



Evaluation of a statewide dissemination and implementation of physical activity intervention in afterschool programs: a nonrandomized trial

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Abstract

In 2015, YMCA-operated afterschool programs (ASPs) across South Carolina pledged to achieve the national standard that calls for every child to accumulate 30 min/day of moderate-to-vigorous physical activity (MVPA) during program time. This study shares the first-year findings related to the dissemination, implementation, and outcomes associated with the statewide intervention to achieve the MVPA Standard. Twenty ASPs were sampled from all YMCA-operated ASPs ($N = 97$) and visited at baseline (spring 2015) and first-year follow-up (spring 2016). Programs were provided standardized professional development training to increase the MVPA children accumulated while attending ASPs. The training focused on extending the scheduled time for activity opportunities and modifying commonly played games to increase MVPA. The RE-AIM framework was used to evaluate the statewide intervention. Accelerometer-derived MVPA was the primary outcome. Implementation was evaluated via direct observation. Intent-to-treat (ITT) and as-treated comparisons were conducted in summer 2016. Reach/adoption was variable, with attendance at trainings ranging from 0 to 100% across ASPs. Effectiveness of the intervention using ITT models indicated no changes from baseline in the percentage of programs meeting the MVPA standard for boys or girls. Implementation levels also varied and were related to increases in both boys' and girls' MVPA for moderate and high implementers. Findings indicate improvements in MVPA can be made from attending the trainings and implementing some or all of the training components. Additional work is necessary to identify ways to ensure staff attend trainings to implement strategies and to identify which specific factors contributed to increases in MVPA.

Keywords

Policy, Moderate-to-vigorous physical activity, Children, Obesity, Theory

INTRODUCTION

In 2011, the YMCA of the USA adopted physical activity guidelines that called for every child enrolled in a YMCA-operated afterschool program (ASP) to accumulate half of their daily

Implications

Practice: Scheduling adequate time for physical activity opportunities daily and attendance at trainings are necessary to maintain or increase the amount of activity children accumulate during the program.

Policy: Policies need to address minimal training hours required for all site leaders and staff on content related to scheduling activity time and maximizing the amount of activity accumulated by children during that time.

Research: Simple, practical, and easy-to-implement strategies for practitioners are available and should be the primary components of interventions targeting increases in activity within these settings.

moderate-to-vigorous physical activity (MVPA) recommendation (i.e., ≥ 30 min of MVPA/day) while attending a YMCA ASP [1]. With over 2700 YMCA facilities in over 10,000 communities serving over 9 million youth, YMCA-operated ASPs have extensive reach and the potential to make a meaningful impact on the health and wellbeing of children.

Interventions have demonstrated that it is possible to increase the amount of MVPA children accumulate in ASPs; however, these studies have primarily been conducted with a limited number of ASPs receiving the intervention [2–10]. Research investigating the delivery of an intervention at-scale to a large number of ASPs over a dispersed geographical region is limited. Such research is necessary for the translation of effective interventions given the challenges associated with the delivery of evidence-based programs to much larger audiences while attempting to maintain program effectiveness [11]. Two previous studies that investigated the dissemination, adoption, implementation, and effectiveness of pre-packaged curricula,

equipment, and training across 164 ASPs in Hawaii [12] and 330 ASPs in Ontario [13] found implementation levels varied across ASPs and modest improvements in MVPA were achieved. This is consistent with the results of previous experimental studies on the implementation and effectiveness of curricula/equipment purchases in ASPs [6, 7, 14].

The present study builds upon these previous efforts by investigating the dissemination, implementation, and effectiveness of a skills-based professional development training to increase MVPA in ASPs across a statewide network of YMCA-operated ASPs. The training, Strategies To Enhance Practice (STEPs) [15], uses a capacity building approach and targets ASP site leaders and frontline staff to create more activity-friendly environments. Prior evaluations of STEP and its components demonstrated improvements in ASP capacity and children's MVPA [16–19]. Although effective, the extent to which STEP can be scaled and delivered to a larger audience of ASPs and retain effectiveness is unknown. Therefore, the purpose of this study was to evaluate the effectiveness of STEP when disseminated and implemented across 97 YMCA-operated ASPs in one southeastern state.

METHODS

Design, participants, and setting

Design—This study employed a single-group quasi-experimental pre-/post-design, with all YMCA-operated ASPs in South Carolina eligible to participate in the professional development trainings. The study is reported in accordance with the Transparent Reporting of Evaluations with Nonrandomized Designs (TREND) statement [20]. Additionally, the study findings are reported using components of the RE-AIM framework [21, 22]. The maintenance component of the framework was not assessed given the absence of a post-treatment follow-up (e.g., >6 months) [22]. Also, reach and adoption were considered analogous in this study given the intervention targeted change at the setting level (i.e., ASPs) that was hypothesized to lead to changes in the MVPA levels of the children attending (i.e., individuals enrolled in the ASPs) [22, 23]. For the purpose of this study, ASPs refer to pre-existing community-based programs that take place immediately after the regular school day (typically 3–6 PM), take place in either a school setting or a community organization outside the school environment (e.g., YMCA facility), are available daily throughout the academic year (Monday through Friday), and provide a combination of scheduled activities, which include snack, homework assistance/tutoring, enrichment activities (e.g., arts and crafts, music), and opportunities for children to be physically active [24, 25]. This definition is consistent with the Afterschool Alliance's nationwide survey [26] which defines an ASP as "... a program that a child regularly attends that provides a supervised enriching environment in the hours after the school day ends. These programs are usually offered in schools or centers and are different from individual activities, such as

sports, special lessons, or hobby clubs." Programs held during the afterschool hours that focus solely on a single activity (e.g., academic tutoring, music lessons) or were designed specifically to promote physical activity (PA) such as clubs (e.g., Girls on the Run) or sports teams (e.g., intra- and inter-murals) were not included in this study.

Setting—A total of 21 YMCA Associations operate independently across South Carolina. One Association did not operate an ASP and therefore was not included in the study [27]. The remaining 20 Associations collectively operated 102 programs for the 2014–2015 school year, with a median of 4 programs per Association (range of 1–13 ASPs operated by a single Association). The number of ASPs operated by YMCAs decreased to 97 (median 4 programs per Association, range 1–13 ASPs) for the 2015–2016 school year due to consolidation as a result of low enrollment in 5 of the ASPs. Based on fall 2014 enrollment, ASPs served 5244 children, while in the fall of 2015, ASPs served 5100 children ages 5–12 years. Across all 20 Associations, programs operated in YMCA facilities (25%), schools (64%), churches (3%), and other community locations (7%). The ASPs operated for an average of 3.3 h/day (± 0.5 h/day) at spring baseline 2015 and 3.2 h/day (± 0.5 h/day) during spring 2016.

Sampling strategy for evaluation of ASPs—A detailed description of the sampling strategy for the evaluation of ASPs is reported elsewhere [27]. In brief, the sampling strategy included a single program from each of the 20 Associations. For Associations that operated a single program ($n = 5$), that program was selected. For Associations that operated two or more programs ($n = 15$), the following sampling strategy was employed. For Associations where all programs enrolled fewer than 50 children ($n = 3$), the largest program was selected. For Associations that operated programs with more than 50 children enrolled ($n = 12$), a single program was randomly selected from these. All sites selected as evaluation sites, both randomly and nonrandomly, agreed to participate as part of their Association's statewide commitment to the initiative. All parents were informed of the study from their respective ASP location. Parents were provided an option to opt-out (passive consent) their child from participating. Children verbally assented on each day when data collection occurred to participate in the measures. All methods were approved by the Institutional Review Board of the University of South Carolina.

Intervention

Strategies to enhance practice (STEPs)—The intervention for physical activity followed the STEP framework [15, 18, 19, 28, 29]. All intervention-related activities were coordinated and delivered by a single full-time employee with 15 years of experience operating YMCA youth programs. For the statewide initiative, the STEP training was divided into two distinct, yet complimentary, trainings. A total of two different types of trainings were offered over the course of the fall

academic year (August–October). The first training was for site leaders (i.e., the individuals directly responsible for a single ASP). It lasted for 2 h and provided an overview and history of the YMCA MVPA standard and strategies to increase children's MVPA in ASPs. Strategies were based on the Theory of Expanded, Extended, and Enhanced Opportunities [29] which focused on extending the amount of allocated time for children to be physically active each day, creating schedules that clearly define the roles and responsibilities of staff during PA opportunities and other scheduled times, and enhancing the games commonly played in the ASPs by using the LET US Play principles (removing lines, eliminating elimination, reducing team size, getting uninvolved staff/kids involved, and being creative with space, equipment, and rules) for modifying games to maximize MVPA [15, 17, 28]. For allocated PA time, ASPs were asked to maintain their 2015 schedule. Based on information collected from the evaluation of ASPs in 2015, ASPs scheduled a median of 59% (~115 min/day) of their daily program for PA opportunities, with 15 ASPs devoting 50% or more of their daily schedule for PA. For any ASP that scheduled less than 60 min for PA, they were asked to increase this to a minimum of 60 min per day (33% of a 3-h program). A total of three site leader trainings were provided, one per region in the state (i.e., Low Country, Midlands, and Up State).

The second training was for all ASP site and frontline staff (i.e., those individuals responsible for interacting and overseeing children during the program, referred to as the all-staff training). It lasted for 2 h and provided an overview of the YMCA MVPA standard and strategies to increase MVPA in ASPs. Strategies included role modeling PA behaviors, scheduling time for children to be active, and following the LET US Play principles. The majority of the training focused on skill development for using the LET US Play principles. Attendees identified a game they commonly play, played the game using its traditional rules, and then played the game again with modifications based on the LET US Play principles. This procedure was repeated for up to five different games. Throughout the training, the LET US Play modifications were continuously introduced, explained, demonstrated, and reinforced. A total of 13 all-staff trainings were conducted. Additionally, monthly emails were distributed to all ASP site leaders. Emails included STEPs-related physical activity promotion content, such as examples of LET US Play principles, links to online 2-minute videos depicting a LET US Play principle, and scheduling physical activity opportunities.

Reach/adoption, effectiveness, and implementation of STEPs

Apart from reach/adoption, the effectiveness and implementation measurements occurred during the spring (March through April) of 2015 and 2016. Consistent with previously established protocols, each ASP was visited

for data collection on four nonconsecutive, unannounced days Monday through Thursday [30–33].

Reach/adoption—For the purpose of this study, the measure of the reach/adoption of the intervention was determined by percentage of Associations, ASPs, site leaders, and staff in attendance at the fall trainings for professional development. This was a deliberate decision given that all YMCA Associations and the ASPs they operated across the state had committed to achieving the HEPA Standards in the summer of 2015. To document reach/adoption, at each training attendees provided their name, position, and their affiliated ASP and Association name.

Effectiveness—The effectiveness of the STEPs intervention was evaluated via accelerometry. All children attending an ASP on measurement days had an opportunity to wear an ActiGraph GT3X+ accelerometer on the hip. Accelerometer data were distilled using 5-s epochs to account for the intermittent and sporadic nature of children's PA [34] and to capture the transitory PA patterns of children [35, 36]. Upon arrival to the ASP, children were fitted with an accelerometer and the arrival time was recorded (monitor time on). Research staff continuously monitored the ASP for accelerometer wear compliance. At the time of a child's departure, research staff removed the accelerometer and recorded the time (monitor time off). Children wore the monitors for the entire time in attendance at the ASPs. The Evenson cutpoint thresholds associated with moderate and vigorous activity were used to distill the PA intensity levels [37] and Mathews cutpoint for sedentary behavior [38]. Children were included in the study if they had one or more valid days of accelerometer data defined by a total wear time (time off minus time on) of ≥ 60 min [30, 32, 39]. The minutes all children spent in MVPA were dichotomized to represent those children who achieved (i.e., ≥ 30 min MVPA/day) and those that failed to achieve (i.e., < 30 min MVPA/day) the PA standard [40].

Implementation—Implementation of STEPs was measured via document review and on-site direct observation [41–44]. The amount of scheduled PA opportunities was determined via program schedules and direct observation. Program schedules were collected on each of the four data collection days at each measurement occasion. The time allotted for PA opportunities was totaled for each day. Time allotted for PA opportunities was also measured via direct observation using the System for Observing Staff Promotion of Activity and Nutrition (SOSPAN) [44]. The observational protocol consisted of continuous scanning and rotating through pre-defined target areas across the entire duration of an ASP. Trained observers completed all observations. Observers completed classroom training, video analysis, and field practice prior to data collection. Classroom training lasted 3 h and included a review of study protocol, orientation to the instrument, and committing observational codes to memory. Video analysis included watching video clips from ASPs and rating those clips using established protocols. Field practice/reliability scans were completed on

at least 6 days in participating sites (i.e., 3 h each day) prior to the beginning of the study. Inter-rater agreement criteria were set at >80% using interval-by-interval agreement for each category [44]. Consistent with published reliability protocols [44], reliability was collected prior to measurement and on at least 30% of data collection days. Inter-observer reliability for the LET US Play principles were estimated via interval-by-interval percent agreement and weighted kappa (κ_w). Percent agreement ranged from 95.0 to 100% and κ_w ranged from 0.43 to 1.00 (median 0.88). Reliability was checked weekly to identify disagreements. Operational definitions of variables with borderline or low reliability (<90% agreement) were then discussed with observers to ensure reliability and prevent observer drift. A total of 13,379 scans were collected across 2015 and 2016 data collection periods.

Each scan was tagged with a “context” variable that identified whether the scan occurred during snack, academics, enrichment, physical activity, or some other scheduled ASP opportunity (e.g., water breaks, transitions). The percentage of scans each day a context variable occurred was also used to assess time allocated for a given context. The percent of scans was compared to the written ASP schedule to determine consistency among the two. Where discrepancies occurred, the direct observation allocated time was used as an indicator of time allocated for a given context.

SOSPAN was used to evaluate the implementation of 12 LET US Play principles during PA opportunities. On each day of observation, the percentage of scans were computed for the following: children waiting in line for turn, children eliminated, small sided-games, staff actively engaged in activity, staff verbally encouraging activity, choice of two or more activities offered, girls provided with their own physical activities, staff giving instructions on how to play games, children waiting for activity to start (i.e., idle time), staff withholding PA as punishment, and staff disciplining children with PA. A twelfth variable was collected at the end of each day—all staff wear clothing to be physically active (yes/no). The distribution of each of the first 11 LET US Play principles were divided into tertiles based on their 33rd and 66th percentile for the principle at baseline [43]. Programs were assigned a 0 (<33rd centile), 1 (33rd to 66th centile), or 2 (>66th centile). Staff wearing appropriate clothing was transformed into a 3-point scale ranging from 0 (none of the days), 1 (some of the days), or 2 (all days). Scores were summed to represent an overall LET US Play implementation score.

Implementation index score—At the end of the spring 2016 data collection period, ASPs were assigned an implementation score based on the following criteria from the measures described above [43]. Programs were awarded a 1 if they (1) attended the all-staff or site leader trainings, (2) dedicated at least 50% of their daily schedule to PA opportunities in spring 2016, (3) increased the amount of time dedicated to PA opportunities from spring 2015 to 2016, or (4) were observed

implementing the LET US Play principles above the median LET US Play implementation scores based on spring 2016 direct observation. This resulted in a possible range in the total implementation score from 0 to 4.

Child and ASP characteristics—Child demographics were self-reported, and standing height and weight were measured using standard protocols with children wearing light clothing [45]. The annual revenue for each YMCA Association was collected from their most recent publicly available annual reports from 2013. The percentage of households in poverty was used as a marker of socioeconomic status of the ASPs. This was based on US Census 2014 zip code information based on the operating location zip code for each ASP. Each ASP’s operating setting, either in a school or YMCA facility, was also recorded. Information was also collected during the spring 2016 to identify if ASPs were involved with other initiatives apart from the HEPA Standards.

Statistical analyses

Analyses were conducted fall 2016. Descriptive statistics were computed by gender for the percentage of youth meeting the 30 min/day MVPA standard, minutes per day of MVPA, and time spent sedentary. The overall test for the effectiveness of the intervention was examined using intent-to-treat (defined as all ASPs received the intervention) repeated-measures random effects logit models, with days measured nested within children, who were nested within ASPs. The models were estimated using the dichotomized MVPA variable (0 = <30 min/day) as the dependent variable for boys and girls, separately, to compare changes in the percentage of children meeting the MVPA Standard over time. Race (African Americans), age (years), ASP operating in YMCA facility, and Census 2010 zip code percentage of households in poverty were included in the models as covariates. As a secondary outcome, the minutes spent in MVPA and sedentary were estimated with random effects quantile regression models at the 50th quantile of the distribution and design-matrix bootstrapped standard errors, separately [46]. The same covariates were used in this model. Time in attendance was used as a covariate in the sedentary quantile model only [27]. As-treated models (identical to those described above with covariates) were also conducted. These models included the level of implementation as a grouping variable, along with a group \times time interaction. In total, there were three implementation groups, with seven ASPs receiving a score of 0 to 1 (only a single ASP had a score of 0, low implementation), seven ASPs with a score of 2 (moderate implementation), and the remaining six ASPs with a score of 3 (high implementation). These groups were utilized in the analytical models to examine the impact of implementation on changes in accelerometer-derived activity and sedentary behavior, using the low implementation group as the reference. All analyses were performed using STATA (v.14.0, College Station, TX).

RESULTS

The descriptive characteristics of the evaluation ASPs and the children enrolled in the programs during spring 2015 (baseline) and spring 2016 (end of first year of intervention) are presented in Table 1. The reach/adoption of the trainings for the evaluation sites and all YMCA-operated ASPs across the state at the site leader and all-staff training occurring fall 2016 are presented in Table 2. Overall, the site leader trainings were poorly attended, with only ~16% of ASP site leaders in attendance and half of these ($n = 10$) representing site leaders from the 20 evaluation sites. Attendance at the all-staff trainings was higher, with ~65% of site leaders in attendance, which represented 70% of all of the Associations (14 of 20 Associations). From the 20 evaluation sites, 9 site leaders attended. Across all 97 ASPs, 45% of all the staff employed attended the all-staff training (average of 36% of staff per Association, range 0–100%), with 53% of the evaluation sites' staff in attendance (average of 13% of staff per Association, range 0–100%). This represented 60% of the Associations (12 out of 20).

The changes in accelerometer-derived proportion of boys and girls, separately, accumulating a minimum of 30 min/day while attending an ASP and the minutes of MVPA and time spent sedentary are presented in Table 3. The intent-to-treat models indicated no statistically significant changes in the percentage of boys [$+0.5\%$, odds ratio (OR) = 1.03, 95% confidence interval (95CI) 0.82 to 1.28] or girls ($+1.5\%$, OR = 1.15, 95CI 0.86 to 1.54) meeting the 30-min MVPA Standard or the number of minutes that boys ($+0.9$ min/day) or girls ($+1.3$ min/day) spent in MVPA from 2015 to 2016. The only statistically significant intent-to-treat change observed was for time spent sedentary, with both boys and girls reducing the overall amount of time spent sedentary by -4.3 and -3.3 min/day, respectively.

The as-treated findings are presented in Table 3 and the STEP's framework components implemented across the three implementation groups are presented in Table 4. Across outcomes, statistically significant improvements favoring the ASPs in the moderate and high implementation groups, compared to the low implementation group, were observed. For the ASPs in the low implementation group, decreases for both boys and girls were observed for the percentage meeting the 30 min/day MVPA Standard (-13.0 and -9.8%) and the number of minutes of MVPA accumulated/day (-4.3 and -3.9 min/day) during the ASP. Likewise, increases in the amount of time spent sedentary were also observed ($+7.5$ and $+5.0$ min/day). Conversely, ASPs in the moderate and high implementation groups saw an increase in the odds of meeting the primary outcome (i.e., 30 min MVPA Standard) in 2016 increase to 2.46 (95CI 1.5 to 4.2) and 4.50 (95CI 2.6 to 7.7) for boys and 3.72 (1.7 to 8.2) and 4.17 (95CI 2.1 to 8.4) for girls, respectively.

DISCUSSION

This study evaluated the statewide dissemination, reach, adoption, implementation, and effectiveness of

professional development trainings designed to increase the percentage of children meeting the 30 min/day MVPA Standard in YMCA-operated ASPs. Overall, the reach/adoption of the trainings was less than anticipated, with roughly two thirds of the site leaders and half of staff attending the all-staff training, whereas limited turnout (less than 20% of site leaders) was observed for the site leader trainings. This resulted in an intent-to-treat analyses that indicated no changes had occurred after the first year of implementation. However, based on detailed process evaluation measures, those ASPs in the moderate and high implementation groups that attended the trainings and implemented the training components achieved improvements in the percentage of both boys and girls meeting the 30 min/day MVPA Standard. These findings have important implications for statewide dissemination and implementation efforts targeting the achievement of this important physical activity goal.

Although no overall changes were observed for either boys or girls in the amount of MVPA accumulated while attending the ASPs, analyses based on the level of implementation revealed sizeable gains for moderate and high implementation ASPs and, conversely, sizeable losses for low implementation ASPs (see Tables 3 and 4). Differences among the implementation groups at the program level revealed that six of the seven low implementers were ASPs that operated out of YMCA facilities (i.e., not school-based), served more African American children (55% vs. 37% and 32%), operated in locations with higher rates of households in poverty (16% vs. 9.4% and 10.7%), and had slightly less annual operating budgets at the Association level (\$1.99 million vs. \$2.50 and \$3.28 million) compared to moderate and high implementers, respectively. These differences at both the Association and child levels may help to explain the changes observed in the scheduled time for physical activity opportunities from 2015 to 2016. Low implementation ASPs increased the amount of their daily program schedule devoted to academics and enrichment by 24% (~40 min/day). Conversely, moderate and high implementation ASPs increased scheduled academic and enrichment opportunities by 6% (~12 min/day) and 2% (~4 min/day), respectively. Low implementation ASPs reduced time for children to be active during their program by 19% (~31 min/day), while moderate implementation ASPs reduced by 10% (~20 min/day) and high implementation ASPs roughly maintained scheduled activity time (~1% or ~2 min/day). In follow-up communication with the site leaders of the low implementation ASPs, they indicated focusing on a new initiative from the YMCA of the USA that targeted reading. This likely explains the shift in scheduled opportunities for academics and physical activity. Given that an initiative focused on reading was introduced concurrently with the initiative described herein, and that the low implementation ASPs served more children from lower socioeconomic status who may struggle academically, it is understandable that these programs shifted their scheduled priorities toward academic and enrichment at the expense of time for physical activity. These observations suggest the need to integrate physical activity and reading into a hybrid intervention,

Table 1 | Baseline (spring 2015) and year 1 (spring 2016) characteristics of the afterschool programs and children in attendance

	Baseline (spring 2015)	End of first year (spring 2016)
Child characteristics		
Sample size (N)	1117	1173
Boys (percentage)	56%	53%
Age (years)	7.7	±1.7
Race/ethnicity (percentage)		
Black	31%	36%
Hispanic	3%	2%
Other	5%	3%
White	62%	60%
Height (cm)	128.5	±11.3
Weight (lb)	67.1	±23.3
Afterschool program schedule		
Total program length (min/day)	195	±29
Snack	11%	±5%
Academics	10%	±8%
Enrichment	16%	±13%
Other	6%	±4%
Physical activity	57%	±16%
Free play	58%	±26%
Organized	43%	±26%
Accelerometer estimates of physical activity		
Sample with valid accelerometer data (n)	1078	1160
Activity intensity		
Sedentary (min/day)	64.3	±24.6
Light physical activity (min/day)	41.2	±17.9
Moderate physical activity (min/day)	11.0	±6.6
Vigorous physical activity (min/day)	10.4	±7.7
Moderate-to-vigorous physical activity (min/day)	21.4	±13.5
Percent meeting MVPA 30 min/day standard	25.9%	26.5%
Total time in attendance (min/day)	127.0	±34.2
		±33.5

Table 2 | Attendance at the professional development trainings offered fall 2016

	Fall site leader training			All-staff training					
	2-h training covering scheduling and overview of LET US Play principles			2-h training covering physical activity role modeling and LET US Play activity modifications					
	Site leader			Site leader			Staff		
	Actual	Attended	%	Actual	Attended	%	Actual	Attended	%
Overall—number of individuals	116	19	16%	116	75	65%	474	211	45%
Evaluation sites—number of individuals	20	10	50%	20	9	45%	139	73	53%
Number of Associations	20	12	60%	20	14	70%	20	12	60%

which may include infusing physical activity into reading lessons or working with ASPs to promote both reading and physical activity (yet delivering them separately) so that one initiative does not take priority over the other. Both approaches are viable future directions to address the topics deemed important to ASP providers.

Even though low and high implementation ASPs scheduled approximately the same amount of time for physical activity opportunities (61 and 62%) at baseline, low implementation ASPs decreased activity time to 42% of their daily schedule in 2016 while high implementation ASPs largely maintained the same amount of time scheduled (64%). From this perspective, allocated time for physical activity appears to be a primary mechanism driving the amount of activity that children accumulate at an ASP. A previous randomized trial in ASPs [8] reported that the amount of time scheduled for activity opportunities increased in both the intervention (+25 min) and control (+23 min) ASPs, with these increases translating into increases in MVPA minutes per day of 8.7 and 9.2 min/day across both groups. Cross-sectional evidence supports this relationship, with ASPs that scheduled the most time for physical activity opportunities having children that accumulate higher amounts of MVPA [27]. This finding is consistent with the Theory of Expanded, Extended, and Enhanced Opportunities [29] which posits a major driving mechanism in youth physical activity interventions is the extension of the amount of time allotted for children to be active. Evidence for the effectiveness of extension in other contexts, such as recess and physical education, support the findings found herein in that programs that maintained (i.e., high implementers) or increased (i.e., moderate implementers) the amount of time children could be physically active showed improvements in MVPA, whereas ASPs that reduced allocated time for activity opportunities (i.e., low implementers) reduced the amount of MVPA boys and girls accumulated [29].

Another distinction among implementation groups was the attendance at the all-staff trainings. The moderate and high implementation ASPs had greater attendance (six of seven and five of six ASPs, respectively) at this training, which focused on the enhancement of the scheduled physical activity opportunities by developing the skills of staff to implement the LET US Play principles as a strategy to maximize the amount of activity children accumulate. The importance of attending this training is supported by the fact that five of seven moderate and five of six high implementation ASPs were also observed implementing the LET US Play principles to a greater extent than the low implementation ASPs. These findings suggest skills-based trainings designed to maximize MVPA during commonly played games, coupled with sufficient time allocated for physical activity opportunities, are major drivers of increases in the amount of MVPA boys and girls accumulate during an ASP [29].

Two previous studies [12, 13] also reported on the dissemination, implementation, and effectiveness of large-scale rollouts of interventions within the ASP

Table 3 | Changes in minutes spent in moderate-to-vigorous physical activity and sedentary from baseline (spring 2015) and year 1 (spring 2016) for the intent-to-treat and as-treated analyses

Sex	Comparisons	ASPs	Minutes per day		Percent meeting 30 min/day moderate-to-vigorous physical activity standard											
			2015	2016	Δ	Percent Δ from 2015	P	OR	(95CI)	P						
Boys	Moderate-to-vigorous physical activity ^a															
	Intent-to-treat ^c	20	22.5	23.4	+0.9	+4%	0.250	33.6	34.1	+0.5	+2%	0.791	1.03	(0.82, 1.28)	0.822	
	Implementation level ^d						0.000					0.000				
	Low	7	25.7	21.4	-4.3	-17%		42.2	29.2	-13.0	-31%		Reference			
	Moderate	7	19.0	21.6	+2.6	+13%		25.4	27.0	+1.6	+6%		2.46	(1.5, 4.2)	0.001	
	High	6	23.1	29.0	+5.9	+25%		35.3	48.2	+12.9	+37%		4.50	(2.6, 7.7)	0.000	
	Sedentary (min/day) ^{a, b}															
	Intent-to-treat ^c	20	60.2	55.8	-4.3	-7%	0.001									
	Implementation level ^d						0.000									
		Low	7	51.3	58.8	+7.5	+15%									
Girls	Moderate	7	68.6	58.3	-10.3	-15%										
	High	6	59.0	50.5	-8.5	-14%										
	Moderate-to-vigorous physical activity ^a															
	Intent-to-treat ^c	20	16.5	17.8	+1.3	+8%	0.071	15.7	17.2	+1.5	+10%	0.367	1.15	(0.86, 1.54)	0.332	
	Implementation level ^d											0.000				
	Low	7	20.9	17.0	-3.9	-19%		23.4	13.6	-9.8	-42%		Reference			
	Moderate	7	13.3	15.6	+2.3	+17%		8.7	12.8	+4.1	+47%		3.72	(1.7, 8.2)	0.001	
	High	6	16.5	20.9	+4.4	+27%		18.3	25.7	+7.4	+40%		4.17	(2.1, 8.4)	0.000	
	Sedentary (min/day) ^{a, b}															
	Intent-to-treat ^c	20	65.8	62.5	-3.3	-5%	0.030									
Implementation level ^d											0.020					
	Low	7	57.8	62.8	+5.0	+9%										
	Moderate	7	73.9	63.7	-10.2	-14%										
	High	6	65.4	60.4	-5.0	-8%										

^a Estimates control for age, race (African American), afterschool program operating in YMCA facility, percent households in poverty based on Census 2010 zip codes, 2013 Association operating revenue^b Estimates control for time in attendance^c P value for time^d P value for time \times implementation interaction

Table 4. | Afterschool program characteristics by level of implementation

Characteristic	Low (n = 7)	Moderate (n = 7)	High (n = 6)
STEPs framework component (percent of programs)			
Reach/adoption			
Training total	57%	86%	83%
None	43%	14%	17%
Site leader (site leaders only)	43%	14%	17%
All staff (site leaders and/or staff)	14%	86%	83%
Implementation			
Physical activity scheduled			
At least 50% of daily scheduled for PA opportunities	0%	0%	83%
Increased scheduled PA from 2015 to 2016	0%	29%	33%
LET US Play (above median)	29%	71%	83%
Afterschool program characteristics			
Number of ASPs operated by Association (total) ^a	17	36	43
Total children enrolled ^a	952	2011	2030
Location of operation (YMCA)			
Across Association	59%	22%	21%
Evaluation sample	86%	29%	17%
Enrollment size			
Across association	63	75	45
Evaluation sample	63	62	63
Age (years)	7.5	7.2	7.4
African American	55%	37%	32%
Percent households in poverty (median)	16.3%	9.4%	10.7%
Annual operating revenue 2013 (median)	\$1,994,556	\$2,498,092	\$3,284,070
Annual operating revenue 2013 per ASP	\$1,373,488	\$1,029,231	\$984,928
Daily operating time (min/day)	2015	2015	2015
Δ	2016	Δ	2016
Percentage of ASP daily schedule dedicated to...	166	199	210
Snack	10%	13%	9%
Academics	13%	11%	6%
Enrichment	10%	22%	14%
Other	6%	5%	8%
Physical activity	61%	49%	62%
Free play	44%	42%	71%
Organized games	45%	45%	21%
Δ	42%	−4%	16%

^a Based on the total number of programs operated by the Associations during 2015–2016 (first-year outcomes) school year

^a Based on the total number of programs operated by the Associations during 2015–2016 (first-year outcomes) school year

environment. These studies found that the reach of these rollouts was high over the duration of the projects, with more than 90% of ASPs adopting the curricula by study's end. Consistent with our findings and not surprisingly, implementation reported by Sharpe et al. [13] was variable, with ASPs using only a limited number of the pre-packaged games provided in the curricula. This resulted in limited changes in MVPA for those ASPs receiving the intervention. Implementation reported by Nigg et al. [12] was also high, which resulted in continuous increases in the percentage of children observed in MVPA across the 5-year study. However, the ASPs evaluated each year were different, and therefore, it is difficult to determine if these observed increases were due to the intervention, given previous experimental studies of the same intervention reported null effects [7, 14] or instead due to the natural differences in activity levels that exist among ASPs [19, 27].

The activity levels and the changes observed across the levels of implementation are comparable to those previously reported. Specifically, the original group randomized controlled trial that evaluated the STEPs framework in 20 non-YMCA ASPs reported similar baseline levels of MVPA (i.e., 22 to 23 min/day for boys, 16 to 18 min/day for girls) [18, 19]. The improvements reported, however, were larger in the original evaluation [18, 19] compared to the ITT analysis reported herein. In a subsequent analysis of the original STEPs intervention of high versus low implementers, high implementation ASPs achieved similar gains in the percentage of boys achieving the 30 min/day MVPA standard [43] compared to those observed in the moderate and high implementation groups in the present study. The important difference between the original STEPs intervention and the one evaluated herein was the explicit focus on more practical and easily implemented intervention elements, specifically the allocation of sufficient amounts of schedule physical activity opportunities along with the almost singular emphasis on the LET US Play principles for the all-staff training. Comparisons to other studies, however, are difficult to do given differences in accelerometer cutpoints to reduce data into activity intensities [6, 8] and differences in outcome measures (e.g., systematic observation, pedometry) [10, 12–14, 47].

This study has several limitations. First, the number of ASPs measured is a subsample of the total number of ASPs operated by the YMCA in the state. Any inferences made regarding the 20 ASPs to the total population of ASPs across the state are based on the assumption of their representativeness. As shown in a previous study [27], the demographic characteristics of the evaluation sample are similar to the non-evaluation ASPs, thereby supporting the inferences made in the analytical models and implementation data to all the ASPs operated by YMCAs across the state. Second, there were no overall intent-to-treat effects, rendering the net impact of the trainings as negligible. However, with the detailed process/implementation evaluation, we were able to identify

low, moderate, and high implementers and relate these classifications to improvements in child MVPA. The as-treated analyses also provided important information about characteristics of ASPs that chose not to attend or implement the intervention, as well as information regarding the impact of the trainings when implemented. We recognize that the amount of the intervention implemented was based on self-selection (i.e., ASPs either opt to implement or not to implement the intervention). However, within a real-world dissemination and implementation evaluation of an intervention, this is not unexpected. To address attendance in the second year of the study, the CEOs in each of the 21 Associations have committed to send their staff to receive the trainings. We anticipate this will substantially increase attendance of staff at all ASPs and, subsequently, increase children's MVPA across the state. Also, the number of trainings will be increased to accommodate Associations that are unable to send their staff to a training not held within their Association's geographical area. Together, we believe these strategies will increase attendance at the trainings. Third, there was no control group as part of this study. Yet, given the MVPA standard was adopted by the YMCA of the USA in 2011, and the ASPs in this study were not achieving this standard at baseline in 2015 [27], there is little reason to believe that the changes reported in this study were due to something other than the intervention provided. Fourth, this study was not designed to assess the full RE-AIM framework, namely we omitted maintenance of the intervention. This study also has several strengths, which include the large number of ASPs evaluated, objective measures of child physical activity and implementation, and the ability to analytically link implementation levels to changes in MVPA.

In conclusion, this study suggests that a statewide dissemination and implementation of an intervention to improve MVPA in ASPs can lead to meaningful changes for those ASPs that opt to attend and eventually implement the intervention. Also, the study provides important information regarding mechanisms of change, especially allocated time for physical activity and the quality of the activity session, which can lead to meaningful changes in both boys' and girls' MVPA. Future studies need to address attendance at the trainings along with issues regarding implementation of the training concepts during daily operation of the programs.

Compliance with ethical standards

Potential conflicts of interest: The authors declare that they have no conflicts of interest.

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Statement on human rights: IRB approval for all study procedures was received by the University of South Carolina's Institutional Review Board.

Statement on the welfare of animals: No animals were harmed during the conduct of the study presented herein.

Informed consent statement: Informed consent was obtained from all individual participants included in the study.

Helsinki or comparable standard statement: All procedures performed in studies involving human participants were in accordance with the ethical standards of the institutional and/or national research committee and with the 1964 Helsinki declaration and its later amendments or comparable ethical standards.

IRB approval: IRB approval for all study procedures was received by the University of South Carolina's Institutional Review Board.

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