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Human Kinetics
ORIGINAL RESEARCH

Feasibility of Integrating Physical Activity Into Early Education Learning Standards on Preschooler's Physical Activity Levels

Sofiya Alhassan, Christine W. St. Laurent, Sarah Burkart, Cory J. Greever, and Matthew N. Ahmadi

Background: For a health behavior intervention to be sustainable within preschool centers, the intervention should be implemented by classroom teachers. Unfortunately, teachers are constrained by demands such as meeting early childhood education standards. Therefore, the purpose of this pilot study was to examine the feasibility and preliminary efficacy of integrating a health behavior intervention into early education learning standards on physical activity (PA), diet, and sleep (PADS) behavior of preschoolers. **Methods**: Two preschool centers were randomized to either the PADS (children, n = 60) or the control (CON; children, n = 54) group. The PADS intervention consisted of PADS lesson plans and activities embedded into Massachusetts early learning standards and were implemented for 4 days per week for 12 weeks. The CON preschool participated in their usual curriculum. PA was assessed using accelerometers for 7 consecutive days at baseline, 6 weeks, and 12 weeks. Other outcome variables were assessed with parental surveys at baseline and 12 weeks. **Results**: Significant group by time interactions were observed for moderate to vigorous PA (percentage of time) during the preschool day (PADS: baseline = 10.6% (4.2%), 12 wk = 13.2% (2.3%); CON: baseline = 12.4% (3.9%), 12 wk = 11.2% (3.6%); $P = .02$). **Conclusion**: This pilot study provides preliminary evidence that integrating health behaviors into learning standards is feasible and potentially an effective way for increasing preschoolers' PA levels.

Keywords: curriculum-based, health behaviors, preschool-children, teacher-led

Obesity-related health behaviors (ORHBs) have been identified as risk factors for increased unhealthy weight gain in preschoolers (2.9–5 y).[1–3] ORHBs include low physical activity (PA), obesogenic dietary intake patterns (lower fruit and vegetable consumption, greater consumption of energy-dense snacks and beverages), poor sleep behavior, and excessive media/screen time. Due to the early presence of ORHBs, early childhood has been identified as a unique window of opportunity for the establishment of lifelong healthy behaviors that could potentially reduce obesity risk as a child ages.[1] For an ORHB program to be effective in preschoolers, the intervention must include strategies that target the environments (preschool center and home) that directly impact their ORHBs.[4] For example, previous studies have shown that these environments impair preschoolers' abilities to regulate their ORHBs through unhealthy influences such as encouraging children to clean their plates even after they are full or limiting structured play time. In addition, although there is clear evidence indicating interrelationships among ORHBs in preschoolers, all 4 ORHBs have not been simultaneously addressed in previous interventions.[5–7]

In the United States, approximately 61% of preschoolers spend a significant portion of their day in some form of nonparental childcare setting (ie, preschool center).[8] Thus, the preschool center represents a unique and essential opportunity to help preschoolers establish healthy ORHBs. Research to date suggests that a preschool center's ORHB environment plays a role in children's ORHBs.[9–11] A review by Ward et al[4] reported that for a health behavior intervention to be sustainable, it must be delivered by the center staff (eg, classroom teachers). However, teachers are generally constrained by other demands, such as meeting early education learning standards (state-mandated policies). Therefore, the majority of health behavior interventions that have been implemented by teachers have reported minimal to no significant change in health behaviors.[12,13] Such findings could potentially be due to the fact that most teacher-led interventions are not directly incorporated into the required learning standards and, therefore, have low implementation compliance. Due to teachers' limited time, interventions that are incorporated into education standards may improve implementation and sustainability in preschools. Currently, it is not known if ORHBs integrated into learning standards can effectively alter health behavior. Therefore, the purpose of this pilot study was to examine the feasibility and preliminary efficacy of integrating a 12-week health behavior intervention into early education learning standards on PA, diet, and sleep (PADS) behavior of preschoolers.

Methods

Participants

This study was a 12-week pilot randomized controlled trial. Three preschool centers were recruited to participate in this study. Center ORHB environments and policies were assessed with a modified version of the Environment and Policy Assessment and Observation Audit Tool (EPAO).[11] The EPAO was modified to include an assessment of the preschool nap environment and policies. Prior to randomization, one center dropped out of the study. The remaining 2 centers with similar ORHB environment and practices were randomized to either the physical activity, diet, and sleep (PADS) or the health tracking control (CON) group. All children within each center participated in their assigned intervention. However, children were individually recruited to participate in the assessment

The authors are with the Department of Kinesiology, University of Massachusetts Amherst, Amherst, MA. Alhassan (alhassan@kin.umass.edu) is corresponding author.

protocol and the home (parent) intervention. Children were eligible for the assessment portion of the study if they were between the ages of 2.9 and 5 years and had 1 parent/guardian willing to participate in the online parent intervention. Children's parents/guardians provided informed consent for themselves and parental permission for their child to participate in this study. The study was approved by the University of Massachusetts Institutional Review Board (Protocol#: 2015–2651).

Intervention

Theoretical Framework. This intervention was based on components of the social-ecological model and the social cognitive theory. The social cognitive theory suggests that behavior is learned and developed through the interrelationships of personal factors (ie, parental support), behavioral factors (ie, parental health behavior practices), and environmental factors.[14] One limitation of social cognitive theory is that it does not address environmental policy, which contributes to a child's behavior, so elements of the social-ecological model were utilized in designing the intervention as well. Social-ecological model is rooted in the interrelationships between the environment and human behavior and integrates several levels of influence to impact health behaviors.[15]

Intervention Development and Teacher Training. The PADS intervention was implemented at the preschool center and home. Each PADS lesson was designed to incorporate Massachusetts Early Learning Standards (eg, Art, Mathematics, and Social and Emotional Learning). For example, a targeted learning standard was measurement (ie, long and short). A lesson plan designed to teach measurement was "Animal Opposites," where students were asked to move around the classroom like opposing animals (ie, mouse crawl [short/small] and bear crawl [tall/big]). Instructions for implementing all activities were provided to the teachers. Each lesson plan included the targeted learning standard, equipment needed, instructions for implementing the lesson, and additional supplementary activities to extend the lesson. Before baseline assessments, all teachers in the PADS center participated in a 2-hour training led by research staff. The PADS intervention curriculum was presented to the teachers and individual lessons/activities were demonstrated.

Implementation of Intervention. Physical activity, diet, and sleep preschool center lessons consisted of fun, age-appropriate activities that were implemented 4 days per week for 12 weeks. The PA portion consisted of 2 components (curriculum [10–15 min] and short bouts of PA [5 min]). The PA curriculum was offered in the morning (twice/week) and was designed to provide moderate to vigorous PA (MVPA) and academic integration. The short bout PA component was implemented 3 afternoons per week utilizing a DVD to aid the teacher in leading the movements. The diet curriculum (15 min in duration) was implemented 1 morning per week and focused on teaching children about healthy eating. The sleep curriculum (10 min in duration, 1 afternoon/wk) focused on teaching the children the benefits of sleeping and napping. The health tracking CON group continued to participate in their usual preschool curriculum.

The home component of the PADS intervention was delivered online. A study website was created and updated weekly to share intervention materials and information with parents. The website contained intervention newsletters, information on the content of the preschool classroom lessons, and ORHB resources and activities to help families improve their ORHBs (eg, healthy choices while eating out). Families were encouraged to participate in weekly family ORHB-related activities as part of an incentive challenge (eg, screen-free day or take a family walk). Preschoolers who completed at least half of the activities with their families received a PA incentive bag (ie, a bag with a kite, beach ball, and jump rope) at the end of the study.

Assessment and Measures

Outcome Measures. Data were collected at baseline and 12 weeks. PA was also assessed at 6 weeks. Standing height to the nearest millimeter (stadiometer; Shorr Height Measuring Board, Olney, MD) and weight to the nearest 0.1 kg (digital scale) were assessed by trained data collectors. Participant PA was assessed with Actigraph accelerometers (GT1M, GT3X, GT3X+, and ActiSleep; Actigraph, LLC, Pensacola, FL), programmed to store data at 15-second epochs. Accelerometers were attached to an adjustable elastic belt and worn around participants' waists at their lower backs to be unobtrusive.[16] Teachers and parents were asked to encourage children to wear the accelerometers for all waking hours for 7 consecutive days and to take it off any time it would get completely wet. Accelerometer data were analyzed with ActiLife software (version 6.9.1; Actigraph, LLC, Pensacola, FL), and a custom algorithm (>20 min of consecutive zeros) was used to determine nonwear and wear time (≥480 min). Three valid wear days were set as the minimum to be included in the analysis. Pate et al[17] cut points for preschool age children were used to classify PA intensities (sedentary, light, moderate, vigorous, and MVPA). Based on our previous work in preschool centers from the Springfield, MA area, we define total daily and preschool day PA as the hours between 7 AM–10 PM and 8 AM–4:30 PM, respectively.[18–22]

Parents/guardians of the participants completed online questionnaires at baseline and 12 weeks through Qualtrics (Qualtrics, Provo, UT). Parents who did not provide an e-mail address were given a paper copy of the questionnaires. Participant demographics were collected at baseline. Child ORHBs, including sedentary (ie, screen time, doing art work or crafts, and playing quiet games indoors), sleep, and diet behaviors (ie, weekly servings of fruits and vegetables), were assessed using modified versions of the self-report Sedentary Behavior Questionnaire, Sleep Disturbance Index, and the Short Food Frequency Questionnaire, respectively.[18,20,21,23–25] Preschool centers' ORHB environment and policies were assessed again at 12 weeks with the EPAO.[11]

Process Evaluation Measures. During each intervention session, a trained research staff member observed the lesson and recorded study fidelity information and preschoolers' acceptability and enjoyment with a semistructured questionnaire. In addition, teachers completed semistructured questionnaires with their comments on each PADS lesson with suggestions for modifications specific to their classroom's needs. Accelerometers were worn by all participants on 1 randomly selected day per week to assess the intensity of the morning PA lessons. After the study, teachers in the PADS school completed an overall evaluation form.

Statistical Analysis

Differences in baseline variables between groups were determined using 2-sample *t* tests for continuous variables and chi-square tests for categorical variables. Changes in PA variables (sedentary, light, and MVPA) were assessed using linear mixed-model analyses with an unstructured covariance matrix (1 model for each variable). Fixed effects included group, time, and group × time. To account for the within-participant nature of the repeated measures, the

participant was included as a random effect. The margins command was utilized to assess outcome adjusted means by group and time. Baseline differences were accounted for in the analyses. Post hoc contrasts were performed to evaluate specific group × time interactions of interest. Statistical significance for all tests was determined using an $\alpha < .05$. All analyses were performed in Stata (version 14; StataCorp LLC, College Station, TX).

Results

A total of 114 preschoolers from both centers participated in the preschool intervention component and were eligible to participate in the study (PADS, n = 60; CON, n = 54). Of this, 52 families responded to our advertisement and were eligible for the home intervention component and the assessment of the outcome variables (PADS, n = 26; CON, n = 26). Accelerometer data were not available in 17 participants (PADS, n = 11; CON, n = 6), due to malfunctioning accelerometers, insufficient wear time, or unreturned monitors. A total of 35 participants (PADS, n = 15; CON, n = 20) with complete data were included in the analyses. Participants' baseline characteristics are presented in Table 1. On average, participants were 3.6 (0.8) years of age and their average body mass index was in the 50th percentile for their age and sex. More than 75% of their daily baseline activities were classified as sedentary time. On average, participants engaged in 113.5 (90.7) minutes per day of screen time. At baseline, participants in the PADS group accumulated more screen time ($P = .02$) and consumed fewer fruits ($P = .02$) compared with participants in the CON group.

Impact of Intervention Activities

Changes in Preschool-Day and Total Daily PA. A significant group by time interaction was observed for preschool day MVPA. The intervention led to a significant increase in the percent of time spent in MVPA (Wald χ^2 [5, N = 85] = 13.1, $P = .02$) in the PADS group, compared with the CON group (Figure 1). In the PADS group, the average increase in MVPA at 6 weeks and 12 weeks was 3.3% (1.3%) (95% CI, 0.9 to 5.8; $P < .01$) and 3.9% (1.5%) (95% CI, 1.0 to 6.9; $P < .01$), respectively. The change in MVPA observed in the PADS group translates to 2.0 (0.8) and 2.3 (0.9) minutes per hour of preschool attendance at the 6-week and 12-week assessment time points, respectively (Table 2). A significant group by time interaction was also observed in preschool day percent of time spent in sedentary time (Figure 2). Specifically, the PADS intervention group observed a 4.8 (2.2) reduction (95% CI, −9.1 to −0.50; $P = .03$) in their percent of time spent in sedentary activities. The observed change in the PADS group sedentary time between baseline and 12 weeks is an average reduction of 2.9 (1.3) minutes per hour of preschool attendance (Table 2).

The impact of the PADS intervention on total daily PA is presented in Table 2. A significant group by time interaction for percent of time spent in vigorous PA (Wald χ^2 [5, N = 85] = 14.4, $P = .01$) was observed in the PADS group, compared with the CON group. The average between-group difference in vigorous PA was 1.3% (0.4%) (95% CI, 0.5 to 2.1; $P < .01$) at the 6-week assessment and 1.4% (0.5%) (95% CI, 0.4 to 2.4; $P < .01$) at the 12-week assessment. Significant group by time interaction was also observed for percent of time spent in total daily MVPA. The average increase in total daily MVPA (percent of time spent) at 6 weeks and 12 week were 2.2% (0.9%) (95% CI, 0.4 to 3.9; $P = .02$) and 3.0% (1.3%) (95% CI, 0.5 to 5.5; $P = .02$), respectively.

Changes in Other ORHBs. Participants' baseline fruit and vegetable intake are reported in Table 1. At 12 weeks, both groups increased their weekly vegetable servings (PADS, 13.4 [10.5]; CON, 12.5 [6.9]). Similarly, at 12 weeks, participants in the PADS group increased their average weekly fruit intake to 14.2 (7.6) servings per week, whereas the fruit intake of the participants in the CON group remained the same (19.8 [9.1]). Also, the intervention did not impact participants' screen time or sleep variables.

Overall, the intervention did not lead to improvements in the PADS preschool center ORHBs environment. However, improvements were observed in the teachers' behaviors. For example,

Table 1 Participants Baseline Characteristics

Variable	PADS (n = 26)	CON (n = 26)	*P* value
Age ,y	3.7 (0.9)	3.6 (0.7)	.90
Sex, % female	46 (n = 12)	54 (n = 14)	.57
BMI percentile	46.6 (28.7)	53.8 (24.3)	.35
Sedentary time, % total day	78.3 (5.9)	75.9 (5.4)	.25
Light PA, % total day	11.1 (2.1)	11.6 (1.8)	.44
MPVA, % total day	10.7 (4.2)	12.4 (3.9)	.22
Weekday screen time, min/d	119.2 (73.7)	67.1 (62.5)	**.02**
Weekend screen time, min/d	176.7 (73.7)	120.0 (134.5)	.18
Sleep behavior, total score	40.1 (8.2)	39.5 (5.6)	.80
Vegetable intake, servings/wk	10.8 (6.9)	9.7 (6.1)	.62
Fruit intake, servings/wk	13.0 (7.6)	19.5 (8.40	**.02**

Abbreviations: BMI, body mass index; CON, control group; MVPA, moderate to vigorous physical activity; PA, physical activity; PADS, physical activity, diet, and sleep intervention group. Note: Values reported as mean (SD). Child sedentary and PA time derived from accelerometers between 7 AM–10 PM; sleep behavior total score = higher scores indicate greater sleep disturbances (range = 26–130). Average accelerometer wear time for PAD and CON groups were 769.2 (99.2) and 814.1 (113.3) min/d, respectively ($P = .25$).

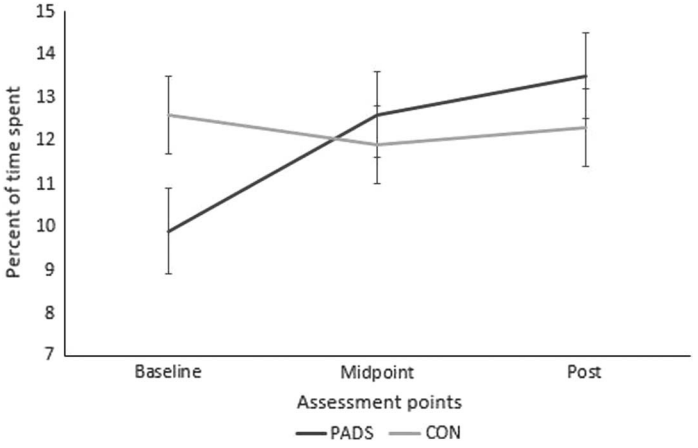

Figure 1 — Preschool day time spent in moderate to vigorous physical activity. *P* value for midpoint (6 wk) to baseline comparison = .02. *P* value for post (12 wk) to baseline comparison = .02. CON indicates control group; PADS, physical activity, diet, and sleep intervention group.

Table 2 Mixed Model Results for PA

	Baseline		Midpoint			Post		
Variable	**PADS**	**CON**	**PADS**	**CON**	***P* value (95% CI)[a]**	**PADS**	**CON**	***P* value (95% CI)[b]**
Total day PA (percent of time)								
Sedentary time	77.9 (1.3)	76.8 (1.2)	76.0 (1.1)	76.2 (1.1)	.30 (–3.70 to 1.13)	75.0 (1.1)	77.1 (1.1)	.08 (–6.67 to .43)
Light PA	11.4 (0.4)	11.2 (0.4)	11.4 (0.5)	12.1 (0.5)	.05 (–1.80 to –.01)	11.8 (0.4)	11.5 (0.4)	.93 (–1.16 to 1.28)
Moderate PA	7.8 (0.6)	8.7 (0.5)	8.7 (0.5)	8.8 (0.5)	.16 (–.35 to 2.07)	9.1 (0.5)	8.4 (0.5)	.08 (–.16 to 3.26)
Vigorous PA	2.9 (0.4)	3.3 (0.3)	3.8 (0.3)	2.9 (0.3)	.002 (.48 to 2.15)	4.0 (0.3)	3.0 (0.3)	.004[a] (.44 to 2.41)
MVPA	10.7 (0.9)	12.0 (0.8)	12.6 (0.7)	11.7 (0.7)	**.02**[a] (.41 to 3.90)	13.1 (0.8)	11.4 (0.7)	**.02**[b] (.50 to 5.51)
Preschool day (min/h)								
Sedentary time	47.4 (0.9)	45.2 (0.8)	45.4 (0.9)	45.1 (0.9)	.10 (–4.09 to .36)	44.4 (0.9)	45.2 (0.8)	**.03**[b] (–5.49 to –.28)
Light PA	6.7 (0.3)	7.3 (0.3)	7.1 (0.4)	7.7 (0.4)	.92 (–1.02 to .92)	7.5 (0.3)	7.4 (0.3)	.28 (–.43 to 1.62)
Moderate PA	4.3 (0.4)	5.5 (0.4)	5.2 (0.4)	5.5 (0.4)	.06 (–.06 to 2.01)	5.7 (0.5)	5.5 (0.4)	.05 (–.02 to 2.73)
Vigorous PA	1.6 (0.2)	2.1 (0.2)	2.3 (0.2)	1.6 (0.2)	**.001**[a] (.44 to 1.73)	2.5 (0.2)	1.8 (0.2)	**<.001**[b] (.56 to 1.62)
MVPA	5.9 (0.6)	7.5 (0.6)	7.5 (0.6)	7.1 (0.6)	**.009**[a] (.51 to 3.50)	8.1 (0.6)	7.4 (0.5)	**.009**[b] (.59 to 4.11)

Abbreviations: CI, confidence interval; CON, control group; MVPA, moderate to vigorous physical activity; PA, physical activity; PADS, physical activity, diet, and sleep intervention group. *Note*: Values reported as adjusted means (SEs). Total day PA (percent time) derived from accelerometers from 7 AM to 10 PM; preschool day PA (in minutes per hour) derived from accelerometers from 8 AM to 4:30 PM. Average accelerometer wear time for PADS group at baseline, 6 weeks, and 12 weeks were 769.2 (99.2), 834.9 (126.7), and 861.4 (73.4) min/d, respectively. Average accelerometer wear time for CON group at baseline, 6 weeks, and 12 weeks were 814.1 (113.3), 815.6 (132.7), and 878.4 (104.7) min/d, respectively.

[a]Between-groups midpoint to baseline comparison. [b]Between-groups post to baseline comparison.

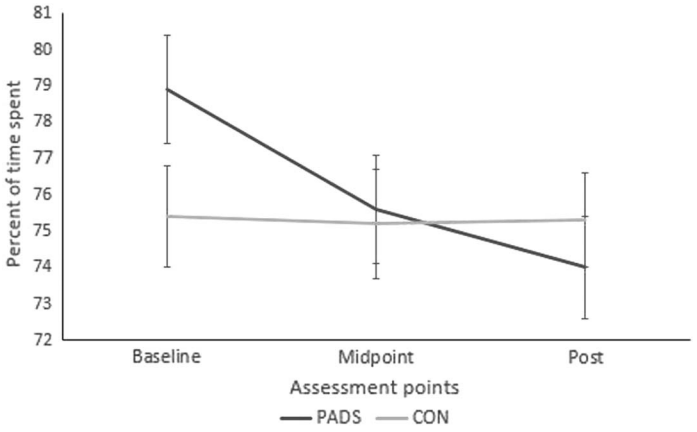

Figure 2 — Preschool day time spent in sedentary activity. *P* value for midpoint (6 wk) to baseline comparison = .10. *P* value for post (12 wk) to baseline comparison = .03. CON indicates control group; PADS, physical activity, diet, and sleep intervention group.

there was a slight improvement in PADS teachers' scores (baseline = 15; post = 16.7) for diet behaviors (ie, gentle encouragement for children to try new or less favorite foods) compared with the CON teachers (baseline = 15; post = 13.3). Also, the PADS center also reduced their servings of fruit juice and weekly servings of high-sugar food items (eg, cookies; change in score from 11 to 13). Scores for teachers' behavior related to PA increased in both the PADS group (baseline = 16.7; post = 20) and the CON group (baseline = 10; post = 13.3). At the completion of the 12-week intervention, compared with the CON center, the PADS center participated in more structured activity during gross motor playtime. Although the PADS center did not increase the number of children who actively slept during nap time, they did see improvements in the number of children who rested quietly during nap time. Classroom teachers' poststudy evaluation form indicated that the study protocol was easily implemented and did not have an adverse effect on their daily preschool routines.

Discussion

Preschool centers have been identified as a valuable setting to help introduce preschoolers to healthy lifestyle behaviors (such as higher levels of PA). Several studies have reported that preschoolers tend to spend a significant part of their preschool day engaged in sedentary behavior and very little time in MVPA.[26–28] In addition, within the preschool setting, it is important that teachers play a key role in implementing interventions aimed at changing preschoolers' ORHBs. Unfortunately, most teachers have limited time to focus on ORHBs due to time constraints related to implementing early learning standards. Therefore, integrating

ORHB activities into learning standards could be an efficient means of impacting preschoolers' ORHBs. The primary aim of the PADS pilot study was to examine the feasibility and preliminary efficacy of integrating PADS into learning standards on preschoolers' ORHBs. The major finding of this pilot study was that such an approach could be a viable means of increasing preschoolers' time spent in MVPA and decreasing levels of sedentary time. The PADS intervention led to significant improvements in children's percent of time spent in MVPA and sedentary time during the preschool day. The observed changes translate to approximately a 2 minutes increase in MVPA and 3 minutes reduction in sedentary time per hour of preschool attendance. Because the average child attends preschool for approximately 8 hours per day (8:00 AM–4:30 PM), the observed intervention-related changes translate to an increase of 16 minutes in MVPA and a reduction in sedentary time by 24 minutes during the preschool day. The observed changes in preschool day PA seem to impact the total day MVPA. The PADS intervention led to a significant increase in total daily MVPA at both 6 and 12 weeks.

It is difficult to compare our study findings to others because, currently, a very limited number of studies have integrated ORHB lesson plans and activities into academic learning standards.[29–31] Of these studies, only 1 study was designed to increase preschoolers' PA levels. In 2008, Trost et al[29] examined the effects of an 8-week intervention that integrated PA into the preschool curriculum and was implemented by classroom teachers in 4 half-day preschool classrooms. Children in treatment classrooms showed improvements in MVPA during their half-day classroom setting. Because this was only half-day preschool, researchers were not able to examine the impact of the intervention on total preschool day PA or on total daily PA. In 2 separate 8-month studies by Kirk et al, [30,31] researchers used a quasi-experimental design to examine the impact of integrating PA into existing classroom literacy lessons on early literacy skills in preschoolers enrolled at 2 preschool centers. PA during the intervention time was assessed using direct observation (System for Observing Fitness Instruction Time). In both studies, researchers reported that the academic program taught using PA resulted in significantly greater bouts of PA in the intervention preschool during classroom time. Due to the study protocols, researchers did not assess participants' PA during the entire preschool day or total day.

In preschool settings, few interventions implemented by teachers have examined the impact of the interventions on total daily PA. Recently, Pate et al[32] conducted a 1-year intervention that examined an adaptable ecological PA intervention implemented by teachers on the PA of 4-year-old preschoolers. The intervention resulted in significant improvements in preschool day MVPA. Compared with the control school, children in the treatment preschools participated in an additional 0.8 minutes of MVPA per hour of preschool attendance. Although the intervention activities were not incorporated into learning standards, teachers were encouraged to modify their practices to adapt the intervention activities to their classrooms.

The MVPA effects observed in the current study are slightly greater than what others have reported. This potentially could be due to the PA dosage implemented in the current study. Within a given preschool day, 2 PA intervention sessions were implemented. The first part of the PA component consisted of integrating PA lessons into the learning standards and was implemented before morning outdoor playtime. The second PA intervention session was implemented in the afternoon (after nap) and consisted of 5-minute activity breaks. At the preschools that participated in this study, children participated in either sedentary activity or light-intensity unstructured free play after nap time. This pattern has been shown in other preschool populations.[20,33] Researchers have reported that preschoolers tend to accumulate most of their PA during morning outdoor play compared with afternoon outdoor playtime.[20,33] This can be attributed to the afternoon preschool day schedule, which usually consists of waking up from nap, followed by a light snack, unstructured classroom playtime and, finally, pick-up time. Therefore, as part of this pilot study, we elected to target this relatively sedentary time during the preschool day by providing the PADS center time to participate in a short bout of structured PA. Compared with unstructured free play, researchers have shown that preschoolers can accumulate more activity during structured playtime.[19]

Although the PADS intervention significantly improved PA, no significant changes were observed in diet or sleep variables. The lack of change in both diet and sleep could be due to the dose of the components. Both the diet and the sleep components were implemented on only 1 day per week for 10 to 15 minutes per session. It is possible that this dosage was not enough to elicit changes in preschoolers' diet or sleep behaviors. In addition, although the study intervention did have a home component, the parent intervention was not effective, primarily due to the format (online) of the intervention. The online format, with no face-to-face contact, was used because focus group data with parents of preschoolers indicated that they wanted a program where they did not have "the extra time of meeting with researchers." Therefore, based on the focus group data, we developed an intervention that provided parents with the intervention information and activities in an online format. Intervention information and activities (for parents to do with their children) were posted weekly to the study website. During the poststudy evaluation, some parents reported that they logged on to the study site to access the information. Unfortunately, we were not able to quantify the number of parent logins to access the information due to the platform used to develop the website. In addition, it is possible that the website was not interactive enough to engage the parents. Once the study started, the research staff had no interaction with parents and, therefore, could not communicate and engage with them. Future studies that utilize an online format should use a platform that enables them to quantify participant usage and one that also contains some time for face-to-face contact, while not overburdening parents.

Due to the intervention design of integrating ORHBs into learning standards, it is difficult to compare the study findings on diet and sleep to other studies. However, previous preschool-based interventions on diet and sleep have yielded mixed results. Similar to the present study, some have found that intervening on diet during the preschool day resulted in no change in diet outcomes. For example, in the 14-week study by Fitzgibbon et al,[34] researchers observed that the intervention had no significant impact on preschoolers' fruit, vegetable, or juice intake. In 2015, Michels et al,[35] implemented a multilevel intervention that included sleep duration in preschoolers. The intervention was implemented across 8 European countries. Researchers reported no significant impact on total weekly sleep duration. The researchers concluded that it was possible that the sleep intervention was too short and/or not intense enough to counter the decrease in sleep duration in their preschool population. Similar to the present study, Michels et al[35] also indicated that their results could be because the sleep intervention received less attention (implemented 1 d/wk) than the other components of the intervention.

It is important that the study findings be interpreted with caution based on some of the study limitations. The primary limitation of this study is related to the short study duration (12 wk) and the small sample size. In addition, it is possible that the lack of adjustment for multiple comparisons and missing accelerometer data could have impacted our findings. Another limitation of the study is related to the diet environment. Specifically, the treatment preschool center provided lunch to the children, whereas in the control preschool, parents provided the food. Finally, we were unable to quantify how often parents logged in to the study website to view the research information. Despite these weaknesses, this study had some strengths. An important strength of this study was that it demonstrated the feasibility of integrating PA activities into learning standards. Finally, an important strength of the study was the use of accelerometers, which provided an objective assessment of PA.

Conclusions

The findings of this pilot study show promise that incorporating ORHBs into learning standards could be used to improve preschoolers' PA levels and does not place an extra burden on teachers' in-classroom instruction. However, the effectiveness of this intervention needs to be evaluated in a larger sample. Unfortunately, this type of intervention was not effective in altering diet and sleep behaviors, or the home environment, potentially due to the intervention dosage and format. Future studies should focus on better engaging parents to change the ORHB home environment, and the format of the intervention should include both an online component and face-to-face contact.

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