intensity activity (minutes), vigorous-intensity activity (minutes), percent time in moderate-intensity physical activity, percent time in vigorous-intensity physical activity, percent time in moderate- to vigorous-intensity physical activity, physical activity heart rate greater than 50% of resting heart rate index (PAHR > 50 Index), percent time in moderate- to vigorous-intensity physical activity (% MVPA), moderate- to vigorous-intensity physical activity in the classroom and outdoors (MVPA – Classroom + Outdoors), vigorous-intensity physical activity in the classroom and outdoors.

Kenny, 1986). Thus, for example, the length of an intervention could be a moderator in that interventions less than 1 week in duration may not be effective in changing MVPA, whereas interventions of more than 4 weeks in duration may be very effective. Because of the health benefits for children engaging in moderate- to vigorous-intensity physical activity (as opposed to remaining sedentary or only engaging in low-intensity activity), the moderator variables were examined in relation to their influence on MVPA (Abbott & Davies, 2004; Janz, Burns, & Levy, 2005; Janz et al., 2010).

To test the statistical significance among ESs ($p < .05$), one-way analyses of variance (ANOVA) were conducted. If the one-way ANOVA was statistically significant, a Bonferroni correction factor was used for the subsequent post-hoc analysis (overall $p < .05$).

To provide an indication of the robustness of the findings, the "Fail Safe N " statistic was calculated (Rosenthal, 1979). This statistic indicates the number of studies containing null results one would need to find to render statistically significant findings trivial or nonsignificant. This value helps to determine the extent to which publication bias may be present (i.e., a propensity to publish studies that report statistically significant effects; Rosenthal, 1979; Scargle, 2000). It was not appropriate to calculate this value for results that were already found to be statistically "nonsignificant."

RESULTS

Descriptive Statistics and Effect Size

A total of 249 articles were comprehensively reviewed, and 15 independent studies containing a total of 2,618 participants met the inclusion criteria (Table 2). All studies were published between 2004 and 2011, and were conducted in the United States, Scotland, Australia, Belgium, or Israel. The mean age of participants was 4.1

years, with a minimum age of 2.6 years and a maximum age of 5.5 years. Of the 15 studies, 4 presented pretest and posttest data for an intervention group only (i.e., there was no control group), while the remaining 11 presented data for intervention and control groups. When outcome data were available for both intervention and control groups, an ES for the difference between the preintervention (Time 1) and postintervention (Time 2) periods was calculated for each group (i.e., separate ESs were calculated for each dependent variable for both the intervention and control groups). The difference between these ESs (i.e., $ES_{\text{Intervention}} - ES_{\text{Control}}$) was then obtained to determine the magnitude of the intervention effect. For those studies in which no control group was included, the ES was simply the difference between the experimental group's preintervention (Time 1) and postintervention (Time 2) physical activity. These calculations produced a total of 73 ESs for analysis.

Overall Effect Sizes

The results showed that from an overall perspective (i.e., the average of all 73 ESs available in the meta-analysis), interventions targeting preschoolers had a small-to-moderate effect on general physical activity levels ($g = 0.44$, $SD = 0.86$, $p < .05$, 73 ESs). With regards to the robustness of the finding, 569 additional studies containing null results would have been necessary to render this finding nonsignificant. For MVPA, physical activity interventions were associated with a moderate effect ($g = 0.51$, $SD = 0.88$, $p < .05$, 39 ESs); an additional 358 studies containing null results would be needed for this finding to be nonsignificant.

Moderator Variable Analyses for MVPA (Table 3)

Intervention Length

Interventions less than 4 weeks in duration had a large effect ($g = 1.28$) on MVPA, while interventions lasting 4.01 weeks

TABLE 2
Characteristics of Studies Included in the Meta-Analysis ($n = 15$)

Year	Author(s)	Country	Sample (M/F)	Age (Years)	Study Design	Intervention Strategies	Measurement Tool(s)	Moderating Variables	Outcome Measurements
2007	Alhassan, Sirard, & Robinson	United States	32 (20/12)	3.6	RCT	Physical activity opportunities ^a	Accelerometry	Intervention length, location, type, activity report, location of play, nature of physical activity	Counts per minute, % MVPA
2007	Benjamin et al.	United States	17 childcare centers	N/A	CRD	Education ^b	Physical activity and nutrition self-assessment tool	Intervention length, location, leadership, type, activity report	Physical activity score—NAP SACC
2010	Boles, Scharf, & Stark	United States	3 (1/2)	3.9	Pre-post design	Education ^b	Accelerometry	Intervention length, location, leadership, type, activity report	Minutes of MVPA
2009	Cardon, Labarque, Smits, & De Bourdeaudhuij	Belgium	583(306/277)	5.3	CRD	Environmental changes ^c	Accelerometry	Intervention location, leadership, type, activity report, location of play	% time in physical activity
2005	Cottrell et al.	United States	50 (22/28)	5.0	RCT	Education ^b	Pedometer	Intervention length, location, type, activity report	Average weekly steps
2007	Eliakim, Nemet, Balakirski, & Epstein	Israel	101 (N/A)	5.54	RCT	Physical activity opportunities + education ^{a,b}	Pedometer	Intervention length, location, leadership, type, activity report, location of play, nature of physical activity	Steps per day
2005	Fitzgibbon et al.	United States	409 (204/205)	4.1	RCT	Physical activity opportunities + education ^{a,b}	Parent report	Intervention length, location, leadership, type, activity report, nature of physical activity	Exercise intensity and frequency
2006	Fitzgibbon et al.	United States	401 (203/198)	4.2	CRD	Physical activity opportunities + education ^{a,b}	Parent report	Intervention length, location, leadership, type, activity report	Exercise intensity and frequency
2008	Hannon & Brown	United States	64 (30/34)	4.0	Pre-post design	Environmental changes ^c	Accelerometry	Intervention length, location, type, activity report, location of play, nature of physical activity	% time in outdoor physical activity
2011	Jones et al.	Australia	97 (N/A)	4.13	CRD	Physical activity opportunities + education ^{a,b}	Accelerometry	Intervention length, location, leadership, type, activity report, nature of physical activity	% MVPA, counts per minute
2004	McGarvey et al.	United States	186 (87/99)	3.09	NRCPS	Physical activity opportunities + education ^{a,b}	Parent report	Intervention length, location, leadership, type, activity report	Active play, family activity
2007	Parish, Rudisill, & St. Onge	United States	21 (11/10)	2.6	QE	Physical activity opportunities ^a	Heart rate monitoring	Intervention length, location, leadership, type, activity report, nature of physical activity	Heart rate, PAHR > 50 Index
2006	Reilly et al.	Scotland	545 (273/272)	4.2	CRD	Physical activity opportunities + education ^{a,b}	Accelerometry	Intervention length, location, leadership, type, activity report, nature of physical activity	Counts per minute, % MVPA
2008	Trost, Fees, & Dziewaltowski	United States	42 (23/19)	4.05	RCT	Physical activity opportunities ^a	Accelerometry	Intervention length, location, leadership, type, activity report, location of play, nature of physical activity	MVPA + VPA – Classroom + Outdoors
2008	Ward et al.	United States	67 (N/A)	N/A	RCT	Education ^b	Participant observation –teacher	Intervention length, location, leadership, type, activity report	Researcher-observed total physical activity (EPAO)

Note. Study Design: RCT = randomized controlled trial; CRD = cluster randomized design; NRCPS = non-randomized controlled prospective study; QE = quasi-experimental. Measurement Tools: NAP SACC = Nutrition and Physical Activity Self-Assessment for Child Care; EPAO = environment and policy assessment and observation; MVPA = moderate-to-vigorous physical activity.

Intervention Strategies:

^a Physical activity opportunities = the addition of physical activity time in the curriculum

^b Education = the addition of education materials or sessions regarding physical activity

^c Environmental changes = modifications to the childcare center (e.g., changes to the playground, addition of equipment, etc.).

TABLE 3

Effectiveness of Physical Activity Interventions on General Physical Activity and Moderate-to-Vigorous Physical Activity (MVPA) and Effect of Moderator Variables on MVPA

	<i>Number of Effect Sizes</i>	<i>Mean Effect Size (Hedges g)</i>	<i>SD</i>	<i>95% CI</i>	<i>Fail Safe N</i>
<i>Dependent Variable</i>					
General Physical Activity	73	0.44	0.86	0.24, 0.65	569
MVPA	39	0.51	0.88	0.23, 0.80	358
<i>Moderator Variable</i>					
<i>Intervention length (weeks)</i>					
<4.00	16	1.28	0.76	0.88, 1.68	393
4.01–12.00	8	0.28	0.52	–0.15, 0.72	
12.01–26.00	9	–0.18	0.43	–0.51, 0.15	
<i>Intervention location</i>					
Early-learning environment	33	0.66	0.86	0.35, 0.96	402
Home-based component	6	–0.28	0.51	–0.82, 0.26	
<i>Intervention leadership</i>					
Teacher	20	0.24	0.50	0.01, 0.48	76
Parent	4	–0.42	0.60	–1.37, 0.53	
<i>Intervention type</i>					
Physical activity	12	0.43	0.55	0.08, 0.78	91
Education	4	–0.42	0.60	–1.37, 0.53	
Environmental changes	18	0.92	1.00	0.42, 1.42	313
Physical activity + education	5	0.01	0.02	–0.01, 0.03	
<i>Protocols for assessing physical activity</i>					
Accelerometry	36	0.47	0.90	0.17, 0.78	302
Heart rate	3	0.99	0.18	0.54, 1.45	56
<i>Location of play</i>					
Indoor	8	0.28	0.52	–0.15, 0.72	311
Outdoor	19	0.87	1.00	0.38, 1.35	
<i>Nature of physical activity</i>					
Structured	16	0.33	0.50	0.06, 0.60	89
Unstructured	13	1.36	0.83	0.85, 1.84	339

Note. MVPA = moderate-to-vigorous physical activity; SD = standard deviation.

to 12.00 weeks or 12.01 weeks to 26.00 weeks had small effects ($g = 0.28$ and -0.18 , respectively). Statistically significant differences were observed between these three intervention lengths, $F(2, 30) = 17.12$, $p < .001$. Post-hoc analysis revealed that the ES for interventions less than 4.00 weeks in duration was significantly superior to the ESs for interventions administered for 4.01 weeks to 12.00 weeks ($p = .003$) or 12.01 weeks to 26.00 weeks ($p < .001$).

Intervention Location

The early-learning environment had a moderate effect ($g = 0.66$) on preschoolers' MVPA, while interventions with home-based components were associated with a small, negative effect ($g = -0.28$). The difference between these intervention locations was statistically significant, $F(1, 37) = 6.61$, $p = .01$.

Intervention Leadership

Interventions led by teachers had a small effect ($g = 0.24$) on preschoolers' MVPA, while interventions led by parents were associated with a small, negative effect ($g = -0.42$).

The difference between these ESs was statistically significant, $F(1, 22) = 5.63$, $p = .03$.

Intervention Type

Interventions that focused on physical activity alone had a moderate statistically significant effect ($g = 0.43$), while interventions involving environmental changes (e.g., play equipment, floor markings) had a large statistically significant effect ($g = 0.92$) on MVPA. Nonsignificant effects were noted for those interventions that included physical activity plus education ($g = 0.01$) or education alone ($g = -0.42$). An ANOVA showed statistically significant differences were present among the intervention types, $F(3, 35) = 4.24$, $p = .01$. Post-hoc analysis indicated that environmental changes were significantly ($p = .02$) more effective at increasing MVPA than were interventions using education alone.

Protocols for Assessing Physical Activity

Interventions that incorporated an accelerometry-based measure of physical activity had a moderate effect on

MVPA ($g = 0.47$), while those that used heart rate monitoring had a large effect ($g = 0.99$). However, the difference between these two ESs was not statistically significant, $F(1, 37) = 0.97, p = .33$.

Location of Play

Indoor play had a small effect ($g = 0.28$), whereas outdoor play had a large effect ($g = 0.87$) on MVPA. This difference was not statistically significant, $F(1, 25) = 2.40, p = .13$.

Nature of Physical Activity

Interventions that used structured activities had a small effect ($g = 0.33$), while those that consisted of unstructured activities had a large effect ($g = 1.36$) on MVPA. A statistically significant difference was observed between the ESs for structured versus unstructured activities on MVPA, $F(1, 27) = 16.59, p < .001$.

DISCUSSION

Overall, physical activity interventions had a small-to-moderate effect on preschoolers' general physical activity levels and a moderate effect on their level of MVPA. Given that many preschoolers are not meeting current physical activity guidelines (Tucker, 2008), these are promising findings—they suggest that interventions do facilitate increased physical activity participation within this age group. The results of our meta-analysis point to physical activity interventions as viable options for generating moderate changes in MVPA participation among young children. Our findings suggest that physical activity interventions for preschoolers should be developed based on the characteristics that have the greatest effects (i.e., take place in early-learning centers, are led by teachers, and involve outdoor play, unstructured activity, and environmental modifications).

The present study supports the suggestion that the early-learning environment is an ideal venue to facilitate MVPA for preschoolers. This finding is encouraging given the recent heightened interest in the childcare center as an appropriate venue to support physical activity among preschoolers (Benjamin, Craddock, Walker, Slining, & Gillman, 2008; Temple, Naylor, Rhodes, & Higgins, 2009; Tucker & Irwin, 2010; Tucker, van Zandvoort, Burke, & Irwin, 2011; Ward, 2010). Furthermore, the findings of our meta-analysis suggest that physical activity interventions offered by teachers are more successful than are those offered by parents insofar as increased MVPA is concerned. Because many preschoolers spend a good portion of their day in the early-learning environment (Dowda, Pate, Trost, Almeida, & Sirard, 2004; Mulligan, Brimhall, & West, 2005; Pate, Baranowski, Dowda, & Trost, 1996), its potential as a location for physical activity interventions is further supported (Tucker, 2008; Ward,

2010). Children in early-learning centers are a captive audience, and parents of preschoolers have previously reported their reliance on childcare staff/teachers to ensure their children are sufficiently active (Tucker, Irwin, Sangster Bouck, He, & Pollett, 2006).

Physical activity occurring *outdoors* had a large effect on children's engagement in MVPA. This conclusion supports the findings of numerous studies that show that physical activity among preschoolers is correlated with outdoor playtime (Bailey et al., 1995; Baranowski, Thompson, DuRant, Baranowski, & Puhl, 1993; Burdette, Whitaker, & Daniels, 2004; McKenzie, Sallis, Nader, Broyles, & Nelson, 1992; Timmons, Naylor, & Pfeiffer, 2007; Tucker, 2008). This finding reinforces the suggested importance of outdoor play for preschool-aged children. In addition, unstructured physical activity had a large effect on children's MVPA levels. This finding is important for parents and childcare providers to consider when supporting activities and playtime among preschoolers.

Our results are also informative with respect to type of intervention. A variety of formats have been used in preschooler physical activity interventions including: physical activity participation interventions, educational interventions, interventions with both physical activity participation and educational components, and interventions involving environmental changes such as the strategic addition of portable playground equipment or pavement markings. Results of our meta-analysis support the conclusion that in comparison with other types of interventions, those that incorporate environmental changes may show the most promise for increasing preschoolers' MVPA. A change to the environment may have the strongest impact because the modifications typically take place outdoors (Cardon, Labarque, Smits, & De Bourdeaudhuij, 2009; Hannon & Brown, 2008). Given the correlation between increased outdoor playtime and increased physical activity among preschoolers, providing environmental modifications may be an effective approach to improve physical activity behaviors (Baranowski et al., 1993).

Finally, although the results of the present study indicate that interventions targeting MVPA are most effective when administered for less than 4 weeks, the sustainability of physical activity changes remains unclear as many studies introducing intervention programs did not collect follow-up information. Moreover, most interventions that were offered for less than 4 weeks involved environmental changes—an intervention characteristic that was associated with a very large ES. It is possible that the finding that interventions of relatively short durations are most effective is a consequence of the intervention type (i.e., environmental changes), and not as a result of the duration of the intervention. Consequently, it is important to interpret these results with caution.

Although the present study offers a unique contribution to the literature pertaining to preschooler physical activity,

it is not without limitations. First, the majority of the studies included were 24 weeks or less in duration. Therefore, it is unclear whether the impact of the interventions was sustained long-term. Second, meta-analyses compare *identical factors* in *nonidentical* studies (i.e., all studies examined physical activity, although it was measured using a variety of operational definitions in a number of different contexts). Combining studies with such diversity is a common critique of meta-analyses (Thomas & French, 1986).

Despite these limitations, the results of our meta-analysis may help to increase the effectiveness of future interventions by providing a synthesis of the characteristics of effective physical activity interventions targeting preschoolers. Based on the results of our study, interventions targeting MVPA have the most success when they: (a) are provided in the early-learning environment, (b) are directed by teachers, (c) incorporate environmental changes, (d) promote unstructured activities or free play, and (e) provide outdoor play time. Interventions utilizing the aforementioned characteristics appear to be most appropriate for improving physical activity in preschool-aged children.

WHAT DOES THIS ARTICLE ADD?

Our meta-analysis provides an overview and synthesis of physical activity intervention research targeting preschoolers and highlights effective strategies for future interventions. However, the “why” of our results poses a substantial challenge for research. For example, why was the ES for interventions less than 4 weeks in duration superior to those ESs reported for interventions longer than 4 weeks in duration? Why were interventions led by parents associated with a negative effect? The present meta-analysis has allowed for the identification of these and other important research questions concerned with explanation. Finally, the findings of our meta-analysis provide additional directions for future research including, but not limited to, the need for physical activity interventions that: (a) follow preschoolers for longer than 26 weeks to examine whether changes are sustained long term, (b) focus on making environmental modifications to childcare centers, (c) include unstructured outdoor playtime, and (d) offer instructions to childcare staff about how to encourage physical activity. Our study provides an overview of the effectiveness of physical activity intervention characteristics typically adopted for preschool-aged children and offers evidence-informed directions for future researchers implementing such programs.

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