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# The 3-year evolution of a preschool physical activity intervention through a collaborative partnership between research interventionists and preschool teachers

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## Abstract

Despite evidence that preschoolers spend the majority of their time in sedentary activities, few physical activity interventions have focused on preschool-age children. Health promotion interventions that can be integrated into the daily routines of a school or other setting are more likely to be implemented. The Study of Health and Activity in Preschool Environments employed a flexible approach to increasing physical activity opportunities in preschools' daily schedules through recess, indoor physical activity and physical activity integrated into academic lessons. Eight preschools were randomly assigned to receive the study's physical activity intervention. Teachers in these schools partnered with university-based interventionists across 3 years to design and implement a flexible and adaptive intervention. The intervention approach included trainings and workshops, site visits and feedback from intervention personnel, newsletters, and physical activity equipment and materials. Teachers reported a high acceptability of the intervention. The purpose of this article is to describe the evolution of a multi-component physical activity intervention in preschools, including (i) a description of the intervention components, (ii) an explanation of

the intervention process and approach, and (iii) a report of teachers' perceptions of barriers to implementation.

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## Introduction

Recent guidelines recommend that preschool-age children participate in 2–3 h of physical activity per day [1–3]. Despite a widespread belief that young children are very physically active, the majority is not meeting these guidelines [4, 5]. A large percentage of young children attend childcare centers or preschools [6], and these programs may play an important role in providing opportunities for children to be physically active. Best-practice guidelines recommend that preschool programs provide multiple opportunities for children to be physically active throughout the day [7]. However, it is difficult for preschool teachers to provide sufficient opportunities for physical activity [8, 9].

Few studies have examined interventions to increase physical activity in preschools [10–12]. Some of those studies reported increases in physical activity, but overall the results have been inconsistent [13–15]. Most physical activity interventions to date have used structured curricula and were implemented by trained research personnel [13]. This approach is ideal for efficacy studies, but a 'real-world'

approach to increasing physical activity will require that preschool teachers implement the interventions.

A small number of interventions have focused on training preschool teachers to implement physical activity opportunities [16–18]. These interventions typically used structured curricula and provided one type of physical activity opportunity during the preschool day. A more flexible approach may be able to accommodate differences in preschool settings and preschool teachers' philosophies and practices for sustainable implementation [19, 20]. Interventions that can be adapted to individual circumstances while maintaining overall fidelity are more likely to be successful [19]. The Study of Health and Activity in Preschool Environments (SHAPES) used a flexible, adaptive intervention that was designed to add additional physical activity opportunities to the preschool day. In this approach, the university-based intervention team (hereafter referred to as the interventionists) guided teachers to use a flexible, adaptive intervention to achieve physical activity goals within diverse contexts, rather than prescribing a standard set of activities [21, 22]. The overall goal was to maximize all physical activity opportunities throughout preschoolers' daily schedules, including opportunities during recess, indoor physical activity and physical activity integrated within academic lessons. The interventionists worked in partnership with teachers over a 3-year period to adapt the intervention implementation process and components. This article provides a detailed account of the development and process evaluation of a complex intervention in complex environments [23]. The purpose is to describe the evolution of a multi-component physical activity intervention in preschools across 3 years.

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## Methods and results

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### Participants

Sixteen preschools in the Columbia, South Carolina area agreed to participate in the study: eight were randomized to receive a physical activity intervention from September 2008 through May 2011, whereas the remaining eight served as pair-matched

controls. Four of the intervention schools were religiously affiliated, private preschools, and four were 4-year-old pre-kindergartens located within public schools. Of the four public school programs, the average percent of students receiving free and reduced lunch in Year 1 was 67% (range: 47–87%). Three of the preschools were half-day programs that operated 3–4 h per day, and the remaining five preschools were full-day programs that operated for at least 6 h. The number of classrooms per school ranged from 1 to 4, with a total of 17–19 classrooms in the intervention each year. Of the 24 lead teachers who participated throughout the 3 years, 63% were black and 2 were first-year teachers. Eighty-six percent of the classrooms had at least one teacher with a bachelor's degree or higher. Schools and teachers received gift card incentives, and teachers received professional development credits for participating in workshops. Pfeiffer *et al.* provides a detailed description of the larger study design [24].

### Intervention overview

The SHAPES intervention was designed to be flexible and adaptive through a collaborative partnership between interventionists and preschool personnel. Interventionists provided examples and targets for overall physical activity, whereas preschool teachers modified intervention strategies for their classrooms. Hence, SHAPES was not a curriculum, but a framework for increasing physical activity during the preschool day. The SHAPES intervention included the intervention components and the approach used to help teachers implement those components. Although the intervention components and the intervention approach were modified over the 3 years, the overall goal to increase children's physical activity and the basic components remained throughout the 3-year intervention.

### Process of adapting the intervention

Interventionists worked closely and collaboratively with the preschool teachers to develop strategies and materials to address barriers that occurred during implementation. During the summers following

Year 1 and Year 2, interventionists and study investigators extensively reviewed intervention activities, identified teachers' perceived barriers and modified the intervention as necessary. As a result, the intervention was modified and enhanced across the 3-year period to increase effectiveness.

### **Process measures**

Process evaluation included multiple sources of data. Interventionists collected detailed field notes of observations and interactions with teachers. Teachers completed workshop evaluations, surveys twice per year, and interviews to formally assess perceived barriers and responses to the intervention. Independent observers conducted two types of observations during the intervention: The Observation System for Recording Physical Activity in Children—Preschool Version, which is a validated momentary time sampling observation system, [25] as well as a standardized checklist for classroom physical activity opportunities and additional contextual information. A complete description of the process evaluation currently is under development.

### **Intervention components**

The components of the intervention were based on a social ecological model, targeting the instructional, social and physical environments within the preschools [26]. Although the intervention targeted social environmental influences at the child level, several behavior change strategies were used at the teacher level, including increasing self-efficacy, modeling and goal setting. As shown in Table I, the components of the intervention evolved over the 3 years based on collaboration between the interventionists and teachers. After Year 1 the original five components (Recess, Learning on the Move, Skill SHAPeR, Gross Motor Centers and TV Turnoff) were simplified and combined into three components (Move Inside, Move Outside, Move to Learn). Teachers were unable to remember the names of the five components, and had difficulty identifying examples of each. To focus on components with the highest probability for high-quality,

wide-reaching physical activity and reduce teacher confusion, the components were reduced and renamed.

#### *Move Inside (originally Skill SHAPeR)*

Several of the intervention schools did not have access to formal, high-quality physical education. Thus, interventionists encouraged teachers to provide daily opportunities that focused on fundamental movement patterns. The initial goal was 60 min of skill-based physical activity per week. During Year 1, teachers received examples of structured, skill-based activities and games that were similar to those used in physical education classes. Following Year 1, teachers expressed concern that they had limited training and skills to lead elaborate skill-based activities similar to formal physical education classes. Therefore, the research team and interventionists changed the goal from providing skill-based activity (Year 1) to providing 10 min per day of indoor activities that did not include academic content (Years 2 and 3). Teachers could break the 10 min into two bouts of at least five continuous minutes. Activities included dancing, calisthenics and obstacle courses.

#### *Move Outside (originally Recess)*

Although all of the preschools had recess policies based on the length of the instructional day, some were vague or rarely enforced. Because children are more active when outdoors [27], interventionists encouraged teachers to provide outdoor recesses when possible or to provide an equal duration and intensity of indoor activities during inclement weather. The initial goal was 60 min of recess every day. Based on teachers' feedback and interventionists' observations that 60 min was an unrealistic time goal, the goal was modified to two 20-min recesses per day after Year 1. In addition, teachers were encouraged to provide at least two 5-min structured activity opportunities at each recess (i.e. teacher-led physical activities). Structured recess activities included organized races and games such as soccer or follow the leader.

**Table I.** Evolution of the SHAPES intervention components

Original intervention	Intervention feedback	Final intervention
Skill SHAPeRS (physical education) <ul style="list-style-type: none"> <li>• Provided 20min per day, 3 days per week</li> </ul>	→ <ul style="list-style-type: none"> <li>• Many schools did not have access to formal PE</li> <li>• Teachers lacked capacity for leading PE activities</li> </ul>	Move Inside <sup>a</sup> <ul style="list-style-type: none"> <li>• Provided at least 10min each day</li> </ul>
Recess <ul style="list-style-type: none"> <li>• Two 30-min sessions of recess are provided daily</li> <li>• Teachers provide active game choices during recess</li> </ul>	→ <ul style="list-style-type: none"> <li>• 60min was an unrealistic goal with many schools' current schedules</li> </ul>	Move Outside <sup>a</sup> <ul style="list-style-type: none"> <li>• At least two 20-min sessions of recess provided daily</li> <li>• Structured activity provided at least 5 min each day</li> </ul>
Learning on the Move <ul style="list-style-type: none"> <li>• PA is integrated into academic lessons for 20min each day</li> </ul>	→ <ul style="list-style-type: none"> <li>• Activity during lessons was brief (less than a minute)</li> <li>• Teachers reported this as favorite component</li> </ul>	Move to Learn <sup>a</sup> <ul style="list-style-type: none"> <li>• Provided at least two 5-min activities daily</li> </ul>
Physical activity centers <ul style="list-style-type: none"> <li>• Classroom activity center is used by all children at least twice a week</li> </ul>	<ul style="list-style-type: none"> <li>• Low overall reach</li> <li>• Low classroom participation</li> </ul>	<ul style="list-style-type: none"> <li>• Not included</li> </ul>
Tv Turnoff <ul style="list-style-type: none"> <li>• Lessons are delivered in school</li> <li>• Homework assignments and materials are assigned and distributed</li> </ul>	<ul style="list-style-type: none"> <li>• Negligible influence on classroom activity</li> <li>• Select teachers did like the attempt to involve parents</li> </ul>	<ul style="list-style-type: none"> <li>• Not Included (unless requested)</li> </ul>
Social environment <ul style="list-style-type: none"> <li>• Teachers verbally encourage PA in children during PE, recess and other PA time</li> <li>• Teachers actively participate in PA with children during PE, recess and other PA time</li> </ul>	<ul style="list-style-type: none"> <li>• Some teachers unable to physically participate due to health or other issues</li> <li>• Some teachers reported their own increase in physical activity as a benefit of the program</li> </ul>	<ul style="list-style-type: none"> <li>• Teachers verbally encourage PA in children during PE, recess and other PA time</li> <li>• Teachers actively participate in PA with children during PE, recess and other PA time</li> </ul>
Physical environment <ul style="list-style-type: none"> <li>• Teachers and administrators assess environment using checklist</li> <li>• Teachers and administrators change environment to enhance PA and safety</li> </ul>	<ul style="list-style-type: none"> <li>• Teachers appreciated provision of physical activity supplies</li> </ul>	<ul style="list-style-type: none"> <li>• Teachers and administrators assess environment using checklist</li> <li>• Teachers and administrators change environment to enhance PA and safety</li> </ul>
School policy and practice <ul style="list-style-type: none"> <li>• Administrator supports policies and practices for PE, recess, and PA and other policies and practices that affect PA and sedentary time</li> </ul>	<ul style="list-style-type: none"> <li>• Directors were difficult to engage due to competing priorities and time commitments</li> </ul>	<ul style="list-style-type: none"> <li>• Not included</li> </ul>

<sup>a</sup>Half-day programs were encouraged to provide as many physical activity opportunities as possible (at least 150min per week) as best fit into their schedule.

### *Move to Learn (originally Learning on the Move)*

To accommodate the schools' emphasis on pre-academic and academic lessons, 'Move to Learn' integrated physical activity into preschool lessons, which previous studies have shown to be successful

[17, 28]. Different preschools operate with different early learning standards; thus, teachers were encouraged to incorporate physical activity into their typical daily lessons. The initial goal was 20min of activity-based lessons per day. However, interventionists and measurement staff observed teachers

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implementing low-intensity active lessons that were very short in duration. This component was not eliminated from the intervention, because it was highly valued by the teachers and added to their overall buy-in to the program. To make the goal more realistic and achievable, the time goal was modified after Year 1. Through Years 2 and 3, teachers were encouraged to conduct two 5-min active lessons per day for a total of 10 min. This included activities such as moving during story time, calendar time and other large group tasks.

### *Gross Motor Centers*

In many preschools, a large percentage of the daily schedule involves center time, where students select individual or small group activities, such as playing with blocks, making arts and crafts, or participating in sociodramatic play. These activities typically involve sedentary or light activity. During Year 1, teachers were encouraged to create active movement centers that focused on gross motor skills, often set to a theme. For example, the March-themed Leprechaun center guided children to ‘crawl’ through a field of ‘shamrocks’, follow the rainbow (‘step’ on multicolored dome cones) and ‘throw’ ‘gold’ in the pot (practice object control by throwing beanbags to a target). After the first year, based on teachers’ feedback and observations, the interventionists determined that this component had lower reach and feasibility than those of the other components. Thus, this component was excluded from Years 2 and 3.

### *Reducing television watching at home*

A four-lesson unit on reducing television (TV) viewing was adapted from previous research [29] and delivered to each classroom once per year for all 3 years of the intervention. Interventionists provided teachers with lesson descriptions and materials in early spring to coincide with National TV Turnoff Week (currently Screen-Free Week). Teachers chose how to implement the lessons, either once per week for 4 weeks or 4 days during 1 week. This component was a single time point activity and had limited impact on preschoolers’ classroom

physical activity. After Year 1, intervention efforts were reduced for this component, but the interventionists continued to supply materials based on teachers’ requests.

### *Social environment*

Interventionists focused on promoting both teachers’ participation in physical activities and their verbal encouragement for preschoolers to be active. Interventionists first encouraged teachers to be physically active with the children, as studies have shown that modeling is important for children’s physical activity [16]. Initial teacher feedback and process evaluation data showed that many teachers were unlikely to participate actively with the children, though this improved throughout the intervention. Thus, interventionists also encouraged teachers to provide positive, specific verbal encouragement of children’s physical activity. This verbal encouragement included recognizing healthy physical activity behaviors (e.g. ‘you’re building strong muscles’, ‘feel your heart beat, that’s a healthy heart’), promoting additional active movements, and not discouraging safe, appropriate physical activity.

### *Physical environment*

Because portable play equipment and materials have been shown to increase physical activity levels among preschoolers [30–32], intervention staff supplied the participating classrooms with a variety of physical activity equipment and materials. Teachers received initial resource kits and additional supplies throughout the 3 years. They also selected classroom-specific equipment as part of the self-assessment process during Year 3. Examples of materials the teachers selected included stethoscopes for listening to increased heart rates during physical activity, physical activity-centered games and sack race bags.

In addition to equipment and materials, the interventionists provided activity ideas to the teachers throughout the intervention. They also encouraged teachers to develop their own SHAPES activities and to share them with other teachers through

newsletters and at SHAPES trainings. Throughout implementation, the interventionists increased the emphasis on teacher-developed activities to increase teachers' ownership of SHAPES activities, materials and procedures. Interventionists publically recognized specific teachers and schools as the source of activities and materials that were developed. Examples of resources developed during the SHAPES intervention are provided in Table II.

### *Policy environment*

In an effort to increase the sustainability of the SHAPES intervention, interventionists attempted to involve directors at the program policy and organizational level. Despite several efforts to involve directors, the intervention was unsuccessful at engaging them. Final interviews with directors and teachers suggested that organizational support might be necessary but not sufficient for sustainability of the SHAPES intervention. For example, teachers described barriers such as limited access to playgrounds or multipurpose rooms that would need director engagement to ameliorate. However, future

research is needed to better understand the policy and organizational structure of this setting and how to influence it.

### **Implementation approach**

SHAPES used a facilitative, as opposed to directive approach, which previous studies have shown to be effective [33–35]. Interventionists interacted with the teachers in multiple ways to increase teachers' capacity to implement the intervention components. The partnership included five types of technical assistance interactions between interventionists and teachers: initial trainings, group workshops, site visits, self-assessment, and newsletters and website. The evolution of the intervention approach is described in Fig. 1.

### *Initial trainings*

Interventionists conducted initial, on-site trainings with teachers during Year 1. The 2- to 3-h introductory trainings were scheduled at a convenient time and held with teachers at their schools. Interventionists provided background information

**Table II.** *Sample resources*

Resource	Brief description
Training manual	Example activities for each of five components including active lessons, skill lessons, Recess, Gross Motor Centers and TV Turnoff
SHAPES top 10 activities (examples)	The top 10 teacher and staff-developed activities
Track Team	Organized races on the playground
Dance Party	Provided music and encouraged dancing
Counting on Calendar	Physical activities for calendar time such as jumping to the days of the month
Featured Teacher Activities (examples)	Activities developed by intervention teachers to be distributed and shared with other intervention teachers. One teacher or school was featured per month
Nursery Rhyme Olympics	Six stations based on favorite nursery rhymes
Moving through the Environment	Multimedia physical activity videos with varied settings
Move to Math	Active songs for pre-k mathematics standards
100 Healthy Hearts	100 physically active ways to count to 100
SHAPE-up Circus	Eight circus acts for learning about the circus, moving during center time and practicing on the playground
Physical Activity Around the World	A poster-size map with physical activities from around the world (e.g. African drum dance, futbol, Olympics)
Recess Recipe Cards	Index cards with teacher tips for making the most of recess
Physical Activity Equipment	Music CDs, scarves, dome cones, beanbags, assorted balls and portable air inflator, parachute, jump ropes, DVDs and staff-developed activity ideas



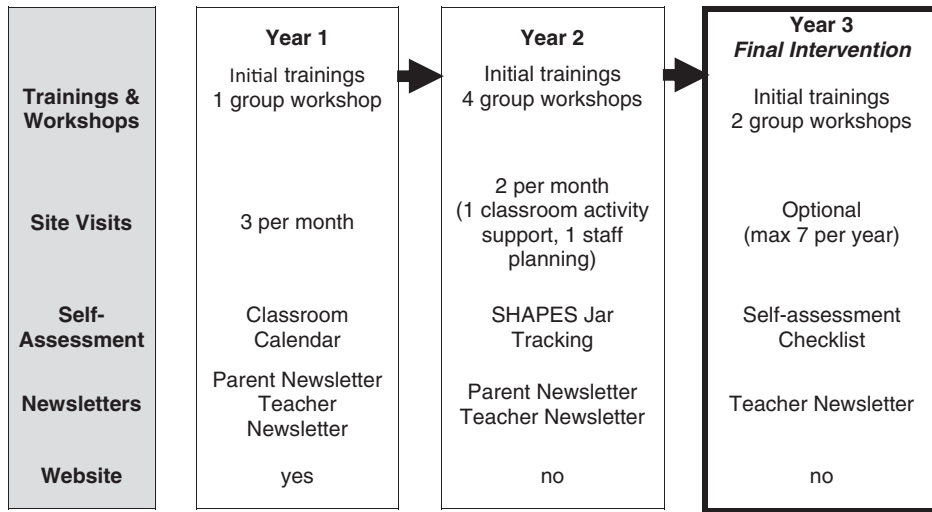


Fig. 1. Evolution of the SHAPES implementation approach over 3 years.

about physical activity, described the intervention components and provided examples, discussed perceived barriers, and distributed physical activity supplies and materials. Interventionists met with new teachers for similar introductory trainings throughout the 3 years.

### Group workshops

In addition to the initial site-based trainings, the interventionists conducted seven group workshops throughout the intervention. Workshops were held in the evenings or on Saturdays, by teacher request. Most workshops offered two training date options to accommodate teachers' schedules. Workshop participants received a healthy meal, a gift card incentive and childcare. The goal of the workshops was to deliver physical activity knowledge and skills so that teachers could create their own physical activity opportunities in their classrooms. Training topics were developed based on interactions with and feedback from teachers and reports from formative process observations that identified skill areas that needed further development. After the first year, through observations and feedback, interventionists recognized that teachers lacked understanding of high-quality physical activity,

especially moderate-to-vigorous physical activity (MVPA). Year 2 and 3 workshops focused on changing teachers' perceptions of physical activity. Open-ended responses on anonymous evaluations indicated that teachers enjoyed the workshops, valued learning from other teachers (e.g. 'Sharing is what it's all about') and appreciated receiving new activities and strategies (e.g. 'I learn something new every time').

Workshops were designed to be fun and interactive and served as an opportunity for teachers and interventionists to share ideas and build relationships. Workshops included demonstrations, group discussion and activities to address teacher barriers. During the first 2 years, staff sent multiple reminders and RSVP requests to teachers through email, post mail and in-person visits. Reminders were reduced in Year 3; however, attendance remained consistent. Attendance ranged from 6 to 30 participants, with an average of 22 participants per workshop, representing the majority of schools. The directors of four of the eight intervention schools attended at least one group training over the 3 years. Additional participants included assistant teachers, aftercare teachers and other community members invited by the participants.

### *Teacher site visits*

Interventionists regularly visited teachers in their classrooms. Intervention team members made 859 classroom site visits (343 during Year 1; 351 during Year 2; and 343 during Year 3). The number of site visits directly supporting teachers in intervention activities decreased from Year 1 (12.5, range from 9 to 18) to Year 3 [4.2 (0–17)]. Overall, site visits averaged approximately 40 min each.

During Year 1, interventionists often led example physical activities for the class and responded to teachers' concerns. During Year 2, visits were structured to include two visits per month. Based on teachers' requests, one of the two visits involved active participation by the interventionist during teacher-led classroom activities. The second visit was a collaborative planning meeting that occurred at a mutually convenient time (e.g. nap, lunch, after school), where interventionists and teachers could discuss, plan and solve challenges related to enhancing preschoolers' physical activity. To increase teachers' independence during Year 3, interventionists purposefully limited their onsite activities with participating teachers and made site-visits optional. Teachers could request either type of site visit (i.e. planning or feedback on implementation of physical activities), but were limited to seven visits during Year 3. During Year 3, 31 (average of 1.8 visits per classroom) of the visits were requested by teachers and an additional 42 were interventionist-initiated direct implementation assistance. The remainder of visits during Year 3 included indirect assistance, such as monthly material and supply deliveries, and other administrative visits. Hence, across the 3 years of implementation the team systematically reduced direct support to teachers.

### *Self-assessment*

The intervention staff encouraged self-monitoring during all 3 years of intervention, as it has been shown to be an effective part of behavior change [36, 37]. At the initial trainings, each lead teacher received a poster-sized calendar to use to track activities daily. Interventionists emphasized that the teachers would not be assessed on how many activities

they performed. Several teachers began to use the calendar to track activities, but did not sustain its use. During Year 2, teachers received a 'SHAPES Jar' to use to monitor classroom physical activities by adding blocks to the jar. A clear jar was selected because it did not require teachers to complete additional paperwork, and both teachers and preschoolers could easily self-monitor physical activities using the jar. Although some teachers involved their students in tracking physical activities by incorporating use of the jar into daily activities, such as circle time or large group activities, continued use was not widespread. During Year 3, a paper assessment was developed to help teachers conduct the assessment on their own as part of usual practice. The self-assessment tool focused on four high-quality targets: time, intensity, reach, and encouragement. Teachers were encouraged to provide sufficient time for physical activity opportunities, focus on higher intensity activities that promoted MVPA, involve as many children as possible, not withhold physical activity as punishment, encourage physical activity verbally and physically participate with the children. To encourage use of the self-assessment during Year 3, teachers who identified barriers or challenges could select additional equipment and materials to address the challenges. Teachers were allotted a small 'Move It Money' account to purchase physical activity equipment and materials identified from their self-assessments.

### *Newsletters*

To communicate regularly with teachers and develop a community of practice, the interventionists distributed newsletters, paper and electronic, to intervention classrooms. Initially, parents and teachers received separate newsletters. The teachers' newsletter included tips and activity suggestions from interventionists and other intervention teachers. In response to teachers' requests, a parent newsletter was distributed to classes to send home with students. This newsletter included family activities and a general description of the intervention. During Year 2, the parent and teacher newsletters were combined into a single entity to be distributed



to both parents and teachers. In Year 3, parent newsletters were discontinued based on teacher feedback about their limited effectiveness (e.g. newsletters returned in backpacks). The teacher newsletter component was further developed in the third year, with teacher-created activities featured each month. Interventionists collaborated with volunteer teachers to share favorite physical activities with other SHAPES teachers each month. The monthly newsletter package included activity descriptions, supplies if necessary and photographs of the featured teachers' classes performing highlighted activities. Interventionists also created, in Year 1, a password-protected website as a resource to share materials and create a networking community. Due to low participation, the website was discontinued for subsequent implementation years.

### Teacher perceptions and barriers

Overall, teachers responded positively to the SHAPES partnership and program (e.g. 'I love SHAPES. I really do—and you know how I was kind of negative to it in the beginning, but I love it. And the kids love it. We love to move'). Teachers particularly enjoyed sharing ideas and learning new activities in workshops (e.g. 'Y'all have taught us a lot. Y'all really taught us a lot'), interventionists' support, and acquiring a new awareness of the importance of physical activity:

Before SHAPES we probably did things [physical activity], but the awareness that SHAPES brought makes what we do more meaningful. What you have taught us helps the children.

Teachers did not find the activities to be difficult to implement (e.g. 'Well, it [SHAPES] worked. And, it wasn't hard'). In addition, they perceived that the children enjoyed them. Teachers enjoyed receiving activities and feedback from other teachers through newsletters and workshops and incorporated these shared activities into daily lessons, special activities such as field days, and graduation performances.

The barriers teachers reported most frequently were lack of time and limited space. Overall,

teachers reported fewer barriers during Spring of Year 3 than during Spring of Year 1. Several schools experienced significant site-related barriers during the 3-year intervention (see Table III for a summary of site changes by school). As one teacher who had limited playground access described during SHAPES collaborative planning:

We're cramped. Construction has been going on all year long! However, I find ways to get the students their exercise [...]. There are things we can do when there is not enough room, [for example] we go behind our classroom and race.

In surveys, the teachers reported that they felt supported by school administrators and interventionists. They also reported being prepared and that the intervention was a worthwhile endeavor.

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## Discussion

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The SHAPES intervention evolved over a 3-year period through a collaborative partnership between interventionists and preschool teachers. A strong asset of the SHAPES program was the positive relationships that developed across time between interventionists and teachers. These relationships fostered productive development and assessment of the final SHAPES intervention. Efforts to build and sustain the partnership between interventionists and teachers promoted 'buy-in', gave the participants a 'sense of ownership' of activity planning, and encouraged teachers to give honest feedback on intervention components and activities. As a result of these partnerships, the research team made critical adaptations to enhance the acceptability and feasibility of SHAPES, without changing the fundamentals of the intervention.

The process of developing and adapting effective materials and intervention strategies through a collaborative partnership required intensive effort by research personnel. Initially, the research team needed to understand the preschool context and build partnerships with teachers. For example, during Year 1, interventionists learned that the

**Table III.** Site changes and organizational characteristics

	School 1	School 2	School 3	School 4	School 5	School 6	School 7	School 8
Max number of classrooms	3	3	3	4	2	2	2	1
Decrease in classroom number	X		X	X			X	
Teacher turnover	X	X	X	X	X		X	X
Lead		X	X	X			X	X
Assistant	X	X	X	X	X		X	X
Administrative issues <sup>a</sup>	X					X		
Limited playground access <sup>b</sup>		X	X	X				X
New curriculum <sup>c</sup>		X			X	X		X

X, occurrence of situation in classroom over the duration of the intervention. <sup>a</sup>Conflict between teacher and administrator. <sup>b</sup>Limited playground access due to construction or other uses of playground/gymnasium. <sup>c</sup>School or district changed academic curriculum, altering teacher lessons and schedule.

teachers lacked physical activity knowledge and skills and needed additional resources to build their capacity. The final SHAPES approach and procedures were designed to be sustainable and easily disseminated [38]. The final components of the SHAPES intervention can be implemented by existing teachers through additional training and capacity development with minimal upfront cost, compared with hiring additional personnel.

The SHAPES intervention was acceptable to teachers. Teachers greatly appreciated the flexible approach and reported that it was easy to implement within their preschool classrooms. While SHAPES was not directly compared with a structured curriculum, the flexibility was key to implementation across diverse preschools and unique preschool contexts which is essential for successful implementation [22]. Teachers valued and enjoyed the partnership with interventionists and relationships with other participating teachers, which have been shown previously to increase the relevance and success of interventions [39, 40]. Teachers did report some barriers to implementing SHAPES, including lack of time, which is similar to previous research findings [41–43]. Reporting a lack of time may be the result of actual or perceived competing priorities to physical activity within the preschool environment. More research is needed on how to make physical activity a priority in preschools. SHAPES was conducted in preschools, which may have a larger number of teachers with higher education when compared with childcare centers. Thus, future efforts are needed

to test whether the approach will work in the broader environment of childcare centers.

This study did not evaluate which component of the SHAPES intervention was the most acceptable or feasible. ‘Move to Learn’ was initially viewed by most teachers as the favorite SHAPES component due to its link to academics. However, extensive process measures indicated that ‘Move to Learn’ physical activity opportunities were the least frequent, lowest in PA intensity and the shortest in duration compared with ‘Move Inside’ and ‘Move Outside’ activities. Although integrating physical activity with academics was beneficial in selling physical activity interventions to teachers, other opportunities may be more effective at increasing physical activity of young children. Additionally, although many behavior change strategies were used throughout the intervention (e.g. modeling and goal setting), the intervention did not include a structured a priori plan for implementing these strategies. Future studies should examine which specific techniques were most effective for changing teacher behaviors. The intervention was part of a randomized control trial to assess its effectiveness [23]. A final analysis of the effect of the SHAPES program on children’s physical activity is in development.

## Conclusions

The research staff–preschool teacher relationship was critical for establishing an effective partnership and intervention. SHAPES used a flexible and

adaptable approach, which was highly acceptable to preschool teachers. Future interventions need to be willing to adapt based on staff and participant feedback within a systematic framework [23], while maintaining the essential elements and goals of the intervention. Investigators and practitioners should develop an ongoing system to incorporate formative feedback from participants and staff to make adaptations throughout the intervention.

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### Conflict of interest statement

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None declared.

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### References

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- Department of Health and Ageing. *National Physical Activity Guidelines for Australians. Physical Activity Recommendations for 0–5 Year Olds*. Canberra: Commonwealth of Australia, 2010.
- Chief Medical Officers of England, Scotland, Wales and Northern Ireland. *Start Active, Stay Active: A Report on Physical Activity for Health from the Four Home Countries' Chief Medical Officers*. London: Department of Health, Physical Activity, Health Improvement and Protection, 2011.
- Institute of Medicine. *Early Childhood Obesity Prevention Policies*. Washington, DC: The National Academies Press, 2011.
- Hinkley T, Salmon J, Okely AD *et al*. Preschoolers' physical activity, screen time, and compliance with recommendations. *Med Sci Sports Exerc* 2012; **44**: 458–65.
- Beets MW, Bornstein D, Dowda M *et al*. Compliance with national guidelines for physical activity in U.S. preschoolers: measurement and interpretation. *Pediatrics* 2011; **127**: 658–64.
- Federal Interagency Forum on Child and Family Statistics. *America's Children: Key National Indicators of Well-Being, 2012*. Washington, DC: U.S. Government Printing Office, 2012.
- McWilliams C, Ball SC, Benjamin SE *et al*. Best-practice guidelines for physical activity at child care. *Pediatrics* 2009; **124**: 1650–9.
- Reilly JJ. Low levels of objectively measured physical activity in preschoolers in child care. *Med Sci Sports Exerc* 2010; **42**: 502–7.
- Pate RR, Pfeiffer KA, Trost SG *et al*. Physical activity among children attending preschools. *Pediatrics* 2004; **114**: 1258–63.
- Ward DS. Physical activity in young children: the role of child care. *Med Sci Sports Exerc* 2010; **42**: 499–501.
- Hesketh KD, Campbell KJ. Interventions to prevent obesity in 0–5 year olds: an updated systematic review of the literature. *Obesity (Silver Spring)* 2010; **18**(Suppl. 1): S27–35.
- Monasta L, Batty GD, Macaluso A *et al*. Interventions for the prevention of overweight and obesity in preschool children: a systematic review of randomized controlled trials. *Obes Rev* 2011; **12**: e107–18.
- Ward DS, Vaughn A, McWilliams C *et al*. Interventions for increasing physical activity at child care. *Med Sci Sports Exerc* 2010; **42**: 526–34.
- Monasta L, Batty GD, Macaluso A *et al*. Interventions for the prevention of overweight and obesity in preschool children: a systematic review of randomized controlled trials. *Obes Rev* 2011; **12**: e107–18.
- Hesketh KD, Campbell KJ. Interventions to prevent obesity in 0–5 year olds: an updated systematic review of the literature. *Obesity (Silver Spring)* 2010; **18**(Suppl. 1): S27–35.
- Brown WH, Googe HS, McIver KL *et al*. Effects of teacher-encouraged physical activity on preschool playgrounds. *J Early Interv* 2009; **31**: 126–45.
- Trost SG, Fees B, Dzawaltowski D. Feasibility and efficacy of a “move and learn” physical activity curriculum in preschool children. *J Phys Act Health* 2008; **5**: 88–103.
- Fitzgibbon ML, Stolley MR, Schiffer LA *et al*. Hip-Hop to Health Jr. Obesity Prevention Effectiveness Trial: postintervention results. *Obesity (Silver Spring)* 2011; **19**: 994–1003.
- MacDonald MA, Green LW. Reconciling concept and context: the dilemma of implementation in school-based health promotion. *Health Educ Behav* 2001; **28**: 749–68.
- Lieber J, Hanson MJ, Beckman PJ *et al*. Key influences on the initiation and implementation of inclusive preschool programs. *Except Child* 2000; **67**: 83–98.
- Hawe P, Shiell A, Riley T. Complex interventions: how “out of control” can a randomised controlled trial be? *BMJ* 2004; **328**: 1561–3.
- Hawe P, Shiell A, Riley T. Theorising interventions as events in systems. *Am J Community Psychol* 2009; **43**: 267–76.
- Craig P, Dieppe P, Macintyre S *et al*. Developing and evaluating complex interventions: the new Medical Research Council guidance. *Int J Nurs Stud* 2013; **50**: 587–92.
- Pfeiffer KA, Saunders RP, Brown WH *et al*. 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**: 728.

25. Brown WH, Pfeiffer KA, McIver KL *et al.* 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**: 167–76.
26. Sallis JF, Cervero RB, Ascher W *et al.* An ecological approach to creating active living communities. *Annu Rev Public Health* 2006; **27**: 297–322.
27. Brown WH, Pfeiffer KA, McIver KL *et al.* Social and environmental factors associated with preschoolers' non-sedentary physical activity. *Child Dev* 2009; **80**: 45–58.
28. Williams CL, Carter BJ, Kibbe DL *et al.* Increasing physical activity in preschool: a pilot study to evaluate animal trackers. *J Nutr Educ Behav* 2009; **41**: 47–52.
29. Dennison BA, Russo TJ, Burdick PA *et al.* An intervention to reduce television viewing by preschool children. *Arch Pediatr Adolesc Med* 2004; **158**: 170–6.
30. Trost SG, Ward DS, Senso M. Effects of child care policy and environment on physical activity. *Med Sci Sports Exerc* 2010; **42**: 520–5.
31. Hannon JC, Brown BB. Increasing preschoolers' physical activity intensities: an activity-friendly preschool playground intervention. *Prev Med* 2008; **46**: 532–6.
32. Nicaise V, Kahan D, Sallis JF. Correlates of moderate-to-vigorous physical activity among preschoolers during unstructured outdoor play periods. *Prev Med* 2011; **53**: 309–15.
33. Bond L, Glover S, Godfrey CG *et al.* Building capacity for systems-level change in schools: lessons from the Gatehouse Project. *Health Educ Behav* 2001; **28**: 368–83.
34. Hawe P, Noort M, King L *et al.* Multiplying health gains: the critical role of capacity building within health promotion programs. *Health Policy* 1997; **39**: 29–42.
35. Ward DS, Saunders RP, Felton GM *et al.* Implementation of a school environment intervention to increase physical activity in high school girls. *Health Educ Res* 2006; **21**: 896–910.
36. Spahn JM, Reeves RS, Keim KS *et al.* State of the evidence regarding behavior change theories and strategies in nutrition counseling to facilitate health and food behavior change. *J Am Diet Assoc* 2010; **110**: 879–91.
37. Eva KW, Regehr G. Exploring the divergence between self-assessment and self-monitoring. *Adv Health Sci Educ Theory Pract* 2011; **16**: 311–29.
38. Johnson K, Hays C, Center H *et al.* Building capacity and sustainable prevention innovations: a sustainability planning model. *Eval Program Plann* 2004; **27**: 135–49.
39. 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; **41**: 327–50.
40. Minkler M. Community-based research partnerships: challenges and opportunities. *J Urban Health* 2005; **82**(Suppl. 2): ii3–12.
41. Hughes CC, Gooze RA, Finkelstein DM *et al.* Barriers to obesity prevention in Head Start. *Health Aff (Millwood)* 2010; **29**: 454–62.
42. Huberty JL, Beets MW, Beighle A *et al.* Environmental modifications to increase physical activity during recess: preliminary findings from ready for recess. *J Phys Act Health* 2011; **8**(Suppl. 2): S249–56.
43. Cox L, Berends V, Sallis JF *et al.* Engaging school governance leaders to influence physical activity policies. *J Phys Act Health* 2011; **8**(Suppl. 1): S40–8.