

This is the peer reviewed version of the following article: Howie, E. and Brewer, A. and Dowda, M. and Mciver, K. and Saunders, R. and Pate, R. 2016. A Tale of 2 Teachers: A Preschool Physical Activity Intervention Case Study. Journal of School Health. 86 (1): pp. 23-30.E], which has been published in final form at <http://doi.org/10.1111/josh.12352>. This article may be used for non-commercial purposes in accordance with Wiley Terms and Conditions for Self-Archiving at <http://olabout.wiley.com/WileyCDA/Section/id-820227.html#terms>

## **A tale of two teachers: A preschool physical activity intervention case study**

Erin Kaye Howie, PhD  
Department of Exercise Science, University of South Carolina  
Current Affiliation:  
Postdoctoral Research Fellow, Department of Physiotherapy and Exercise Science, Curtin  
University  
GPU Box U1987  
Perth, Western Australia 6845  
Phone: +61 8 9266 4660  
Email: [howieek@email.sc.edu](mailto:howieek@email.sc.edu)

Alisa Brewer, MSPH  
Department of Exercise Science, University of South Carolina  
Current Affiliation:  
Director, Community Engagement & Outreach, Virginia Commonwealth University  
Center on Health Disparities  
P.O. Box 980501  
Richmond, CA 232928  
Phone: (804) 828-6890  
Email: [aebrewer@vcu.edu](mailto:aebrewer@vcu.edu)

Marsha Dowda, PhD  
Data Manager/Biostatistician  
Department of Exercise Science, University of South Carolina  
Suite 212, 921 Assembly St  
Columbia, SC 29208  
Phone: (803) 777-7165  
Email: [mdowda@mailbox.sc.edu](mailto:mdowda@mailbox.sc.edu)

Kerry L. McIver, PhD  
Measurement Coordinator  
Department of Exercise Science, University of South Carolina  
Suite 212, 921 Assembly St  
Columbia, SC 29208  
Phone: (803) 777-4418  
Email: [mciverkl@mailbox.sc.edu](mailto:mciverkl@mailbox.sc.edu)

Dale Murrie, MAT  
Project Coordinator  
Department of Exercise Science, University of South Carolina  
Suite 212, 921 Assembly St  
Columbia, SC 29208  
Phone: (803) 777-1023  
Email: brabhamd@mailbox.sc.edu

Ruth Saunders, PhD  
Associate Professor  
Department of Health Promotion, Education, and Behavior, University of South Carolina  
915 Green Street, Room 529  
Columbia, SC 29208  
Phone: (803) 777-2871  
Email: rsaunder@mailbox.sc.edu

Russell R. Pate, PhD (corresponding author)  
Professor  
Department of Exercise Science, University of South Carolina  
Suite 212, 921 Assembly St  
Columbia, SC 29208  
Phone: (803) 777-2456  
Email: rpate@mailbox.sc.edu

**Keywords:** physical activity, preschool, intervention, implementation

## **ABSTRACT**

**BACKGROUND:** Preschool settings vary greatly, and research has shown that interventions are more successful when they can be adapted to individual settings. This is a descriptive case study of how two teachers successfully adapted and implemented a preschool physical activity intervention.

**METHODS:** The Study of Health and Activity in Preschool Environments (SHAPES) was a three-year physical activity intervention. A detailed case study of two high-implementing teachers was conducted. Multiple data sources included accelerometry, direct observation, teacher surveys and intervention staff field notes.

**RESULTS:** Teacher A focused on integrating physical activity into a wide range of activities, including parent and community events. Teacher B focused on high-intensity, structured activities. Both teachers supported the intervention, worked closely with intervention staff, and operated their classroom as an autonomous unit with support from their directors. Teacher A provided an average of 31.5, 78.0 and 67.5 minutes of physical activity opportunity per day of observation during Years 1, 2, and 3. Teacher B provided an average of 2.7, 33.5, and 73.3 minutes of physical activity opportunity per day of observation.

**CONCLUSION:** Successful implementation of physical activity interventions may look different in different contexts; thus, interventions should allow for flexible implementation.

**Keywords:** children, physical activity, intervention, preschool

Few Americans, including young children, meet recommendations for physical activity<sup>1-3</sup>. Young children spend significant amounts of time in childcare and preschool settings, and the centers they attend significantly influence their physical activity levels<sup>4,5</sup>. Unfortunately, while in those settings, children are primarily sedentary<sup>4,6</sup>. Thus, researchers and policy makers have identified preschools as a critical setting to increase physical activity opportunities for young children<sup>7-9</sup>.

Interventions can increase physical activity in preschool children<sup>10-13</sup>, but the results of intervention studies have varied<sup>14</sup>. This may be due in part to variability in the ways preschools implement interventions<sup>15,16</sup>. Implementation is influenced by context, including individual and organizational factors<sup>17,18</sup>. Due to contextual variations, an intervention that is successful in one preschool<sup>19</sup> may be less successful in a different setting<sup>20</sup>. Therefore, it may be optimal for teachers to customize interventions to fit their specific context<sup>21,22</sup>.

Despite the need to better understand contextual factors that influence implementation in schools, few studies include in-depth descriptions of the implementation process<sup>23</sup>. This type of research, known as Type 3 evidence, focuses on the design and implementation of the intervention, contextual factors influencing implementation, and intervention acceptability<sup>24</sup>. This approach answers important questions about “real-world” implementation of interventions that can help to increase the success of public health interventions. It is common practice for real-world interventions to be adapted based on individual contexts<sup>25-27</sup>, but the details of tailored implementation are lost when intervention outcomes from several schools or units are reported together. For example, only half of the studies reporting the results of childhood obesity interventions included information on how the intervention was modified<sup>28</sup>. This case

study provides two examples of successful physical activity intervention implementation in two preschool classrooms. Two successful classrooms were selected, rather than a low implementing classroom, to illustrate “what works” in a flexible, adaptive intervention approach. This approach may provide information that typical reports of intervention effects do not, and this information can be used to inform future intervention efforts. A better understanding of the factors that influence implementation and the ways interventions are successfully adapted will help practitioners replicate successful interventions to increase physical activity in preschools.

## **Methods**

This case study takes a holistic approach<sup>29</sup>, using both qualitative and quantitative methods<sup>30</sup> and multiple data sources. The two preschools were part of a larger randomized control trial, the Study of Health and Activity in Preschool Environments (SHAPES) (5R01HD055451), in which 16 preschools in Columbia, South Carolina were randomized to receive either a three-year physical activity intervention or a delayed intervention.

### *Case Selection*

Study investigators and research staff used three data sources to identify high-implementing classrooms: child-level accelerometry data, directly-observed process evaluation data, and field notes and interactions. The full protocol has been described in detail elsewhere<sup>31</sup>. Briefly, accelerometers (Actigraph GT1M and GT3x, Pensacola, FL, USA) were used to collect physical activity data on participating children for five school days at the beginning and end of each school year. The Observational System for Recording Physical Activity in Children – Preschool Version (OSRAC-P)<sup>32</sup> and a summative process evaluation were used by independent observers to directly observe classroom-level physical activity behaviors. These measures are

further described in sections that follow. Intervention staff recorded independent process data throughout the intervention, including detailed field notes, participation records and communications with teachers. Three investigator/research staff teams analyzed the data independently, and each team identified three high-implementing classrooms. Two highly performing classrooms were identified by all three research teams; these classrooms were selected for this case study.

#### *Intervention summary*

The SHAPES intervention was based on the social ecological model<sup>33</sup>. The intervention targeted the instructional, social and physical environments and was designed to be flexible and adaptable while maintaining fidelity to the intervention elements<sup>34,35</sup>. Teachers were provided with example activities, but SHAPES was not a scripted curriculum. It focused on incorporating physical activity into multiple opportunities throughout the preschool day, in ways that fit each classroom and teacher. The intervention staff utilized several research-based behavioral change strategies, including modelling, social support and goal setting. These strategies were not specified *a priori*, but were included in the trainings and intervention materials as needed throughout the intervention. In a collaborative process, intervention staff and teachers produced and altered intervention components and materials throughout the three-year intervention, while maintaining the essential components of the intervention.<sup>36</sup> Intervention staff utilized process evaluations, field notes, and feedback from teachers to identify areas of weakness and make changes to or supplement the intervention.

The final intervention components consisted of three targeted physical activity opportunities: Move Inside, Move Outside and Move to Learn. Move Inside included

opportunities that occurred within the classroom, without a traditional learning component (i.e., math, reading, science), such as physical education, dancing, or aerobic exercises. Move Outside was recess that occurred outdoors. Move to Learn included opportunities with an academic component, such as moving while counting or acting out a story. The intervention also targeted changes in the social and physical environments to increase physical activity. These changes included verbal encouragement and participation by teachers and providing adequate space and resources for physical activity. Primary intervention implementation activities included initial teacher trainings (N=1) and workshops (N=7), regular site visits by intervention staff, newsletters, provision of physical activity equipment, and distribution of activity examples. During site visits, intervention staff facilitated teacher-led activities, provided additional intervention materials and discussed barriers and solutions with teachers. The frequency of staff contact was reduced across the three years of intervention. A more detailed description is provided elsewhere.<sup>31</sup>

### *Measures*

To assess intervention fidelity, four data sources were used, as shown in TABLE 1. The Observational System for Recording Physical Activity in Children – Preschool Version (OSRAC-P), is a validated momentary time sampling observation system that was used to assess classroom physical activity behavior<sup>32</sup>. OSRAC-P assesses young children’s physical activity as well as contextual factors (eg group context or adult involvement). Students selected at random are observed for 5 seconds, followed by a 25-second record interval. The process observation tool was a standardized checklist completed by an independent observer to record classroom physical activity opportunities, child enjoyment, adult behavior, and activities conducted by the



teachers. Observations were completed twice per year. Teachers completed surveys in the spring of Year 1 and the fall and spring of Years 2 and 3. In addition, intervention staff recorded process data throughout the intervention, including detailed field notes, training participation records and communications with teachers.

### *Analysis*

Intervention field notes, OSRAC-P direct observations, and process observations were compiled for the two selected teachers by year. A case study approach based on naturalistic inquiry was used to investigate events as they occurred naturally in their environment.<sup>37</sup> A thematic analysis was used to identify themes among and across cases<sup>38</sup> ~~using methods from grounded theory research were used~~. Data for each teacher were reviewed by the lead author for emerging themes, including their most common physical activity opportunity, examples of each intervention component, and deviations from the original intervention. Results were summarized and reviewed by intervention staff (Author AEB).

To ensure the rigor of this qualitative study, trustworthiness, including credibility, dependability and confirmability,<sup>39</sup> was established through the following methods. The credibility of the study, referred to as validity in quantitative studies, was strengthened through the use of multiple sources (independent observers, teachers, intervention staff) and multiple methods (surveys, interviews, objective measures and observations).<sup>40</sup> Dependability (reliability) and confirmability (objectivity) were established through an audit trail.<sup>39</sup> An audit trail was maintained throughout the study and consisted of all correspondence with teachers and administrators, emails, interview transcripts, field notes, accelerometer and observation data, and written documents from schools.

## RESULTS

### Teacher A

*Classroom description.* Teacher A, who had more than 20 years of teaching experience, faced recurring health issues that limited her participation in physical activity. Her classroom, Classroom A, was located within a public elementary school. The elementary school had two separate preschool programs. Classroom A was a full-day, tuition-based program; the other program was a publicly-funded, Title I program that served students from low-income and at-risk families. The two programs had separate teachers and directors, with limited interaction. Teacher A had two assistants who changed each year. Classroom A's program offered extended care until 6:00 pm and was located in a large, double classroom. The classroom had its own age-appropriate playground adjacent to the classroom. Classroom A did not have formal physical education and Teacher A did not have any formal physical education training. A summary of Teacher A's demographics and involvement in the intervention is shown in TABLE 2.

*Intervention Summary.* Overall, Teacher A expressed enjoyment of the SHAPES experience, particularly working with fellow teachers at workshops. She saw SHAPES as a way to integrate movement within the curriculum. During the three-year intervention, Teacher A was a strong advocate for the Move to Learn component, which incorporated physical activity in pre-academic lessons, which include early childhood activities prior to formal schooling that teach fundamental skills. In an interview, she described physical activity as:

It's essential and part of how we learn. It's educational. Movement in the classroom isn't just jumping up and down. Movement is using equipment properly...a way for the children to learn about their hearts.

As part of academics, she said that “moving [keeps students] engaged in curriculum [and works] when being observed by the [school] district.” She did note some limitations of Move to Learn, compared to other activities: “It may not always be high intensity, but something beneficial is happening.” Indicative of the value she placed on Move to Learn, Teacher A added a summary of each child’s moving and learning to parent progress reports.

***Move Inside.*** Favorite Move Inside activities of the teacher and her assistants included dancing to music during circle, large group, and center time. Assistant teachers often led these activities, using internet video links of dancing and movement.

During Year 1, Teacher A focused more on skill development activities. Working with intervention staff, she created lesson-themed physical activity centers. For example, during March, children could participate in the leprechaun trail center during free play time and roll through the field of shamrocks, jump over the rainbow, and throw gold into the leprechaun’s pot. Teacher A also used music to promote object control and skills such as balancing a beanbag on various body parts.

To improve the reach of physical activity opportunities, intervention staff worked with Teacher A to include activities in which all children participated actively. One Move Inside example was a musical chairs game. Teacher A encouraged all students who were “out” to actively cheer (jump, dance, etc.) for the remaining players.

During Year 3, an assistant teacher in Classroom A utilized an interactive presentation tool, SmartBoard, to lead physical activities. She compiled a list of physically-active video links, chosen from a variety of internet sources. Children selected videos from the list and participated

in the physical activities the videos presented. This became a daily activity opportunity, highly requested by the students.

***Move Outside.*** Teacher A provided multiple sessions and long durations (30 to 60 minutes) of daily outdoor recess. Additionally, she and her assistants initiated structured activities, including laps around the playground, tag, basketball, and parachute games. Another favorite activity was described by Teacher A this way:

Our best recess station is listening to SHAPES music blaring out our classroom window! The children are enjoying spring and moving to the beat of their favorites!

Similar to most teachers in the intervention, Teacher A did not often lead structured activities at recess. However, during Year 1, she began to try to incorporate such activities. They had short races and, with intervention staff help, tried to teach the children tag. These games were complicated for the students to follow. Teacher A and her staff continued to sample and adapt structured activities, and successfully integrated structured activities into recess during Year 3. The assistant teachers set up a race course with supplied cones and gave children lap counters. Children were able to participate as they wanted and, during an observation, most children participated for a sustained amount of time.

Teacher A started a “going green” theme during Year 3 which included developing a garden on the playground. She recognized that this was not high intensity and thought of ways to increase physical activity levels through garden activity, such as running under the water hose.

***Move to Learn.*** Active story time was a strength of Teacher A. She incorporated stories into all parts of the day, including recess and transitions. Her students also performed stories for

parents, other classrooms, and community members. Active story time continued during Year 3, with the annual performance of *The Nutcracker*. Recognizing that many children were not active as one child acted out a part, Teacher A began to incorporate roles for all children concurrently. During the class reading of *The Nutcracker*, all children acted out parts of either sword-fighting princes or dancing ballerinas.

***Additional Intervention Involvement.*** Teacher A was a strong advocate for including physical activity in special events and parent activities. During all three years, Teacher A included intervention staff in her efforts to incorporate physical activity into parent open houses, community performances, and graduation ceremonies. Signature activities included a “Line Up for Health Night” with a guest line-dancing teacher, an annual kite flying night, and a yearly camping outing with a family hike.

For Year 3, Teacher A requested development of a monthly calendar with physical activity suggestions for each day. Consistent with the intervention’s increased focus in Year 3 on teacher-developed resources, Teacher A worked with intervention staff to develop the activity calendars, which were distributed to intervention teachers each month with the SHAPES newsletter.

***Director Feedback.*** The preschool director of Classroom A participated in a one-time luncheon held for directors and attended two training workshops. During interviews, the director discussed her strong personal value of the importance of physical activity. The director reported giving freedom to teachers to implement physical activity, focusing on teacher autonomy. The director was a supporter of SHAPES: “Without a doubt, physical activity among our children increased due to SHAPES. Our teachers became physical fitness experts.”

**Implementation Fidelity.** During Year 1, Teacher A provided an average of 31.5 minutes of physical activity opportunity per day of observation. During Year 2, she provided an average of 78.0 minutes of opportunity per day, and during Year 3, she provided an average of 67.5 minutes of opportunity. Percent of total daily observations in MVPA increased from 5% to 7% over the three years.

### **Teacher B**

**Classroom description.** Teacher B was a first-year teacher when the intervention began, with a background in dance and dance instruction. She had the same assistant throughout the 3 years. Teacher B's classroom, Classroom B, was one of two classrooms participating in SHAPES in School B. Teacher B and the other participating teacher sometimes joined together for planning meetings and physical activities, such as graduation ceremonies. Classroom B used the school playground, adjacent to the classroom. Like Classroom A, Classroom B did not have access to formal physical education and Teacher B had no formal physical education training; however, the School B physical educators attended the initial intervention training, provided physical activity calendars for students and families throughout the school year, and shared the school's physical activity equipment.

**Intervention Summary.** Teacher B set multiple goals throughout the intervention to keep all children moving, increase physical activity during transition times, provide creative encouragement, increase indoor activities to more than 30 seconds duration, provide more and higher intensity inside activities when the class was unable to go outside, and increase the

intensity of all activities. During Year 3, Teacher B implemented a structured time each day for physical activity called “Move It Time.”

***Move Inside.*** Teacher B’s signature activity was indoor activity stations, used primarily for rainy day recess. During stations, Teacher B would set up multiple activities around the classroom, split the class into groups of 3 to 5 children, and have them rotate through the stations for 2-3 minutes at each station. For example, she created winter-themed stations where children participated in snowflake matching relays, “bobsledding,” and “ice-skating” using wax-paper skates.

She enjoyed the intervention music and used the classroom rug as a “dance floor” during center time. During Year 3, she experimented with various high-intensity activities in an attempt to “wear out” what she described as her above-average-active class.

***Move Outside.*** As part of a school-wide program during Year 2, Classroom B walked the bus loop every day after lunch for 5 minutes. Teacher B also led structured races and set up obstacle courses outside for use during recess. She incorporated stations into outdoor recess as well, and during Year 3 shared the activity description for an outdoor obstacle course with all of the intervention teachers, through a video presentation.

***Move to Learn.*** Despite her admitted reluctance to use Move to Learn, Teacher B developed many lesson-related activities, such as a musical chairs-like game to learn left and right. In Year 3, Teacher B regularly used “100 Healthy Hearts,” an activity shared by another intervention school, which encouraged short bursts of high intensity activity to help students practice counting to 100. She used this activity daily to help her students release some energy:

“You know, they’re so rambunctious. The ‘hearts’ have really helped. It’s something that wears them out.”

***Additional Intervention Activities.*** Teacher B made additional efforts to involve her students in tracking daily physical activity. During Year 2, Teacher B created a “SHAPES Jar helper,” adding to other weekly classroom assignments for students. SHAPES classrooms were asked to fill a jar with color-coded blocks, based on the types and amounts of physical activity they performed each day. Teacher B’s “SHAPES Jar helper” was the student responsible for selecting the class activity and putting the corresponding blocks into the jar. During Year 3, Teacher B continued to use the SHAPES Jar with her “Move It Time.”

***Director Feedback.*** The school principal of Classroom B attended the initial training and the one-time luncheon for directors. In interviews, the director described multiple health and wellness initiatives he had approved and implemented at the school, such as a school-wide walking program. He described how he personally values physical activity as a way to support his focus on giving children from disadvantaged backgrounds an equal opportunity and to foster a sense of community with parents and families. He described his leadership style as a hands-off approach with the teachers, giving them autonomy to act as professionals within their classrooms.

***Implementation Fidelity.*** During Year 1, Teacher B provided an average of 2.7 minutes of physical activity opportunity per day of observation. During Year 2, she provided an average of 33.5 minutes of physical activity opportunity per day of observation, and during Year 3, provided an average of 73.3 minutes of physical activity opportunity per day of observation. Percent of total daily observations in MVPA increased from 4.5% to 10.5% across three years.



## DISCUSSION

Two teachers in two preschools successfully implemented a preschool physical activity intervention using different approaches. Both teachers set goals to increase physical activity opportunities, as guided by the essential elements and guiding principles of the SHAPES intervention. Both approaches yielded successful results, illustrating the importance of being able to adapt an intervention to a specific classroom; interventions need to be flexible and adaptable to individual centers and classrooms to increase external validity and sustainability<sup>17, 26, 27, 41-43</sup>. The different approaches were encouraged by the flexibility and adaptability of the intervention and were not prescribed by research staff. Rather, the teachers adapted the intervention to best fit their style, classroom, resources, and abilities. This approach capitalized on the teacher's knowledge of her students and setting, as well as her creativity as a preschool teacher. The teachers also made changes at various levels of the social ecologic framework, including policy changes (Teacher B including a Move It time scheduled in the day), classroom environment changes (both teachers utilizing additional equipment), community-level changes (Teacher A's involvement of parents and other community members), and interpersonal-level changes between teachers and students. While the teachers in SHAPES responded favorably to the flexible and adaptive approach, further research is needed to determine if the flexibility enables the intervention to be adapted to a variety of settings.

### *Differences between Teacher A and Teacher B*

Teacher A and Teacher B used different approaches to incorporate the intervention into their classrooms. Teacher A incorporated physical activity into all classroom activities, while

Teacher B scheduled physical activity into certain parts of the day. She included specific, set-aside time for physical activity in her daily schedule. While physical activity was not solely limited to this time, it constituted a major physical activity opportunity. Teacher A's preference was to incorporate physical activity into daily lessons. She found this approach addressed the director's strong focus on academics, engaged the students' attention, and kept the students learning.

Teacher B's background in dance prepared her to engage actively in high-intensity activities with the children and to give verbal encouragement to increase activity intensity. While Teacher A also verbally encouraged physical activity, she could not physically participate at high intensities. Thus, research staff (intervention staff and independent evaluators) observed lower intensity activities in her classroom. However, assistant teachers participated in physical activity. Because both teacher encouragement and modeling may be important for increasing children's physical activity<sup>44</sup>, teachers should participate to the best of their ability and engage other classroom personnel when available (staff, parents, etc.).

#### *Similarities between Teacher A and Teacher B*

Despite their different approaches, Teacher A and Teacher B had similarities. Both teachers bought into the intervention from the beginning and they, their assistants, and their directors participated in most intervention training activities. Assistants in both classrooms led physical activities in the classroom. And, both school directors supported physical activity and recognized and supported the teacher's role and autonomy in providing appropriate activities.

Following the initial buy-in, both teachers continued to work with intervention staff to improve physical activity opportunities in their classrooms throughout the three years of intervention. They tried various activities, provided valuable feedback, and honed their unique approaches for providing preschool physical activity. Both teachers were able to adapt the intervention despite barriers (e.g., neither classroom had formal physical education); other teachers in the intervention were less successful at overcoming barriers. More research is needed to better understand how these contextual factors influence implementation<sup>45</sup>.

### *Strengths and limitations*

This case study benefitted from excellent intervention staff-teacher relationships and the detailed intervention records, which provided a rich description of the intervention for both cases. The various sources and types of information were triangulated to create a holistic picture of implementation. The two cases represented different settings and different teaching styles. However, these are only two examples. The purpose of the study was to examine “what works” in classrooms that effectively implemented a flexible, adaptive intervention. This approach may provide information that typical reports of intervention effects do not, and this information can be used to inform future intervention efforts. A detailed quantitative process evaluation of all levels of implementation of SHAPES classrooms is currently being conducted.

## **IMPLICATIONS FOR SCHOOL HEALTH**

Physical activity interventions can be implemented successfully using flexible approaches. Thus, intervention staff in schools should allow for flexibility and adaptability of intervention components, while still adhering to the essential intervention components. In order

to support unique approaches, on-going training is needed help teachers adapt physical activity interventions to their own classroom environments. This includes regular professional development in physical activity for classroom teachers that builds capacity and helps teachers to identify key opportunities for physical activity within their classrooms. Schools also should seek to engage additional school staff, directors and parents to support teachers in providing opportunities for physical activity. This may include providing tangible resources and supplies, leading activities with children, or assisting classroom teachers in planning and executing activities.

**HUMAN SUBJECTS APPROVAL STATEMENT**

This study was approved by the University of South Carolina's Institutional Review Board.

**ACKNOWLEDGEMENTS**

[This study was supported by a grant from the \*Eunice Kennedy Shriver\* National Institute of Child Health & Human Development \(5R01HD055451\).](#)

DRAFT

## Reference List

1. Troiano RP, Berrigan D, Dodd KW, Masse LC, Tilert T, McDowell M. Physical activity in the United States measured by accelerometer. *Med Sci Sports Exerc.* 2008 January;40(1):181-188.
2. Oliver M, Schofield GM, Kolt GS. Physical activity in preschoolers: understanding prevalence and measurement issues. *Sports Med.* 2007;37(12):1045-1070.
3. Tucker P. The physical activity levels of preschool-aged children: a systematic review. *Early Childhood Research Quarterly.* 2008 January 1;23(4):547-558.
4. Pate RR, Pfeiffer KA, Trost SG, Ziegler P, Dowda M. Physical activity among children attending preschools. *Pediatrics.* 2004;114(5):1258-1263.
5. Finn K, Johannsen N, Specker B. Factors associated with physical activity in preschool children. *J Pediatr.* 2002 January;140(1):81-85.
6. Reilly JJ. Low levels of objectively measured physical activity in preschoolers in child care. *Med Sci Sports Exerc.* 2010 March;42(3):502-507.
7. McWilliams C, Ball SC, Benjamin SE, Hales D, Vaughn A, Ward DS. Best-practice guidelines for physical activity at child care. *Pediatrics.* 2009 December;124(6):1650-1659.
8. Larson N, Ward DS, Neelon SB, Story M. What role can child-care settings play in obesity prevention? A review of the evidence and call for research efforts. *J Am Diet Assoc.* 2011 September;111(9):1343-1362.
9. Institute of Medicine. Early Childhood Obesity Prevention Policies. Washington, DC: The National Academies Press; 2011.
10. Fitzgibbon ML, Stolley MR, Schiffer LA et al. Hip-Hop to Health Jr. obesity prevention effectiveness trial: postintervention results. *Obesity (Silver Spring).* 2011 May;19(5):994-1003.
11. Hannon JC, Brown BB. Increasing preschoolers' physical activity intensities: An activity-friendly preschool playground intervention. *Prev Med.* 2008 June;46(6):532-536.
12. Trost SG, Fees B, Dziewaltowski D. Feasibility and efficacy of a "move and learn" physical activity curriculum in preschool children. *J Phys Act Health.* 2008 January;5(1):88-103.
13. Eliakim A, Nemet D, Balakirski Y, Epstein Y. The effects of nutritional-physical activity school-based intervention on fatness and fitness in preschool children. *J Pediatr Endocrinol Metab.* 2007 June;20(6):711-718.

14. Ward DS, Vaughn A, McWilliams C, Hales D. Interventions for increasing physical activity at child care. *Med Sci Sports Exerc.* 2010 March;42(3):526-534.
15. Dusenbury L, Brannigan R, Falco M, Hansen WB. A review of research on fidelity of implementation: implications for drug abuse prevention in school settings. *Health Educ Res.* 2003 April;18(2):237-256.
16. Helitzer D, Yoon SJ, Wallerstein N, Garcia-Velarde LD. The Role of Process Evaluation in the Training of Facilitators for an Adolescent Health Education Program. *Journal of School Health.* 2000 April;70(4):141.
17. Durlak JA, DuPre EP. Implementation matters: a review of research on the influence of implementation on program outcomes and the factors affecting implementation. *Am J Community Psychol.* 2008 June;41(3-4):327-350.
18. Ringeisen H, Henderson K, Hoagwood K. Context matters: schools and the "research to practice gap" in children's mental health. *School Psych Rev.* 2003 June;32(2):153.
19. Fitzgibbon ML, Stolley MR, Schiffer L, Van HL, KauferChristoffel K, Dyer A. Two-year follow-up results for Hip-Hop to Health Jr.: a randomized controlled trial for overweight prevention in preschool minority children. *J Pediatr.* 2005 May;146(5):618-625.
20. Fitzgibbon ML, Stolley MR, Schiffer L, Van HL, KauferChristoffel K, Dyer A. Hip-Hop to Health Jr. for Latino preschool children. *Obesity.* 2006 September;14(9):1616-1625.
21. Klesges LM, Williams NA, Davis KS, Buscemi J, Kitzmann KM. External validity reporting in behavioral treatment of childhood obesity: a systematic review. *American Journal of Preventive Medicine.* 2012 February;42(2):185-192.
22. Kok MO, Vaandrager L, Bal R, Schuit J. Practitioner opinions on health promotion interventions that work: opening the black box of a linear evidence-based approach. *Soc Sci Med.* 2012 March;74(5):715-273.
23. Brownson RC, Chiqui JF, Burgeson CR, Fisher MC, Ness RB. Translating epidemiology into policy to prevent childhood obesity: the case for promoting physical activity in school settings. *Ann Epidemiol.* 2010 June;20(6):436-444.
24. Rychetnik L, Hawe P, Waters E, Barratt A, Frommer M. A glossary for evidence based public health. *J Epidemiol Community Health.* 2004 July;58(7):538-545.
25. Bartholomew LK, Parcel GS, Kok G, Gottlieb NH. *Planning Health Promotion Programs: An Intervention Mapping Approach.* 2nd ed. San Francisco, CA: Jossey-Bass; 2006.
26. Greenhalgh T, Robert G, Macfarlane F, Bate P, Kyriakidow O. Diffusion of innovations in service organizations: systematic review and recommendations. *Milbank Q.* 2004;82(4):581-629.
27. Rogers EM. *Diffusion of Innovations.* 5th ed. New York: The Free Press; 2003.

28. Klesges LM, Williams NA, Davis KS, Buscemi J, Kitzmann KM. External validity reporting in behavioral treatment of childhood obesity: a systematic review. *American Journal of Preventive Medicine*. 2012 February;42(2):185-192.
29. Stake RE. Qualitative Case Studies. In: Denzin NK, Lincoln YS, editors. *The Sage handbook of qualitative research (3rd ed.)*. Thousand Oaks, CA: Sage Publications Ltd; 2005. p. 443-466.
30. Yin R. *Case Study Research: Design and Methods*. 2nd ed. Newbury Park, CA: Sage Publications; 1994.
31. Pfeiffer KA, Saunders RP, Brown WH, Dowda M, Addy CL, Pate RR. Study of Health and Activity in Preschool Environments (SHAPES): study protocol for a randomized trial evaluating a multi-component physical activity intervention in preschool children. *BMC Public Health*. 2013;13(1):728.
32. Brown WH, Pfeiffer KA, McIver KL, Dowda M, Almeida MJCA, Pate RR. Assessing preschool children's physical activity: An Observational System for Recording Physical Activity in Children - Preschool Version (OSRAC-P). *Res Q Exerc Sport*. 2006;77(2):167-176.
33. Sallis JF, Cervero RB, Ascher W, Henderson KA, Kraft MK, Kerr J. An ecological approach to creating active living communities. *Annu Rev Public Health*. 2006;27:297-322.
34. Hawe P, Shiell A, Riley T. Complex interventions: how "out of control" can a randomised controlled trial be? *BMJ*. 2004 June 26;328(7455):1561-1563.
35. Hawe P, Shiell A, Riley T. Theorising interventions as events in systems. *Am J Community Psychol*. 2009 June;43(3-4):267-276.
36. Howie EK, Brewer A, Brown WH, Pfeiffer KA, Saunders RP, Pate RR. The 3-year evolution of a preschool physical activity intervention through a collaborative partnership between research interventionists and preschool teachers. *Health Educ Res*. 2014 June;29(3):491-502.
37. Creswell JW. *Qualitative Inquiry and Research Design: Choosing Among Five Approaches*. Thousand Oaks, CA: Sage Publications; 2007.
38. Braun V, Clarke V. Using thematic analysis in psychology. *Qual Res Psychol*. 2006;3(2):77-101.
39. Lincoln YS, Guba EG. *Naturalistic Inquiry*. Beverly Hills, CA: Sage Publications; 1985.
40. Sandelowski M. Rigor or rigor mortis: The problem of rigor in qualitative research revisited. *ANS Adv Nurs Sci*. 1993 December;16(2):1-8.
41. Scheirer MA. Is sustainability possible? A review and commentary on empirical studies of program sustainability. *American Journal of Evaluation*. 2005 September;26(3):320-347.



42. Kok MO, Vaandrager L, Bal R, Schuit J. Practitioner opinions on health promotion interventions that work: opening the black box of a linear evidence-based approach. *Soc Sci Med*. 2012 March;74(5):715-723.
43. Dusenbury L, Brannigan R, Falco M, Hansen WB. A review of research on fidelity of implementation: implications for drug abuse prevention in school settings. *Health Educ Res*. 2003 April;18(2):237-256.
44. Brown WH, Gooze HS, McIver KL, Rathel JM. Effects of teacher-encouraged physical activity on preschool playgrounds. *Journal of Early Intervention*. 2009;31(2):126-145.
45. Brownson RC, Chiqui JF, Burgeson CR, Fisher MC, Ness RB. Translating epidemiology into policy to prevent childhood obesity: the case for promoting physical activity in school settings. *Ann Epidemiol*. 2010 June;20(6):436-444.

**Table 1: Description of Four Data Sources for Process Information**

Process Measure	Information Provided
OSRAC-P	Duration, type and intensity of child physical activity
Process Observation Tool	Minutes of physical activity <i>opportunities</i> per each intervention component, fidelity of opportunity (adult encouragement, child enjoyment, etc.)
Teacher Surveys	Self-reported implementation of intervention, barriers to implementation
Intervention Staff Field Notes	Training and workshop participation, site-visit records and observations, developed intervention materials

TABLE 2: Summary of Two Teachers in a Preschool Physical Activity Intervention

	<b>Teacher A</b>	<b>Teacher B</b>
<b>Demographic</b>	<i>20+ years teaching experience, physical health problems</i>	<i>First year teacher, dancer and dance instructor</i>
<b>School/Program</b>	<i>Tuition-based within a public school</i>	<i>Title I, year-round public school</i>
<b>Site Visits for Technical Assistance</b>		
Year 1	22 technical (8 other)	17 technical (5 other)
Year 2	21 technical (7 other)	10 technical (8 other)
Year 3	17 technical (19 other)	5 technical (15 other)
<b>Trainings Attendance</b>		
Year 1 (out of 1)	1	0
Year 2 (out of 4)	4	3
Year 3 (out of 2)	2	1
<b>Contributed to the Newsletter (out of 9 of opportunities)</b>	7	6
<b>Average Minutes of Physical Activity Opportunity Observed Per Day of Observation</b>		
Move In	16	10.3
Move Out	44.3	36.5
Move to Learn	8.3	2.4