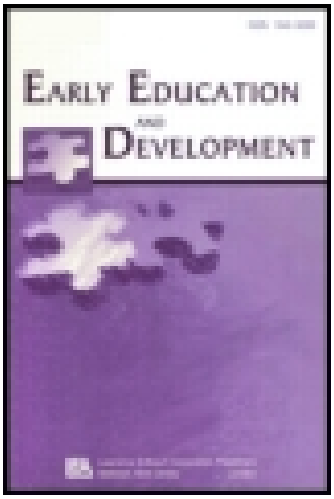

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Allison C. De Marco [a], Susan Zeisel [a] & Samuel L. Odom [a]
[a] Frank Porter Graham Child Development Institute, The University of North Carolina, Chapel Hill
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An Evaluation of a Program to Increase Physical Activity for Young Children in Child Care

Allison C. De Marco, Susan Zeisel, and Samuel L. Odom

Frank Porter Graham Child Development Institute, The University of North Carolina, Chapel Hill

Research Findings: In the past 20 years, obesity rates among U.S. children have skyrocketed. In fact, 15.4% of 2- to 4-year-olds in North Carolina, where this study takes place, are obese, making it the 5th worst obesity rate in the nation. Research indicates that young children in preschool settings largely engage in sedentary activities, demonstrating the need for programs that encourage physical activity. Starting physical activity early helps children set patterns for lifelong learning and participation. In this article we describe the development and evaluation of a program of physical activities, Be Active Kids, designed to increase the level of physical activity of children birth to age 5 in child care settings in North Carolina. Using a single case study, multiple baseline design, we introduced the intervention in 6 classrooms in 3 child care centers. Teachers received a standardized training, and children in each classroom were observed for their level of physical activity during the baseline and treatment phases. Results demonstrated that teacher training and implementation of physical activities increased light and moderate/vigorous physical activity and was particularly effective when activities were teacher directed. *Practice or Policy:* This study provides evidence that a program of physical activity can help even the youngest children to be more physically active.

In the past 20 years, obesity rates among U.S. children and youth have skyrocketed (Ogden, Carroll, Kit, & Flegal, 2012; Pate et al., 2006; Singh, Kogan, & van Dyck, 2010). According to the Centers for Disease Control and Prevention (CDC; 2012), 17% of approximately 12.5 million children ages 2–19 years are obese. This is alarming, as an increasing amount of data suggests that being overweight during childhood and adolescence is significantly associated with insulin resistance, dyslipidemia (disruption in [typically elevation of] the amount of lipids in the blood), and elevated blood pressure later in life (Daniels, 2006). Obese youngsters who lose weight through better nutrition and increased physical activity see an accompanying decrease in insulin concentration and improvement in insulin sensitivity (Steinberger & Daniels, 2003). Furthermore, epidemiological studies have shown that physical activity appears to offer some degree of protection against coronary heart disease (Miller, Rosenbloom, & Silverstein, 2004; Saris, 1985). Research indicates that young children in preschool settings engage in largely sedentary activities (Pate, McIver, Dowda, Brown, & Addy, 2008), demonstrating the need for programs that encourage physical activity. Moreover, the development of appropriate motor skills

Correspondence regarding this article should be addressed to Allison C. De Marco, Frank Porter Graham Child Development Institute, The University of North Carolina at Chapel Hill, 517 South Greensboro Street, Carrboro, NC 27150. E-mail: ademarco@unc.edu

through movement experiences in the early childhood years may lead to more competency in later life, increasing engagement in more physical activities that lead to a healthy lifestyle and increased cognitive development (Gabbard, 2000; Haywood & Getchell, 2001; National Association for Sport and Physical Education [NASPE], 2002; Thompson, Humbert, & Mirwald, 2003). In this article we describe the development and evaluation of a program of physical activities, Be Active Kids,[1] designed to increase the level of physical activity of children birth to age 5 in child care settings in North Carolina.

LITERATURE REVIEW

U.S. children spend at least 4 hr watching television daily (Rideout & Hamel, 2006), although the American Academy of Pediatrics (2010) recommends no more than 1 to 2 hr of quality TV and videos a day for older children and no screen time at all for children younger than 2. In prior research watching television was related to weight status such that more than 2 hr of daily TV watching was a risk factor for higher weight (Saelens et al., 2002). This screen time, coupled with busy family schedules, limited play time and play space (both indoors and outdoors), and perceived safety concerns, results in children who are engaged in little physical activity, including less free play and exploration (Huang, Esposito, Fisher, Mennella, & Hoelscher, 2009; McDermott, 2007). This is compounded by the increased caloric intake from fats and sugars in children's diets (Popkin, 2007; Troiano & Flegal, 1998). In the state of North Carolina, where this project was conducted, 15.4% of children ages 2 to 4 are obese (North Carolina Department of Health and Human Services, 2010), making it the fifth worst obesity rate in the nation (Trust for America's Health, 2008). *Overweight* and *obese* are terms that refer to weights that are greater than what is considered healthy for a specific height and are determined by body mass index, a value calculated from one's height and weight (Vidoni & Ignico, 2010). For the first time in more than 100 years, U.S. children's life expectancies are declining because of the increase in overweight (Olshanksy et al., 2005). Being overweight and the lack of physical activity may lead to coronary heart disease, hypertension, Type II diabetes, and other chronic diseases (Blair & Brodney, 1999; Lichtenstein et al., 2006; Rocchini, 2002). It is not surprising that about one third of overweight preschool children and about one half of overweight school-age children remain overweight in their adult years (CDC, 2009). Childhood obesity also tends to be higher for African American, Latino, and low-income children compared to the general population (Haas et al., 2003; Sherry, Mei, Scanlon, Mokdad, & Grummer-Strawn, 2004).

However, participation in regular physical activity helps build and maintain healthy bones and muscles, reduces the chances of developing obesity and chronic diseases, and may reduce experiences of depression and anxiety (Biddle & Asare, 2011; Janssen & LeBlanc, 2010). Introducing children early to physical activities helps children set patterns for lifelong learning and participation. Recommendations for physical activity in preschoolers suggest that children should be encouraged to develop competence in fundamental motor skills that will serve as the building blocks for future motor skillfulness and physical activity (NASPE, 2009). Beyond resulting in health improvements, physical activity influences other areas of development, including cognition, behavior, and stress management. In school settings increased physical activity is

[1]Blue Cross Blue Shield of North Carolina and Blue Cross Blue Shield of North Carolina Foundation are independent licensees and registered marks of the Blue Cross Blue Shield Association. Be Active Kids is a registered mark of Blue Cross Blue Shield of North Carolina.

related to higher test scores and reduced behavioral problems (Donnelly & Lambourne, 2011). A review of 850 articles by a panel working with the CDC found a positive relationship between physical activity and academic performance as well as strong evidence of beneficial effects on musculoskeletal health, cardiovascular health, and weight in overweight children (Strong et al., 2005). Clearly, it is important to get children moving and keep them moving.

Toward this end, it is essential that parents and caregivers become more involved in children's physical activity and nutrition, influencing children's behaviors and habits when they are young. Child care facilities are excellent settings in which to begin to address physical activity, as 7.4 million children younger than the age of 5, or about 68% of the young children of working mothers, are in some form of care (U.S. Census Bureau, 2011). There is also room to improve. Although one may assume that if children are given the opportunity to be physically active, such as during unstructured free play and recess, they will do so and at a high level of intensity, this is not always the case (Brown, Pfeiffer, McIver, Dowda, Addy, & Pate, 2009). Research has demonstrated that preschoolers are fairly stationary, even when they are playing outside (Pate et al., 2008; Reilly et al., 2004). In fact, they are inactive for much of the preschool day: Observational research with children in 24 preschool programs (including Head Start, faith-based programs, and child care centers) indicated that as much as 89% of the activity could be characterized as sedentary (Pate et al., 2008). Even when children were playing outside, an environment in which they were expected to be moving around, 56% of activity was characterized as sedentary and only 17% was moderate to vigorous (Brown, Pfeiffer, et al., 2009). Furthermore, teachers rarely encouraged children to be physically active or used teacher-arranged activities to promote physical activity (Brown et al., 2006, Brown, Googe, McIver, & Rathel, 2009). Yet child care settings can be an excellent avenue for increasing children's physical activity, as research has demonstrated a relationship between the preschool attended and a child's level of activity (Hinkley, Crawford, Salmon, Okely, & Hesketh, 2008). Interventions for physical activity have focused on children and youth (van Sluijs, McMinn, & Griffin, 2007), but few have been developed or evaluated for use with young children in the child care setting (Campbell & Hesketh, 2007; Chau, 2007; Ward, Vaughn, McWilliams, & Hales, 2010). The current study is one of the few studies to evaluate Be Active Kids, a program of physical activities developed for use with children from birth to 5 years old in their child care settings in North Carolina. The following research questions guided the evaluation of the Be Active Kids intervention, which included teacher training and the introduction of a physical activity curriculum:

1. What is the level of light and moderate/vigorous physical activity at baseline?
2. Does the Be Active Kids intervention increase the amount of light and moderate/vigorous physical activity and decrease the amount of sedentary physical activity?
3. Does the Be Active Kids intervention increase the amount of teacher-directed physical activity?

METHODS

Sites

Child care sites were selected to participate in the Be Active Kids evaluation from among participants in the Shape NC initiative through the North Carolina Partnership for Children/Smart Start, working with their 30 communities and 30 centers. We selected three child care centers

within a 1-hr radius of The University of North Carolina at Chapel Hill to minimize travel time: a church-based child care center, a language immersion center, and a community child care center in a more rural part of the state. We implemented the program in two classrooms for each age group in the three centers—toddlers (1–2 years), twos (2–3 years), and preschoolers (4–5 years)—for a total of six program classrooms. School 1 had a toddlers and a twos classroom. School 2 had a twos and a preschool classroom. School 3 had a toddlers and a preschool classroom. We were limited to three programs given the resources available to run the project. However, this included six classrooms, which, according to the What Works Clearinghouse, is the minimum required to meet standards for a multiple baseline single case design (Kratochwill et al., 2010).

Intervention

Be Active Kids physical activity program. A series of physical activities designed to increase activity levels and geared toward each age group were designed based on a review of existing programs; recommendations for physical activity (American Academy of Pediatrics, 2010; Dowda, Pate, Trost, Almeida, & Sirard, 2004; McCall & Craft, 2004; NASPE, 2009; National Research Council, 2011; Pica, 2007; Sharma, Chuanh, & Hedberg, 2011; Ward et al., 2010); and key informant interviews and consultation with early childhood educators, physical education and inclusion specialists, and physical therapists. Up to 40 activities were created for each age group and inserted into notebooks along with directions for setting up and leading each activity, adaptations to assist with the inclusion of children with disabilities, suggestions for ways to simplify or make the activity more challenging, and ideas for including content related to early numeracy and literacy. The activities were first piloted with nine child care classrooms at a lab center at a major university. The researchers trained the pilot teachers on the program (described below) and subsequently observed the classroom teachers as they tried out the activities. Pilot teachers provided written feedback about their experiences with the activities. These suggestions were then incorporated into the activity program prior to the evaluation, which included deleting some activities and modifying others.

Teacher training. The teachers at each center received a 2-hr training conducted by the project investigators to introduce the Be Active Kids physical activity program. All teachers, both lead teachers and assistants, attended the training. They first received information about the importance of promoting physical activity in child care settings to combat obesity and influence children's behaviors and habits early. We also noted the links between physical activity and other areas of development, including cognition, behavior, and stress. We then covered motor development and the important physical milestones attained in the first 5 years. Strategies were given for how to incorporate physical activity into the child care day and how to prepare to teach the lessons in the program. In addition, teachers were given tips for how to make activities more active, such as decreasing wait times and increasing activity levels in more traditionally sedentary or light activities. Teachers were then provided with suggestions on how to modify physical activities for use with young children with developmental disabilities. The training concluded with a presentation of the physical activities and accompanying materials so that teachers could review the program and ask any questions. Teachers received a notebook with introductory sections reviewing the material from the training sessions and activities for them to implement in their

classrooms, both indoors and outdoors. In addition they received age-appropriate materials to carry out the activities. These included items such as balls, chalk, scarves, beanbags, bubble soap, floor markers, cones, and hula hoops.

Teachers were asked to incorporate activities into their lesson plans. They were specifically asked to use an indoor and outdoor lesson on days the researchers were observing their classrooms and were encouraged to try many activities and to incorporate them at other times. They were also asked to record the activities in their lesson plans and encouraged to adapt the activities to meet their specific space and any limitations specific to their class. Treatment integrity was monitored through the collection and review of these lesson plans.

It is also important to note that it was not possible to blind teachers to the nature of the study because the intervention was the training about physical activity in child care settings and the use of the developed activities. Multiple baseline single case design studies, such as this one, are created to demonstrate that the intervention itself is producing the effect, and the participants serve as their own comparison groups. Thus, given that the teachers were aware of the nature of the study from the beginning, Hawthorne effects, if they existed, would have been evident in both phases.

Data Collection

Evaluation data were collected through standardized classroom observations and surveys. To examine the effectiveness of the physical activity program we used a single case study (SCD), multiple baseline design with three treatment groups (child care centers) that received the intervention at different times to demonstrate a potential effect multiple times (Kratochwill et al., 2010). Like gold-standard randomized controlled trial designs, SCDs are designed to address threats to internal validity. Internal validity may be strengthened in these designs through replication or randomization (Kratochwill & Levin, 2010). However, randomization in SCDs is rare (Kratochwill et al., 2010). Instead, most SCD researchers address internal validity concerns through the structure of the design and systematic replication of the intervention effect during the experiment (e.g., Horner et al., 2005; Kazdin, 1982; Kratochwill & Levin, 1992). This was the approach we took here. Assignment of classroom observation periods was based on classroom availability. The design was further strengthened by the lack of attrition of teaching staff in study classrooms across the observation period.

Each classroom was observed five times prior to the intervention (baseline phase) and five times after the intervention (treatment phase), the start times of which were staggered by several weeks. After the five initial observations using the PlayCheck observation system described below, each center received the training and information on how to incorporate the physical activity program into the child care day. Teachers then implemented the program with their children. The six classrooms each received an incentive of $100 per classroom.

Each center director completed a short demographic survey about her center. Data collected included the school schedule; total number of children and number of children per age group; race/ethnicity of children; number of children with a disability; and star rating, which is used as an indicator of child care quality in North Carolina and ranges from a low of 1 to a high of 5. The lead teacher in each of the six classrooms completed a demographic survey about her classroom. This survey sought information about the age group cared for; number of children; number

of adults; gender, race/ethnicity, disability status of the children; and lead teacher's educational attainment, age, race/ethnicity, number of years providing child care, tenure at the current center, and experience with physical activity programs for young children.

Classroom observation. The observation procedure, PlayCheck, and manual were adapted from the Observational System for Recording Physical Activity in Children–Preschool (OSRAC-P). The OSRAC-P Coding System was initially developed in 2002 (Brown et al., 2006), combining two observational systems, the Children's Activity Rating Scale (Puhl, Greaves, Hoyt, & Baranowski, 1990) and the Code for Active Student Engagement Revised (Brown, Odom, Li, & Zercher, 1999). The OSRAC-P is a direct observational system designed to collect information about children's physical activity in preschools (e.g., classrooms, child care settings) and the behavioral (e.g., prompts for physical activity) and contextual (e.g., location of physical activity, immediate educational/play context, group composition) circumstances of their physical activity in those environments. Unlike the OSRAC-P, which is a *focal child* system in which a single child serves as the focus of the observation and all decisions about categories to be coded are made in reference to that focal child, our adapted PlayCheck version was a *whole-class* system because we were interested in how the new physical activity program impacted the physical activity level of the entire child care classroom. For the PlayCheck we coded in three categories: (a) children's physical activity level (moderate/vigorous, light, or sedentary), (b) information about the physical environment (e.g., indoors or outdoors, weather), and (c) information about the social environment relative to each observed child (i.e., free play/teacher led, group composition, number of teachers, and prompts to encourage or discourage physical activity). The operational definitions for activity level, prompts, and free play/teacher directed are given in Table 1. This table provides the code, a definition for each, and an example.

TABLE 1
Operational Definitions of PlayCheck Codes

Code	*Definition*	*Example*
Sedentary physical activity	Stationary/motionless (resting state/motionless with head, finger, hand, or foot or writing and drawing movement only and no major limb movement or two major joint movements)	Sits passively looking at book or having a book read to child
Light physical activity	Stationary with easy movement of limb(s) or trunk (arm, trunk, or leg movements without moving the entire body from one place to another) and translocation (moving body from one location to another at a slow and easy pace)	Throwing ball or object without translocating
Moderate/vigorous physical activity	Translocation (moving body from one location to another at a moderate, fast, or very fast pace)	Two repetitions of skipping, hopping, jumping, leaping, kicking, or galloping
Encourage prompt	Teacher prompted the focal child to engage in or maintain physical activity	Teacher says to the focal child, ''Run fast as you can!''
Discourage prompt	Teacher prompted the focal child to stop or decrease physical activity	Teacher tells Jo, who is peddling furiously, to slow down on the tricycle
Free play	The child is engaged in self-directed activity	Independent digging in the sandbox
Teacher directed	The teacher is leading an activity	Ring-around-the-rosy

The physical activity categories describing the level of intensity were derived from those developed for the original observational system, the OSRAC-P. The original system had five physical activity level categories: stationary/motionless, stationary with movement of limbs or trunk, slow/easy movement, moderate movement, and fast movement (''OSRAC-P Training Manual,'' 2012). Van Cauwenberghe, Gubbels, De Bourdeaudhuij, and Cardon (2011) conducted a validity evaluation comparing ActiGraph activity counts to OSRAC-P activity intensity. The evaluation found that mean ActiGraph activity counts were significantly and positively associated with mean OSRAC-P activity intensity ($r = .66$, $p < .001$; $n = 31$). Furthermore, the correlation between the ActiGraph activity counts and the OSRAC-P activity intensity level during each observation interval was significant and positive ($r = .52$, $p < .001$; $n = 4{,}218$).

Upon consultation with one of the OSRAC-P developers it was determined that collapsing the five categories to three would best suit our purposes, so we combined stationary with movement of limbs or trunk and slow/easy movement as ''light'' and moderate movement and fast movement as ''moderate/vigorous.'' The developers also used three collapsed categories in later research (Pate et al., 2008). Stationary movement is represented as a resting state or involves very limited or confined movement. Limb/trunk physical activity represents nonvigorous arm, leg, and trunk movement but no translocation from one place to another. Slow/easy movement must include translocation with both feet when walking.

In conjunction with computer programmers, the PlayCheck system was developed using a momentary time-sampling procedure for collecting observational information. Using this procedure, observers watched each child (up to 10 children per observation session) in a classroom or an outdoor environment for 2 min, making a recording every 10 s, for a total 20-min recording period given 10 children. The 10-s recording cycle included observing for 7 s and then recording three items (activity level; type = free play/teacher directed, indoor/outdoor; and encourage/discourage prompt) in 3 s, for a total of 12 recordings for each child in the 2-min segment. Tones and flashes from the system prompted each recording period. For each observation period there were two 20-min coding periods, one inside and one outside. For each recording interval the observer recorded the highest level of physical activity observed—moderate/vigorous, light, sedentary, or unknown if the child had gone out of sight. Observational data were collected on Acer tablet computers and downloaded into an Excel database.

Observers were trained to use the modified observation system, the PlayCheck system, by watching videos of children's physical activity in child care settings and discussing codes to come to a common understanding of the operationalized definitions of each activity level (moderate/vigorous, light, and sedentary). There were three observers, each of whom had an extensive background in child care and child care observation systems. Two of the observers had previous experience developing and evaluating a program of physical activities for young children with special needs. Observers then did in situ observations at local child care centers to become familiar and comfortable with the procedure. Once comfortable in situ, each observer viewed and coded three reliability videos recorded at a local nonevaluation site child care program to assess interobserver agreement (IOA). IOA was calculated through proportional agreement, one of the common statistical measures of reliability in SCD (Hartmann, Barrios, & Wood, 2004). According to Hartmann and colleagues (2004), minimum acceptable values of IOA range from .80 to .90 (on average). IOAs for this project averaged .87 (.75–.98) across codes. Once observations were under way, periodic reliability observations across phases were conducted for 10% of visits to assess IOA. Assessed through proportional agreement, IOAs averaged .88 (.75–.98).

At the start of each observation period 10 children were selected for observation if the class contained more than 10 students. Until observers became familiar with the students numbered vests were used to identify the next child to be observed. During observations, observers situated themselves within 10 to 15 feet of each child so that they could see the child, peers, and adults in the immediate group; see any physical activity; and hear any directions or interactions among children and adults. With tones and changes of screen color, the tablet prompted the observer when to make each recording and when to move to the next child, following prenumbered children in order.

Data Analysis

Descriptive statistics, including means, standard deviations, and frequencies, were run for the center and classroom surveys to describe the evaluation sites. Proportions of time spent in each physical activity level aggregated across all observed children overall and by free play or teacher directed were calculated across the preintervention and the postintervention observations. These proportions were then used to create graphs to visually display changes in physical activity. In addition, effect sizes were calculated with Tau-*U*s (Parker & Vannest, 2009). Tau-*U* is a method for single case research to measure data nonoverlap between two phases (baseline and intervention). The index is well suited for small data sets following the ''S'' sampling distribution (similar to the Mann–Whitney *U* and Kendall's rank correlation); thus, *p* values and confidence intervals are available (Vannest, Parker, & Gonen, 2011). A strength of this technique is the ability to analyze data for several phase contrasts, here baseline to intervention, from a single design independently (Parker, Vannest, Davis, & Sauber, 2011).

RESULTS

Demographics

The demographics of the Be Active Kids evaluation centers and each classroom are provided in Table 2 along with descriptions of each center. Table 3 displays demographic characteristics of the study teachers. The centers were fairly large, averaging 90 children with about 13 teachers. Enrolled children were largely White (74.6%). Few children were identified as having disabilities. Star ratings were high, averaging 4.7 stars out of 5.

School 1 was located in a church in a larger university town in North Carolina. The school had an enrollment of 73 primarily White (96%) children, from infants through preschoolers. The center employed 14 teachers. Three of the five lead teachers had a bachelor's degree and averaged 11.5 years of experience. Few children ($n = 2$) had a disability. The school earned 5 stars on the North Carolina star rating system. School 2 was a 5-star private center and was located in a medium-size college town in North Carolina. Eighty-three children were enrolled. Of these, close to half (47%) were White, 30% were Latino, and 12% were multicultural. The center employed 12 teachers. Three of the seven lead teachers had bachelor's degrees. On average, the teachers had more than 11 years of child care experience. Close to 5% of children ($n = 4$) had a disability. School 3 was a private center in a small North Carolina town in a more rural part of the state. There were 116 children enrolled, from infants to 5-year-olds. Of the children enrolled, 81% were White

TABLE 2
Be Active Kids Evaluation Center and Classroom Description

Variable	*M* (SD) *or* % (n) *of Classrooms*	*Min and Max*
Total children	90.7 (22.5)	73–116
Total teachers	13.3 (1.2)	12–14
Percent White children	74.6% (25.1)	46.9%–95.8%
Percent African American children	6.9% (7.3)	0%–14.6%
Percent Latino children	11.4% (16.2)	1.4%–30.1%
Percent Asian children	2.1% (2.5)	0%–4.8%
Percent children of another race[a]	5.0% (6.0)	1.4%–12%
Number of children with disabilities	3.3 (1.2)	2–4
Star rating[b]	4.7 (0.6)	4–5
School schedule	2 @ 7 a.m.–6 p.m. 1 @ 7:30 a.m.–5:30 p.m.	
Age group cared for		
Infants	25% (2)	
Toddlers	25% (2)	
Twos	25% (2)	
Preschool	25% (2)	
Total children in classroom	14.3 (5.5)	8–24
Total adults in classroom	2.8 (0.9)	2–4
Number of boys	7.1 (2.9)	3–12
Number of girls	7.1 (4.1)	3–15

[a]''Other'' were described as Trinidadian, Indian, and multicultural.
[b]Two centers had 5 stars and one had 4 stars.

and 15% were African American. There were 14 teachers. Only one of the lead teachers had a bachelor's degree. They averaged close to 10 years of child care experience. Only four children (3.4%) were identified as having a disability. The center had earned 4 stars.

Overall, the classrooms averaged 14.3 students ($SD = 5.5$, range = 8–24). Classes averaged about three teachers, and classes were evenly split between boys and girls (see Table 2). Most of the lead teachers in study classrooms had at least a 2-year degree (see Table 3). Teaching staff were more diverse than the students, with 37.5% White teachers. Both experience in the child care field and tenure at the current center were extensive. Just one teacher had prior experience with physical activity in child care settings.

Physical Activity

Overall, moderate/vigorous physical activity was low prior to the intervention, occurring in only 12.2% of the observation periods, similar to previous research (e.g., Brown, Pfeiffer, et al., 2009). Sedentary activity, such as digging in the sandbox (25.6%), and light activity, such as slow walking or sliding down a slide (61.6%), were much more common than light or moderate/vigorous activity. After the implementation of the physical activity intervention, in general, moderate/vigorous and light physical activity increased (to 16.6% and 64.3%, respectively) and sedentary behavior decreased (to 18.9%).

TABLE 3
Demographics of Lead Teachers in Study Classrooms ($n = 8$)

Variable	*M* (SD) *or* % (n)
Highest level of education	
High school diploma or equivalent	25% (2)
Associate's, 2-year degree	50% (4)
Bachelor's degree	25% (2)
Degrees attained	
High school diploma or equivalent	100% (7, 1 missing)
Associate's, 2-year degree	62.5% (5)
Bachelor's degree	25% (2)
Master's degree	0
Doctoral degree	0
Certifications[a]	37.5% (3)
Female	100%
Age	
Younger than 30	0
30–39	37.5% (3)
40–49	50% (4)
50–59	12.5% (1)
60 or older	0
Race/ethnicity	
White	37.5% (3)
Black/African American	25% (2)
Latino	37.5% (3)
Primary role	
Early childhood teacher	100% (8)
Special education teacher	0
Teacher's assistant	0
Experience (years)	12.4 (4.9; range = 6–21)
Tenure at center	
0–1 years	12.5% (1)
1–2 years	0
2–3 years	0
More than 3 years	87.5% (7)
Experience with physical activity programs for young children ages 0–5	12.5% (1)

[a]Certifications include Early Childhood Education Credential and K–5 Credential.

Visual analysis. Figure 1 provides a visual depiction of the changes from baseline to the treatment phase for moderate/vigorous, light, and sedentary physical activity. In this figure observations have been aggregated across classrooms and combined for each phase. There was much more change in physical activity level once the Be Active Kids program was introduced for teacher-directed physical activity, including a large decline in sedentary activity compared to activity that was not teacher directed.

Figures 2 and 3 provide a visual representation of the multiple baseline design, in which two classrooms entered the treatment phases every 3 weeks, at Weeks 6, 9, and 12. The unit of measure was the percentage of observation segments. In the non-teacher-directed graphs (see Figure 2)

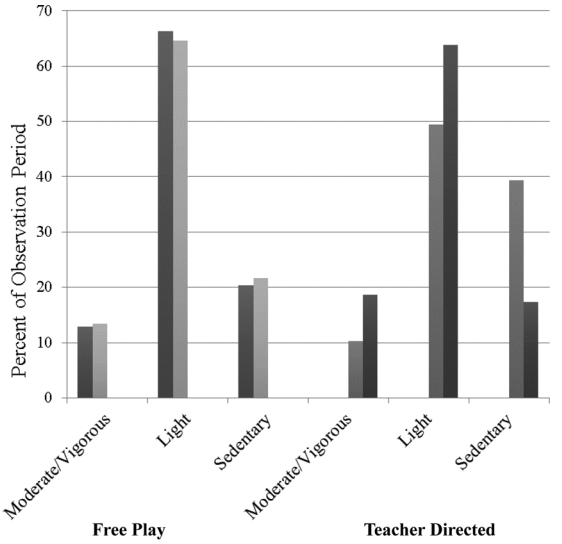

FIGURE 1 Proportion of physical activity observed during the baseline (left bar) and treatment (right bar) phases—comparing free play and teacher-directed activity.

there is less consistent improvement from the baseline to treatment phases. In Figure 3, which indicates activity level during the teacher-directed periods, there is little regularity during the baseline observations, particularly for School 3. However, in the treatment phase moderate/vigorous and light activity levels were consistently higher and sedentary activity was consistently lower. For example, in Classroom 3B, a preschool class, during free play observation periods the proportion of observed moderate/vigorous physical activity decreased from an initial baseline mean of 20.27% (15.06–24.66) to a mean of 12.18% (0–31.94) during the intervention, light activity went from 65.37% (52.65–83.26) to 47.24% (0–82.35), and sedentary activity actually increased from 14.19% (1.67–26.55) to 20.58% (0–50). When teachers were leading the activities in 3B the proportion of moderate/vigorous physical activity increased from 5.43% (0–20) to 18.92% (8.44–25.84) at intervention, light activity also increased from 47.90% (0–100) to 64.12% (54.12–71.57), and sedentary activity decreased from 26.67% (0–76.19) to 16.75% (9.9–21.18). In a younger classroom of toddlers, 1B, this difference was also evident. When activities were not teacher directed, moderate/vigorous activity increased minimally from 8.34% (2.86–17.02) to 8.56% (0–15.56), light activity decreased slightly from 69.90% (65.96–73.65) at baseline to 63.29% (45.39–72.5) at the intervention, and sedentary activity again actually increased from 21.09% (17.02–26.03) to 28.01% (13.33–49.65). During the teacher-directed observation period these toddlers saw more improvement in their moderate/vigorous and light activity and decreased their sedentary activity: Moderate/vigorous increased from 5.24% (0–11.32) to 8.27% (2.65–18.63), light activity increased substantially from 47.65% (33–60.38) to 77.82% (69.61–87.61), and sedentary activity decreased quite a bit from 44.14% (16.98–57.14) to 13.52% (9.73–23.76). The other four classrooms largely followed similar patterns across activity levels.

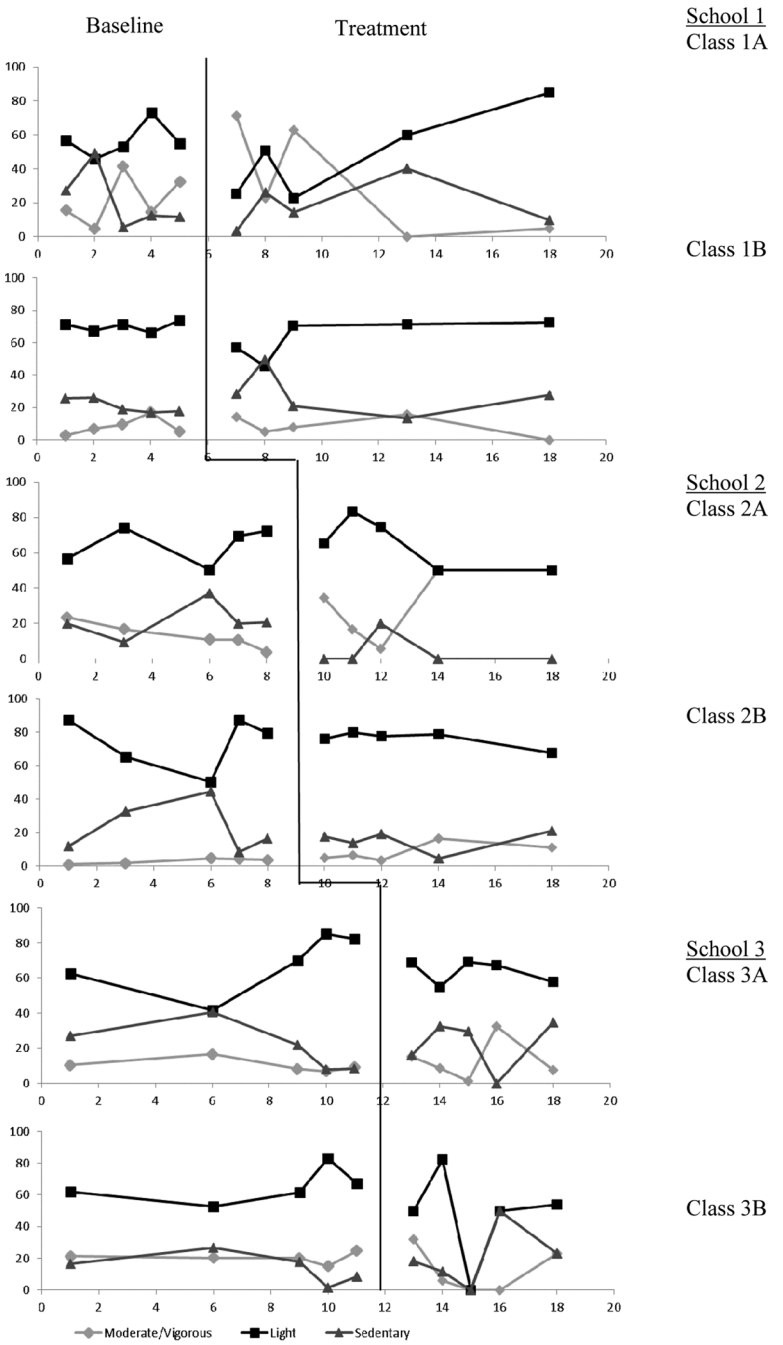

FIGURE 2 Multiple baseline design for non-teacher-directed activity. x-axis = week of observation; y-axis = percentage of observation period.

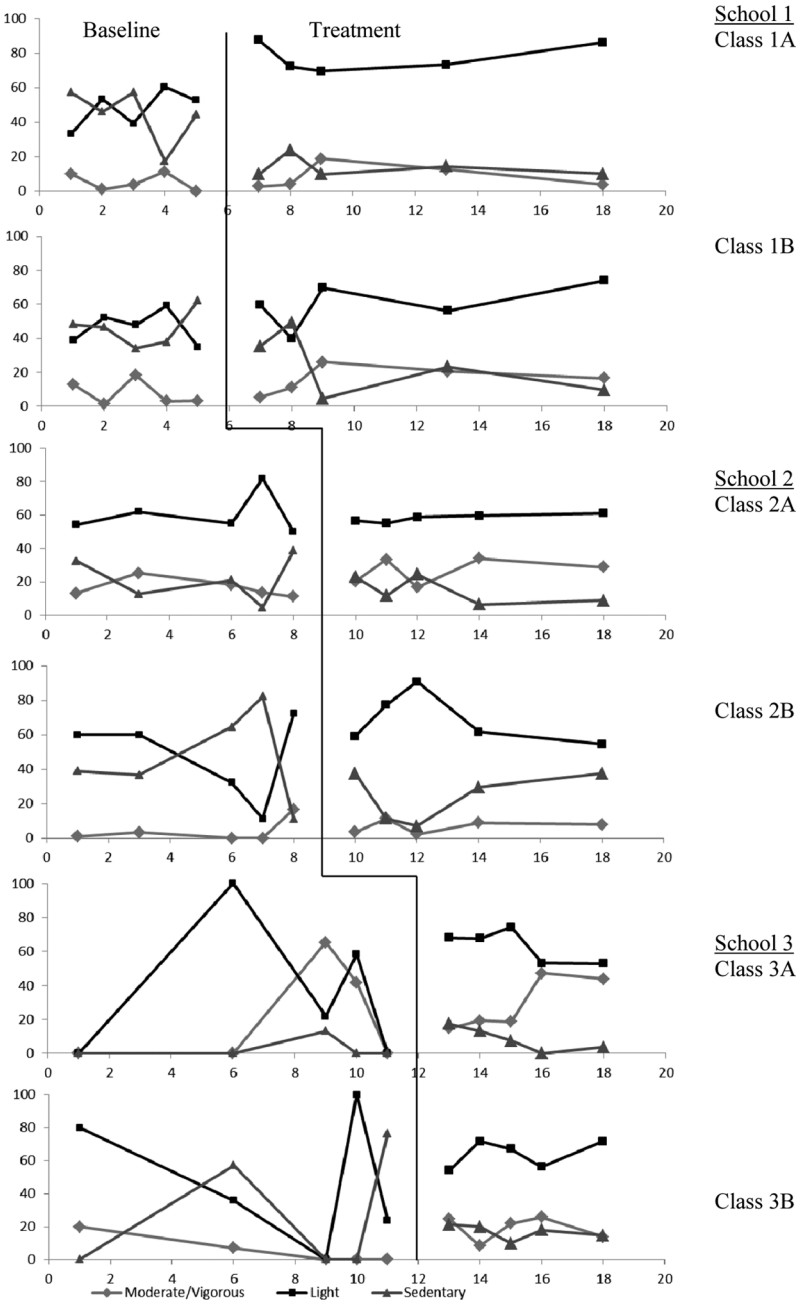

FIGURE 3 Multiple baseline design for teacher-directed activity. x-axis = week of observation; y-axis = percentage of observation period.

Effect size. Nonparametric statistical analyses of effect size, Tau-*U* (Parker et al., 2011), were conducted to supplement the visual analyses provided in Figures 2 and 3 and to evaluate the practical significance of differences between the two phases, baseline and intervention (Parker, Hagan-Burke, & Vannest, 2007; Ximenes, Manolov, Solanas, & Quera, 2009). The Tau-*U* effect sizes in Table 4 provide a statistical comparison between non-teacher-directed and teacher-directed physical activity for each evaluation classroom. Effect sizes can be interpreted according to the following range of Tau-*U* scores: weak or small effects = 0–0.65, medium to high effects = 0.66–0.92, and large or strong effects = 0.93–1.0 (Parker & Vannest, 2009). Overall, 94% of the data from teacher-directed physical activity (17 of 18 effect sizes) showed improvement between the baseline and intervention phases compared to only 39% (7 of 18 effect sizes) when activities were not teacher directed. More effect sizes were in the medium to large range when activities were teacher directed. This was particularly true for moderate/vigorous activity (with Tau-*U*s ranging from 0.36 to 0.84) and sedentary activity (ranging from 0.20 to −0.92), for which effect sizes were 0.50 or above for four of the six classrooms. Light activity had the smallest effect sizes (ranging from 0.12 to 1.0), as there was less change from the baseline to treatment phases. Effect sizes were in the expected direction for non-teacher-directed activity but were not of the same magnitude, with only two showing medium or large effects (−0.92 for sedentary in Class 2A and 0.76 for moderate/vigorous for Class 2B).

TABLE 4
Tau-*U* Effect Sizes and Confidence Intervals by Evaluation Classroom

		Teacher Directed		*Non–Teacher Directed*	
School/ Classroom	*Activity Level*	*Tau-U Effect Size*	*90% Confidence Interval*	*Tau-U Effect Size*	*90% Confidence Interval*
1A	Sedentary	−0.60†	−1.23, 0.03	−0.12	−0.75, 0.51
	Light	0.68†	0.05, 1.31	−0.20	−0.83, 0.43
	Moderate/vigorous	0.60†	−0.03, 1.23	0.12	−0.51, 0.75
1B	Sedentary	−0.92**	−1.55, −0.29	0.44	−0.19, 1.07
	Light	1**	0.37, 1.63	−0.36	−0.99, 0.27
	Moderate/vigorous	0.36	−0.27, 0.99	−0.04	−0.67, 0.59
2A	Sedentary	−0.28	−0.91, 0.35	−0.92**	−1.55, −0.29
	Light	0.12	−0.51, 0.75	−0.04	−0.67, 0.59
	Moderate/vigorous	0.76*	0.13, 1.39	0.56	−0.07, 1.19
2B	Sedentary	−0.52	−1.15, 0.11	−0.12	−0.75, 0.51
	Light	0.44	−0.19, 1.07	−0.12	−0.75, 0.51
	Moderate/vigorous	0.52	−0.11, 1.15	0.76*	0.13, 1.39
3A	Sedentary	0.60†	−0.03, 1.23	0.12	−0.51, 0.75
	Light	0.44	−0.19, 1.07	−0.36	−0.99, 0.27
	Moderate/vigorous	0.36	−0.27, 0.99	−0.04	−0.67, 0.59
3B	Sedentary	0.20	−0.43, 0.83	0.20	−0.43, 0.83
	Light	0.20	−0.43, 0.83	−0.60†	−1.23, 0.03
	Moderate/vigorous	0.84*	0.21, 1.47	−0.28	−0.91, 0.35

†$p < .10$. *$p < .05$. **$p < .01$.

DISCUSSION

This study evaluated a physical activity program, Be Active Kids, for very young children in child care settings accompanied by a teacher training component that provides some evidence that such a program can increase the level of physical activity. Consistent with previous research (Brown, Pfeiffer, et al., 2009), activity in these child care centers was largely light or sedentary prior to the introduction of the physical activity program. Overall, from preintervention to post-intervention four of the six classrooms saw increased moderate/vigorous physical activity, light physical activity increased in three classrooms, and sedentary physical activity decreased in five. The biggest increases in physical activity were found during teacher-directed activity. In teacher-directed activities moderate/vigorous and light activity increased in five and six classrooms, respectively. These findings demonstrate the success that teacher training has on increasing physical activity for children in child care settings. Teachers are more comfortable providing safe and developmentally appropriate physical activities for children that promote healthier child outcomes.

Practice Implications

Given the rate of obesity among children in the United States, the implementation of physical activity should be a priority for child care settings. This was highlighted by the recent launch of the First Lady's Let's Move! Child Care initiative, which provided a nationwide call to child care providers to make positive, healthy changes in the way they serve children (Nemours Foundation, 2012). Based on this national charge and the findings from this evaluation, incorporating teacher-directed physical activity into the child care day can make a difference by increasing the amount of moderate/vigorous and light physical activity that young children participate in. Although self-directed free play is essential for child development (Bergen, 2009; Russ, 1993), in this case we found that the physical activity level was lower during free play activities. This finding dovetails with the idea of intentional teaching, in which teachers have specific outcomes or goals for children's learning and development (Epstein, 2007). Previous research also discovered that teacher-implemented activities increased moderate to vigorous physical activity during intervention days for five children in two preschool programs (Brown et al., 2009). Moreover, in their recent article Pate and colleagues (2013) acknowledged the need to better understand how to promote physical activity in young children, laying out the top 10 research questions related to physical activity in preschool children. Based on these findings, to combat obesity and promote a healthy lifestyle early on, child care teachers need to take the lead to ensure that high levels of physical activities are taking place, highlighting the need for teacher training as recommended in a recent review (Kreichauf et al., 2012). Providing space, materials, and teacher encouragement without specific directions for free play that encourage children to move more is another step child care centers can take to increase physical activity.

Furthermore, although we did not separately code teacher strategies we did anecdotally observe that teachers appeared much more planful in reducing lines and wait times for children during teacher-directed physical activity, which was emphasized during the teacher training. This may be a good method for making an activity more physically active. Teachers should be cognizant of having sufficient equipment so that children do not have to wait long for a turn

or provide alternative activities for those awaiting a turn, such as hopping in place or clapping and cheering as their classmates complete the activity.

Limitations

The findings should be interpreted in light of study limitations. First, the evaluation was conducted with three child care centers that were part of Shape NC, an initiative in child care settings focused on change in policies, practices, and environments to increase physical activity and healthy eating (Blue Cross Blue Shield of North Carolina Foundation, 2013). In conjunction with the North Carolina Partnership for Children, the Blue Cross Blue Shield of North Carolina Foundation launched a 3-year project to fight childhood obesity. Participating child care programs worked on improving their nutrition and physical activity policies and increased active play environments by creating outdoor learning environments and utilizing existing programs such as Be Active Kids. Thus, these centers may have been predisposed to implement the program and encourage increased physical activity, as the directors of these sites were already committed to increasing physical activity and were encouraging their teachers to do so. Second, we had hoped to be able to document changes in lesson planning through a review of lesson plans. Although we observed teachers utilizing the activities provided, not all teachers documented their use in their lesson plans. Thus, it was hard to determine from lesson plans whether there was actually a change in planning for physical activities. Third, although the baseline and intervention phases were staggered across time and fit the timing we had for the evaluation, the study design could have been stronger had we included additional baseline measures in Schools 2 and 3 while School 1 implemented the intervention. In addition, the baseline could have been continued for School 3 while the intervention was applied to Schools 1 and 2. This model will be incorporated into future evaluation efforts. Finally, the study design lacked a systematic examination of the sites for factors such as lack of indoor or outdoor space or materials that might limit children's opportunities for physical activity. These conditions may have impacted implementation of the physical activities in ways that could have depressed physical activity.

Future Directions

As next steps it would be useful to evaluate the program with a wider variety of child care centers and even with less formal child care providers who provide much of the child care in rural communities (Ghazvini, Mullis, Mullis, & Park, 1999; Smith, 2006; Walker & Reschke, 2004). It would also be valuable to modify the PlayCheck observation system to include some additional codes, including strategies teachers incorporate from the training to increase physical activity among their children. Future evaluations should also incorporate a follow-up to determine whether teachers continue using the lessons after the completion of the study. Future directions may also include broadening the teacher training to include a coaching session in which trainers provide onsite, live cues to the teachers during physical activity periods. Cues may include suggestions for how to better structure an activity, how to minimize wait times, or when and how to encourage a child's physical activity.

Furthermore, although this study examined individual children for defined periods of time in order to get a snapshot of classroom activity levels, a more thorough observation of single

children for longer periods of time may allow researchers to obtain a picture of the activity patterns of individual children both before and after the introduction of the intervention. By sampling multiple children for longer periods researchers could obtain a more detailed picture of classroom activity. Longer periods of observation would also provide additional information on ways in which teachers encourage and discourage physical activity. One of the biggest factors determining the amount of physical activity is teacher attitude and involvement (Brown, Googe, et al., 2009). A study of teacher and director attitudes and whether training improves attitudes about the importance of physical activity and promotion of activity would help inform future directions for interventions. A detailed examination of indoor and outdoor spaces before and after the intervention would also yield information about barriers to physical activity and allow for the development of modifications that could encourage more physical activity. Each lesson in the evaluated program includes suggestions for curricular concepts. Examining how teachers incorporate these curricular concepts while encouraging physical activity would also provide valuable information about what activities work best and are the most likely to be used in child care settings. For example, activities that have explicit directions for how to also include early numeracy skills may be more attractive to teachers. Lastly, assisting sites to develop a physical activity resource center and examining teacher use would yield information about what teachers use in their activities. This resource center could include music, props such as musical instruments, materials to encourage gross motor skills such as paddle balls, as well as books that include movement and stories that link to activities to expand the concepts into other areas of learning.

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