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Physical Activity and Psychological Correlates During an After-School Running Club

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ABSTRACT

Background: After-school programs (ASPs) have the potential to contribute to moderate-to-vigorous physical activity (MVPA), but there is limited empirical evidence to guide their development and implementation. **Purpose**: This study assessed the replication of an elementary school running program and identified psychological correlates of children's MVPA. **Methods**: We used pedometry to measure participant PA%, MVPA%, and MVPA% of PA during a 20-session alternating treatments design and examined associations between various psychological constructs and MVPA levels using odds ratios. **Results**: PA% (62.2% vs 76.1%, effect size [ES] = −0.65) was lower and MVPA% (33.3% vs 15.8%, ES = 0.75) and MVPA% of PA (53.6% vs 20.2%, ES = 0.91) were higher during game vs lap running conditions. The constructs of recognition, ego orientation, and expectancy beliefs distinguished between children with high and low MVPA. **Discussion**: The replication of results for MVPA with a different cohort provides evidence of program generalizability. Only game days met the ASP national recommendation for providing activities at an intensity of 50% MVPA% or greater. **Translation to Health Education Practice**: Running laps and running games both contribute to PA accrual, but they do so in different ways. ASP providers should weigh the demands and outcomes of each format.

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Background

Children between the ages of 6 and 11 years should be physically active at least 60 min/d with most accrued in the form of moderate-to-vigorous physical activity (MVPA).[1] Less than 45% of U.S. children of this age, however, attain at least 60 minutes of MVPA on at least 5 d/wk.[2] Of concern is that most children lose out on the health-enhancing benefits of regular physical activity (PA), which include cardiorespiratory fitness, healthy body weight, and optimal body composition.[1] Physical inactivity tends to track from youth to adulthood[3] and is associated with some 35 diseases/conditions that afflict persons over their life course.[4] Schools have long been cast as an important and cost-effective resource for PA promotion.[5,6] School-based PA interventions have been shown to increase the proportion of children engaging in MVPA at school, with studies showing an overall increase in daily MVPA of between 5 and 45 minutes.[7] Physical education (PE) plays a central role in the comprehensive school physical activity program model,[8] but evidence suggests that elementary schoolchildren often fall short of reaching the intensity target of quality PE (ie, 50% of lesson in MVPA).[9,10] This shortfall is compounded by weak PE policy (eg, only 19 of 50 states have time requirements for elementary school PE)[11] and the average daily dosage is nearly 10 minutes shorter than recommended (ie, 20.7 minutes vs 30.0 minutes).[10,12] Thus, it is fair to describe PE as "the pill not taken."[13]

Of growing interest, then, is the role that after-school programs (ASPs) might play in helping children reach the recommended 60 min/d of MVPA.[14-16] This focus is particularly relevant in light of findings that children do not compensate for the lost PA minutes on days they do not have PE.[17] The National AfterSchool Association (NAA) has set both time and intensity standards for ASP PA—at least 20% of ASP time or 30 minutes of PA time during which students engage in MVPA at least 50% of the time—which equates to a minimum of 15 MVPA minutes per session.[18] In California, the location of the present study, state guidelines recommend that ASPs provide a minimum of 60 MVPA minutes during a 3-hour session.[19]

Despite such explicit recommendations, investigations of PA/MVPA during ASPs show great variation. Across 4 studies that included 1997 children in 56 elementary ASPs, PA ranged between 21.3% and 87.9% of session length and less than half the

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participants reached NAA-recommended PA intensity targets.[16,20-22] Beets et al[23] reported a pooled effect size of 0.44 for increased PA across 6 ASP intervention studies, indicating that various programs can improve PA. Demetriou et al[24] indicated that there is currently only modest support for ASP interventions on improving overall child and adolescent PA and body composition. Many questions remain unanswered—thus, there is further need to design, implement, and assess quality ASP programs that target PA.

Understanding the psychological determinants of PA among children is important and may be specific to setting (ie, ASP, PE, recess). Recent reviews of the correlates of PA among youths aged 4–12 indicated that intention to be physically active and PA preference were positively associated with PA accrual, whereas other constructs such as self-efficacy, enjoyment, perceived competence, and expectancy beliefs were consistently indeterminate.[25,26] Specific to running (ie, the focus of the present investigation), Xiang and colleagues conducted a series of studies to assess relationships among various psychological constructs after implementing the Run for Your Life program in elementary school PE classes.[27-30] In their first study, mastery goals and perception of a mastery-focused climate were associated with student persistence/effort during running.[27] In their second study, motivation levels reduced over the year long program but expectancy beliefs and interest most strongly and positively predicted motivation for running over time.[28] In their third study, students with high task orientation, regardless of their ego orientation level, demonstrated greater motivation for running.[29] In their fourth study, students moved to more motivationally adaptive goal patterns as they matriculated from elementary to middle school grades.[30]

Focusing an ASP program on running is conceptually appealing because it is a basic skill and running programs require limited equipment, organization, and instruction. A study of a before-school running program that involved 88 third- and fourth-grade students at 2 schools showed that participants averaged 53.4% MVPA per session,[31] thus making a case for designing and assessing an ASP running program.

Intuitively, students enrolling in a running ASP should be sufficiently motivated to run at an intensity and duration that results in achieving ASP MVPA recommendations. Nonetheless, continuous running is repetitive (eg, traditional laps) and, if considered boring, could limit the likelihood of students attaining maximum levels of MVPA during sessions.[32] In a previous study, we compared PA engagement in an ASP during 2 conditions (running laps and running games) and found that PA% was higher during lap running (70.8% vs 59.8%) but MVPA% and MVPA% of overall PA time were higher during running games (39.9% vs 25.4% and 66.3% vs 35.2%, respectively).[33] The replication of studies is a primary means for assessing the reliability (ie, repeatability) and generalizability of an intervention; it is essential in the advancement of human behavioral research[34] and is particularly important relative to disseminating health-related programs.[35]

Purpose

The main purpose of the current investigation was to assess the replication of the initial running games vs running laps intervention with a new cohort. We did not assess student psychological variables in our original study; thus, in keeping with focus of Xiang et al's studies on motivation and efficacy,[27-30] we sought to examine psychological variables potentially associated with children's MVPA accrual during an afterschool program.

Methods

Setting and participants

Grant School, located in the century-old Mission Hills neighborhood of San Diego, is a K–8 school within the San Diego Unified School District. At the time of the study, Grant enrolled approximately 700 students, 80% of whom lived in the neighborhood. The majority of students were white (51%) and 33% were eligible to receive free- and reduced-price lunch.

Club members at least 9 years old by June 2017 and who were not part of the original study were eligible to participate. The study was approved by San Diego State University Institutional Review Board. Parents and children provided written consent and assent simultaneously on-site and parents reported their child's birthdate, height, and weight on the consent form. Of 41 age-eligible runners on the spring club roster, 13 had participated in the original study in 2016 (ie, ineligible), 7 declined, and 8 did not return signed consent forms. Therefore, a sample of 13 students participated in the study and wore pedometers during sessions. Of these, 2 did not meet the 20% criteria for attendance at each session type, resulting in an analytic sample of 11 participants (see Table 1). Most were male (n = 9), white (n = 7), between 9 and 10 years old, in the healthy range for body composition, and participating in running club for their first year (Table 1). Overall session attendance was 63.6% ± 17.5 and there was no difference in attendance rates between running and

Table 1. Current study participant characteristics.

Participant	Sex	Ethnicity[a]	Age	Body mass index percentile	Previous years	Participation (%)	
						Laps	Games
A	F	W	9.8	65.2	0	100.0	80.0
B	M	A	9.2	37.1	0	80.0	90.0
C	M	F	11.5	11.5	1	60.0	30.0
D	M	W	9.0	89.8	1	100.0	70.0
E	M	W	9.0	—	1	50.0	70.0
F	M	B	9.0	89.9	2	20.0	70.0
G	M	W	11.0	8.1	0	70.0	60.0
H	M	W	9.9	—	3	40.0	40.0
I	M	H	11.4	53.3	0	70.0	20.0
J	F	W	11.7	64.2	0	50.0	80.0
K	M	W	9.0	27.7	0	50.0	100.0
M			10.0	49.6	0.7	62.7	64.5
SD			1.1	28.9	1.0	23.4	23.9

[a]A = Asian; B = Black; F = Filipino; H = Hispanic; W = white

games formats (P = .86). Participants in this study were similar to those in the original study for age (10.0 vs 9.5 years), body composition (49.6 vs 58.3, mean body mass index percentile), previous club experience (0.7 vs 0.9 years), and attendance on game days (64.5 vs 67.1, mean percentage).

Running club format

Running club operated in a park adjacent to the school and club sessions were scheduled for 45 minutes between 2:15 PM and 3:00 PM on Mondays and Wednesdays. The study was conducted over 10 weeks between March and May 2017, during a different season and approximately 6 months after the start of the original study. Participants' parents paid a $25 fee per semester for the program. Parents who could not afford the club were granted a fee waiver.

Study participants typically arrived at the park immediately after school dismissal and put on a pedometer after checking in. A t test revealed no significant differences for pedometer wear time between lap and game days ($M_{overall}$ = 35.8 min ± 3.5, P = .67). Sessions on some days followed the traditional format (ie, lap days) and on other days running games were provided (ie, game days). Following club tradition, members could earn periodic rewards for running, including toe tokens for every 3 miles completed and a $5 gift card for juice or Italian ice at 12 and 21 miles.

Lap days

The format for lap day sessions followed traditional procedures, which primarily consisted of students running laps around a ⅓-mile concrete and grass course. Students moved at their own pace and manner of locomotion. Parent volunteers typically recorded runner lap-by-lap progress on cards the students carried. In addition, volunteers often walked/ran laps to supervise and offer encouragement and periodically timed students as they ran a lap or mile.

Game days

During game day sessions, participants warmed up by running laps. They then engaged in preplanned games from the Sport, Play, and Active Recreation for Kids (SPARK) program.[36] The lead author (DK), an experienced teacher and coach familiar with SPARK, selected and led all games. He encouraged and praised students during game play and participated in games if needed (eg, uneven number of students). (See Table 2 for a games menu.) After the games, students finished the session by running a chase lap (ie, getting an advanced start to attempt to complete 1 lap before being passed by DK). Warmup and chase laps (ie, beginning and end of game days) took ~5 minutes of a 45-minute club session, leaving approximately 40 minutes for running games.

Traditional laps were not completed on game days. However, to continue with the awards program, students were credited with completing a lap for every 500 steps they accumulated on their pedometer during the session, a value derived from group baseline steps per lap during the original study.

Session weather conditions

t-Tests on weather data (https://www.wunderground.com) for the Mission Hills neighborhood revealed no

Table 2. Game day menu from SPARK PE sources.[a]

Game day session	Game name and sequence	SPARK unit/source
1 and FU 1	Builders and Bulldozers	Aerobic Games
	Hospital Tag	Chasing and Fleeing
	Hearty Hoopla	Aerobic Games
2 and FU 2	Fitness in the Middle	Fitness
	Hospital Tag	Chasing and Fleeing
	In Synch Run	FRUNNING
	The Good Ship SPARK	Games
3 and FU 3	Prediction Run	FRUNNING
	Hospital Tag	Chasing and Fleeing
	Quick Draw	ASAP
	Catch up Run	FRUNNING
4 and FU 4	Active Lifestyle	Personal Best
	Hospital Tag	Chasing and Fleeing
	Battle Cards	Personal Bes
	Pass the Hat	Walk/Jog/Run
5 and FU 5	20/10 Run	FRUNNING
	Offense/Defense	ASAP
	Target Throw	Flying Disc
	Hospital Tag	Chasing and Fleeing
	Hoopla Run	FRUNNING

[a]SPARK indicates Sport, Play, and Active Recreation for Kids; FU, follow-up day. FRUNNING (www.sparkpe.org/wp-content/uploads/FRUNNING.pdf).

significant differences between lap and game days at 2:51 PM for temperature ($M_{overall}$ = 20.2°C ± 1.6, P = .74), humidity ($M_{overall}$ = 57.3% ± 7.2, P = .39), and wind speed ($M_{overall}$ = 16.9 km/h ± 5.3, P = .22). Additionally, the average conditions during the replication study were comparable to those in the original study (temperature, +2.0°C; humidity, −3.9%; wind speed, −0.2 km/h; pedometer wear time, −1.2 minutes).

Research design

An alternating treatments design with an initial baseline (ie, lap days) and final best-treatment-only (ie, game days, based on percentage of time in MVPA and %PA time in MVPA) follow-up was used. This design helps minimize sequence effects and accommodates unstable data patterns while enabling the effectiveness of 2 treatments to be assessed relatively quickly.[37] The study involved a baseline of 5 lap day sessions (AAAAA), followed by 10 sessions of alternating lap and game day conditions (BBBAAABABA) and 5 follow-up game day sessions (ie, best condition; BBBBB). The order of formats during the alternating treatment phase was randomly generated (http://www.graphpad.com/quickcalcs/randomize1/) and not disclosed to participants in advance.

Measures

Physical activity

The Walk4Life MVP digital pedometer was used to measure PA and to distinguish MVPA from non-MVPA time via a step filter set to 140 steps/min. We selected this cadence based on previous research that used the pedometer and found that children at 7.3 metabolic equivalents accumulated steps equivalent to a 140 steps/min cadence.[38] MVPA assessed by the instrument for this age group has been shown to be reliable and to compare favorably to accelerometry.[39] The instruments were calibrated prior to the study using both directly observed 25-step and 25-shake tests and only those passing successive tests within ±1 step were used. The lead author (DK) or an adult volunteer monitored proper pedometer placement and recorded the time at which participants put them on and removed them. Participants wore the pedometers until checking out at the end of the session, at which time pedometer wear time, step count, PA duration, and MVPA duration were recorded. PA% and MVPA% were calculated by dividing PA time and MVPA time by wear time and MVPA% of PA was obtained by dividing MVPA time by PA time.

Psychological variables

A 50-item questionnaire was administered to both the original (n = 14) and current (n = 11) study participants prior to the respective investigations. The lead author read each item aloud to participants individually during a 10- to 15-minute segment of running club and they responded orally. The first 3 items asked for grade level, gender, and prior participation in running club. Participants answered the remaining 47 items (13 subscales) using a 5-point Likert-type scale that included the options **no** (*never* or *strongly disagree*), no (*rarely* or *disagree*), ? (*sometimes* or *I am not sure*), yes (*frequently* or *agree*), and **yes** (*always* or *strongly agree*). This format has been used previously in studies assessing PE running programs in elementary schools.[27-30]

Seventeen items were extracted from the Motivations of Marathoners Scales (MOMS)[40] and prefaced by the statement, "An important reason I run in the Grant after-school running program is to. . . ." These items included 3 of 4 (ie, psychological, achievement, and social) categories and 5 of 9 (self-esteem, competition, personal goal achievement, affiliation, and recognition) subscales from the original 56-item MOMS. Subscales, sample items from the current questionnaire, and subscale alpha coefficients from the original MOMS[40] were as follows: (1) self-esteem (eg, "feel more confident about myself," "feel a sense of success," α = .88); (2) competition (eg, "get more laps than my friends," "be faster than my friends," α = .83); (3) personal goal achievement (eg, "compete with myself," "improve my running speed," α = .80); (4) affiliation (eg, "hang out with other runners," "have something in common with others," α = .84); (5) and recognition (eg, "earn respect of other kids," "make my family or friends proud of me," α = .91).

Ten items, adapted by Xiang et al[27,29] from the Task and Ego Orientation in Sport Questionnaire,[41] focused on achievement goal orientations. These were prefaced by the statement, "I feel really successful in the Grant after-school running program when. . . ." Subscales, sample items from the current questionnaire, and subscale alpha coefficients from the Xiang et al[27] study were as follows: (1) task orientation (eg, "I do my very best," "I learn something that is fun to do," α = .88) and (2) ego orientation (eg, "I am the only one who can run the most laps," "the other kids cannot run as well as me," α = .84).

Thirteen items, also adapted from items used by Xiang et al,[29] asked participants to rate their level of agreement with various statements. Five items assessed the construct of expectancy beliefs such as "I am very good at the Grant after-school running program" and "By participating in the Grant after-school running program, I will become a better runner." An alpha coefficient of .82 was reported in Xiang et al's study.[29]

Six items assessed 3 task values—importance, interest, and usefulness. The task values, sample items from the current questionnaire, and corresponding subscale alpha coefficients from the Xiang et al study[29] included: importance (eg, "For me, being good at the Grant after-school running program is not very important," α = .75), interest (eg, "In general, I find the Grant after-school running program is way fun," α = .93), and usefulness (eg, "Compared to my activities in PE, the things I learn in the Grant after-school running program are not useful at all," α = .78). Two items assessed intention for future participation in running: "If every week you had one free activity day in PE I would choose running" and "If the Grant after-school running program continues next year, I would very much like to do it again" (α = .75).

The final 7 items assessed the construct of self-efficacy and its dimensions of task, scheduling, and coping efficacy as they pertain to running. Items were adapted from efficacy scales used in studies of children's PA[42,43] and adult exercise.[44,45] The efficacy dimensions, sample items from the current questionnaire, and subscale alpha coefficients from the original studies included[42-45] (1) task efficacy ("I get embarrassed about my skill level when I go run," α = .72–.81), (2) scheduling efficacy (eg, "I can go run on days when the Grant after-school running program does not meet," α = .71–.81), and (3) coping efficacy (eg, "I can go run even when I lack energy," α = .54–.91).

Data analyses

Physical activity

Raw data were entered into a Microsoft Excel 2016 workbook and differences between lap days and game days were assessed. Analyses were conducted at both the individual participant and aggregate levels and effect sizes were calculated for each student's PA%, MVPA%, and MVPA% of PA using the Tau-U Calculator (http://www.singlecaseresearch.org/calculators/tau-u). Tau-U is a quantitative method of analysis used in single case research that "combines non-overlap between phases with trend from within the intervention phase. In addition, it provides the option of controlling undesirable Phase A trend."[46(p284)] Conceptually, the computed Tau-U value × 100 represents the percentage of data points showing changes between phases (ie, in the current study, change in level between lap days and game days). Tau-U can range between −1.00 (indicating that all baseline values exceed all treatment values) and 1.00 (indicates the reverse). Absolute values for Tau-U are interpreted as effect sizes, and they are classified as small or weak (≤0.65), medium to high (0.66–0.92), and large or strong (≥0.93).[47]

At the aggregate level, omnibus effect sizes for participant PA%, MVPA%, and MVPA% of PA were calculated using the same Tau-U calculator. Additionally, visual analyses for data stability, level, and trend between and within conditions (lap vs game days) of graphed PA%, MVPA%, and MVPA % of PA were conducted according to standard procedures.[37]

Psychological variables

Data for PA from both the original (n = 14) and replication (n = 11) studies were combined for the analyses of relationships between psychological variables and PA and 2 categorical variables were derived. First, the untreated level of MVPA (ie, MVPA% of total pedometer wear time during lap running conditions) served as a proxy for inherent interest in running more vigorously. Second, the measure of the percentage difference between games and laps in MVPA of total PA served as a proxy for the response to treatment (ie, difference between games vs laps on MVPA-PA%). For inherent interest and response to treatment grouping variables, those at or above and below the median split score were classified as high and low, respectively.

Questionnaire data from both the original and replication studies were used to compute mean scores and standard deviations for each psychological subscale overall and for the grouping variables of inherent interest and response to treatment. Independent t tests and Cohen's d were used to determine the existence and strength of statistically significant differences between groups for each psychological subscale.

Results

PA time

Overall (ie, inclusive of both lap and game days), participants accumulated 24.1 PA minutes (15.5 minutes of light PA and 8.6 minutes of MVPA) during Club sessions, but there were differences among the 2 conditions. During lap days they averaged 35.3 minutes of pedometer wear time and accumulated 26.2 PA minutes (21.4 minutes of light PA and 4.8 minutes of MVPA). In contrast, they averaged

36.4 minutes of pedometer wear time on game days and accumulated 22.0 PA minutes (9.6 minutes of light PA and 12.4 minutes of MVPA). Paired *t* tests revealed that there were significant statistical differences between lap and running conditions for minutes of PA and MVPA. For PA, 4.2 more minutes (95% confidence interval, 0.7–7.6 minutes) were accumulated on the average lap day versus game day, t (1, 9) = 2.69, P = .02, d = 0.87. For MVPA, 8.6 more minutes (95% confidence interval, 5.4–9.7 min) were accumulated on the average game day vs lap day, t (1, 9) = 7.89, P < .001, d = 2.51.

Percentage time effect size analyses

Table 3 displays individual participant data as well as group means, standard deviations, and weighted Tau-U effect sizes for PA%, MVPA%, and MVPA% of PA. Overall, students engaged in PA 76.1% of session time on lap days and 62.2% on game days. PA% was more variable on lap days (SD = 12.1% vs 7.2%) and the weighted Tau-U value of −0.65 was statistically significant and considered a medium to high effect size. Overall, they engaged in MVPA 33.3% of session time on game days and 15.8% on lap days. MVPA% variability was higher on lap days (SD = 12.3% vs 8.3%) and the weighted Tau-U value of 0.75 was significant and considered a medium to high effect size. MVPA% of total PA was more than 2.5 times greater during game than lap sessions (ie, 53.6% vs 20.2%). MVPA% of PA variability was higher on lap days (SD = 13.8% vs 10.0%) and the weighted Tau-U value of 0.91 was statistically significant and in the upper range of a medium to high effect size.

Visual analyses

Figure 1 shows group mean PA%, MVPA%, and MVPA% of PA across all 20 running club sessions. For percentage of time in PA (lower panel), data points during both lap and game conditions show stability within and across phases. Level data generally favored lap conditions, with trend lines showing a modest and no increase, respectively, for lap and game conditions over time.

For percentage of time in MVPA (Figure 1, middle panel), there was stability for both lap and game conditions within and across phases except during follow-up (ie, games) when MVPA% during sessions 16 and 20 was much lower than during sessions 17–19. Level data favored game conditions, with MVPA% in 8 of 10 game sessions being higher than all lap sessions and the remaining 2 game sessions higher than 7 of the 10 lap sessions. Trend lines show a modest MVPA% decrease during game sessions and a modest increase during lap sessions over time.

For MVPA% of PA (Figure 1, upper panel), there was stability during both lap and game conditions both within and across phases. There were no overlapping data points among conditions, clearly indicating that the intensity of PA (ie, PA time spent in MVPA) was higher during game conditions. Sharp increases occurred between the baseline lap and first 3 game conditions. Over time there was a modest descending trend for percentage of PA time in MVPA during games conditions and a slight upward trend during lap conditions.

Individual participant results

Table 3 displays mean PA%, MVPA%, and MVPA% of PA for each participant during the laps and games

Table 3. Comparison of PA accrued during lap day (N = 10) and game day (N = 10) sessions.[a]

	PA%		ES		MVPA%		ES		MVPA%-PA		ES	
Participant	Laps	Games	Tau-U	P	Laps	Games	Tau-U	P	Laps	Games	Tau-U	P
A	65.8	51.7	−0.60	0.03*	6.7	24.1	0.38[b]	0.18	8.6	47.2	0.40[b]	0.16
B	62.7	58.3	−0.41	0.14	7.2	34.5	0.98	***	11.9	59.2	1.00	***
C	92.0	77.5	−0.39[b]	0.37	11.1	44.9	1.00	0.02*	12.4	58.1	1.00	0.02*
D	58.7	60.3	0.03	0.92	13.7	32.5	1.00	***	24.0	54.6	0.94	0.001**
E	84.6	67.9	−0.89	0.01*	39.3	51.5	0.71	0.04*	46.2	76.1	1.00	0.005**
F	88.2	59.0	−1.00	0.05*	24.6	31.7	0.43	0.38	27.9	59.5	1.00	0.04*
G	79.1	67.5	−1.10[b]	0.001**	9.2	27.8	0.90	0.007**	11.8	41.2	0.95	0.004**
H	64.9	62.6	−0.50	0.25	11.0	32.1	1.00	0.02*	19.7	49.9	1.00	0.03*
I	89.6	65.6	−1.00	0.04*	6.8	27.0	1.00	0.04*	7.5	41.2	1.00	0.04*
J	64.9	50.9	−0.58	0.09	4.0	22.5	1.00	0.003**	6.7	43.1	1.00	0.003**
K	86.8	63.2	−1.00	0.002**	39.6	37.9	−0.04	0.90	45.8	60.0	0.76	0.02*
M			76.1	62.2			15.8	33.3			20.2	53.6
SD			12.1	7.2			12.3	8.3			13.8	10.0
Weighted ES (95% CI)			−0.65 (−0.87, −0.42)***					0.75 (0.53, 0.97)***			0.91 (0.67, 1.00)***	

[a]PA indicates physical activity; ES, effect size; MVPA, moderate-to-vigorous physical activity.
[b]Corrected for baseline trend
*P < .05. **P < .01. ***P < .001.

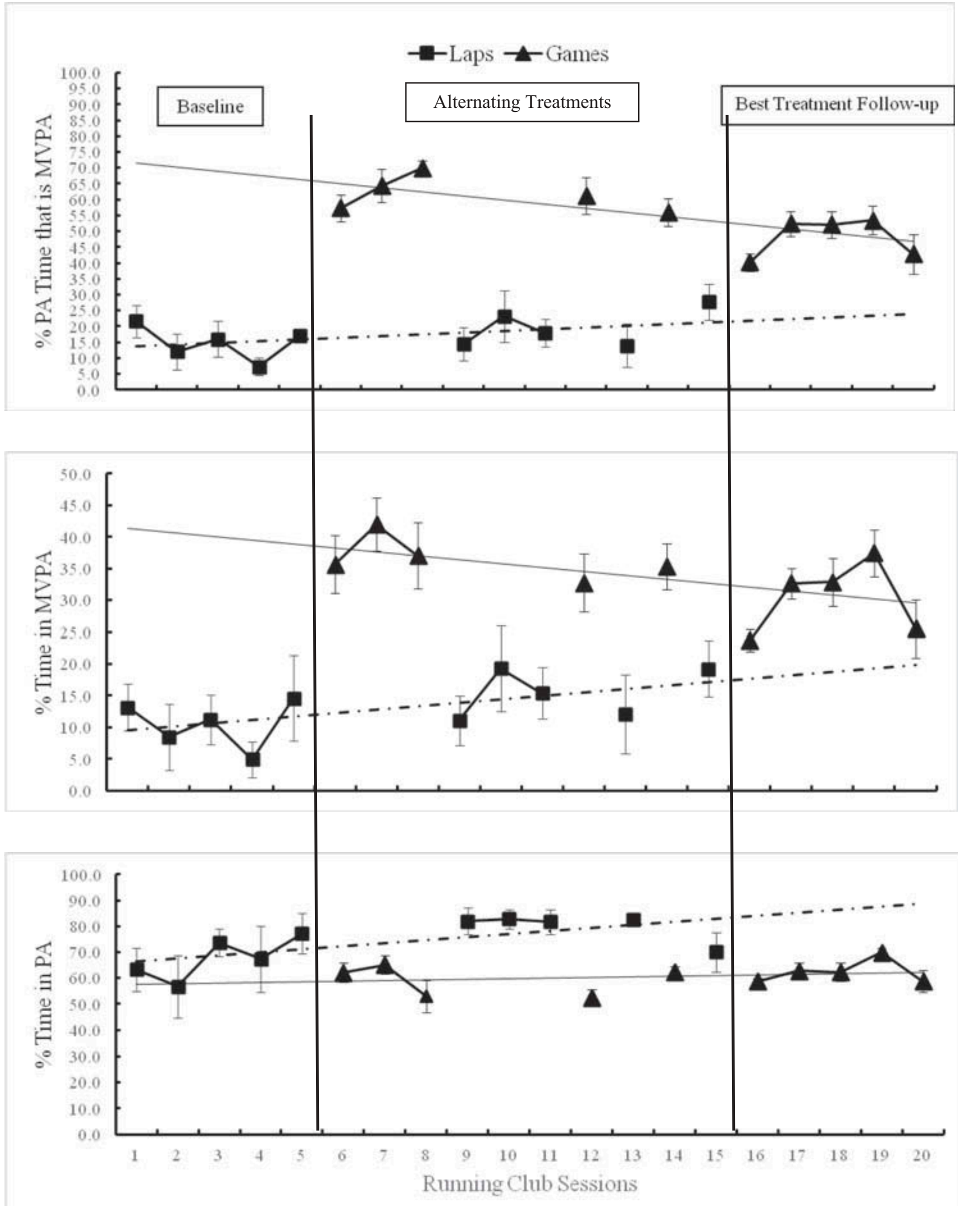

Figure 1. PA levels during lap and game days across the alternating treatment design.

conditions. For PA%, Tau-U values for 10 of 11 participants (90.9%) were negative and for 6 participants they were statistically significant, indicating that the average PA% (ie, ambulatory movement at any intensity) per session was greater during the laps than games conditions.

For MVPA%, Tau-U values for 10 of 11 participants (90.9%) were positive, indicating that MVPA% was greater during game than lap day conditions. Eight (72.7%) of the Tau-U values were statistically significant, with 2 and 6 values, respectively, demonstrating a medium to high and a large or strong effect.

For MVPA% of PA, Tau-U values for all participants were positive, indicating that MVPA% of PA was also greater during game days. Ten of the 11 Tau-U values (90.9%) were statistically significant, with 1 and 9 values, respectively, demonstrating a medium to high and a large or strong effect.

Psychological variables

Based on the mean scores of the 13 psychological constructs that were measured on a 5-point Likert type scale (Table 4), running club participants (*n* = 25; ie, current participants plus those in the original study) regarded the program as a venue for personal goal achievement (M = 4.48) and being important, interesting, and useful (M = 4.11) and approached the club with task orientation

Table 4. Descriptive data and statistically significant between-group differences for psychological variables and PA (N = 25).[a]

							Inherent interest[b]				
						Overall	Low	High			
Psychological construct	Items	Cronbach's α	M	SD	M	SD	M	SD	t	P	d
Competition	4	.66	2.30	1.02							
Recognition	4	.80	2.60	1.06	2.06	0.69	3.10	1.09	2.82	.01	1.14
Affiliation	3	.72	3.51	1.01							
Personal goal achievement	3	.52	4.48	0.62							
Self-esteem	3	.69	3.63	0.91							
Task orientation	5	.67	4.22	0.58							
Ego orientation	5	.82	2.24	0.93	1.82	0.64	2.63	0.99	2.41	.03	.97
Expectancy beliefs	5	.77	3.72	0.72	3.40	0.67	4.02	0.62	2.40	.03	.96
Importance, interest, and usefulness	6	.67	4.11	0.56							
Intention	2	.38	4.08	0.78							
Task efficacy	1		4.16	1.08							
Scheduling efficacy	2	.43	3.48	1.07							
Coping efficacy	4	.36	3.15	0.77							

[a]PA indicates physical activity.
[b]Low and high inherent interest was operationally defined as persons below vs persons at or above the median value for mean MVPA% for lap running, respectively.

(M = 4.22) and task efficacy (M = 4.11). In contrast, they did not view running club as a forum for being competitive (M = 2.30), gaining recognition (M = 2.60), or demonstrating an ego orientation (M = 2.24).

Nine of 12 scales that had multiple items demonstrated satisfactory internal consistency (α_{range} = .66–.82, Table 4). Independent t tests were conducted for these 9 scales and for task efficacy (Table 4). High inherent interest participants (ie, higher MVPA% in the running laps condition) had statistically significant higher scores than low inherent interest participants on Recognition (d = 1.14), Ego Orientation (d = .97), and Expectancy Beliefs (d = .96) subscales (Table 4). No differences were detected between high and low response to treatment groups.

Discussion

Overall PA engagement (eg, MVPA min) and higher intensity PA (eg, MVPA% of allocated time) are both important for children's health,[48] and both are identified among standards for after school programs.[18,19] Using MVPA% is especially useful because it allows for PA intensity comparisons to be made among programs of different lengths. Overall, the running club sessions averaged 35.8 minutes in length and provided participants a substantial portion of recommended PA time (M = 24.1 PA minutes, 35.7% of it in MVPA). Similar to the original study,[33] PA% was greater during lap days than game days (+13.9%$_{replication}$ vs +11.0%$_{original}$) and MVPA% (+14.5% during both replication and original) and MVPA% of PA (+31.1% $_{replication}$ vs +23.4%$_{original}$) were higher on game days. Weighted effect sizes in the current study were larger than those in the original study[33] for PA% (−0.65 vs −0.46), MVPA% (0.75 vs 0.68), and MVPA% of PA (0.91 vs 0.80). Additionally, in the current study, games fostered slightly higher PA engagement than in the original study[33] (62.2% vs 59.8%), but activity intensity levels were less intense (MVPA% = 33.3% vs 39.9%; MVPA% of PA = 53.6% vs 66.3%).

Similar to the original study,[33] MVPA time for games conditions (12.4 minutes) surpassed the 10 minutes of additional MVPA estimated that ASPs provide.[49] In addition, game days, but not lap days, once again met the stipulation that ASPs provide activities in which MVPA% of PA ≥ 50%.[18] Also similar to the original study, neither condition met the national recommendation of 30 minutes of PA per session[18] or the California recommendation of 30–60 minutes of MVPA per session.[19] Nonetheless, it may not be realistic to expect sustained levels of MVPA to occur during the running programs of prepubescent children because their anaerobic systems are not fully developed.[50]

The mean values for specific psychological constructs compare closely to those identified across a series of 4 studies of a running program during PE in elementary schools by Xiang and colleagues[27-30]: task orientation (4.22 vs 4.02); ego orientation (2.24 vs 2.97); expectancy beliefs (3.72 vs 3.78); importance, interest, and usefulness (4.11 vs 3.60); and intention (4.08 vs 3.02). Higher scores for (1) task orientation; (2) importance, interest, and usefulness; and (3) intention by running club participants over general PE students may have resulted from more homogeneous attitudes toward running in a program in which participation was voluntary, unlike required as in PE.

Three psychological construct scores were higher among participants with greater inherent interest in running (ie, MVPA% during lap conditions). The higher scores for recognition were surprising.

Recognition is a construct falling under the regulatory style of external regulation in self-determination theory's continuum of motivation[51] and represents external social reinforcement. Yet MVPA within elementary-aged schoolchildren has previously been found to be associated with intrinsic and identified motivation types.[52] Ego orientation scores were also higher. This goal achievement mindset is also an externalized construct in that performance is compared to others for the sake of being the best instead of doing one's best.[53] Yet in a PE setting, children in the same age group as ours —who had high ego–high task goal orientations—accumulated more vigorous PA than high ego–low task and low ego–low task goal orientations.[54] Though there was no statistical difference in task orientation between high and low inherent interest groups in our study, the high interest group scored higher on task orientation (4.33 vs 4.10), distinguishing themselves as high ego–high task individuals. Lastly, we observed higher scores on expectancy beliefs in the high inherent interest group. High expectancy beliefs suggest that one's attitude toward vigorous running is positive, which in turn heightens the behavioral intention for doing it. Indeed, in a PE setting among similar-age children, expectancy beliefs were positively associated with PA, which included MVPA measures.[55] Further study with larger samples is needed before drawing conclusions.

Strengths and limitations

Only a limited number of studies of PA interventions in ASPs have been conducted,[24] and investigations of running programs are even rarer. We were able to obtain an objective measurement of PA that enabled assessing 3 different outcomes (PA%, MVPA%, and MVPA% of total PA). A strength of using an alternating treatments design is that it permitted the assessment of differences between program conditions as well as trends over time for the same participants (ie, a comparison group was not needed). As well, in addition to assessing group data, we were able to analyze program effects for individuals, an important feature for practitioners who want to build individual choice options into the activities they provide. Along the same line, we used 2 different analytic strategies (ie, statistical determination of effect size via the degree of nonoverlap among data points and visual analysis). Lastly, the study is one of the very few to include an assessment of psychological variables.

Of special note it that the study is both an extension (ie, psychological variables) and a replication of one we conducted earlier. Replication studies are important for assessing the repeatability and generalizability of interventions[34] and are particularly valuable in the dissemination of health-related programs.[35]

Limitations of the study include being conducted in a single school and a small sample size. Thus, the statistically significant and the null results for psychological variables should be considered preliminary, especially for females. In addition, accelerometers are more sophisticated than pedometers and a preferred choice by many researchers. Nonetheless, the Walk4Life MVP pedometer used in the study has been shown to produce reliable PA measures with this age group and the results compared favorably to accelerometry.[39] Because pedometers are less expensive, easier to operate, and produce data that are easier to interpret than accelerometers, their use in assessing after-school programs, especially by practitioners, may be more generalizable. An additional limitation is that the analysis of psychological variables included data from participants in both the current (n = 11) and original (n = 14) studies. Psychological variables had not been explored in the original study, and including them here increased the number of respondents to a level that permitted statistical analysis. Thus, the cautious interpretation of findings is recommended. Additional studies of PA programs in ASPs should be conducted with ethnically diverse students, more females, and other age groups and include the analysis of psychological constructs.

Translation to Health Education Practice

Overall, there was strong evidence of a replication effect—the study confirmed that both running laps and running games can contribute to PA accrual in an ASP and that the 2 formats may provide substantially different outcomes relative to PA intensity. From a psychological standpoint, high-intensity games may be especially valued by those who have little intrinsic interest in continuous uninterrupted running, do not enjoy it, or are not task oriented in terms of goal achievement. In contrast, lap running is typically participant directed and performed individually and for some may fulfill autonomy needs. Relative to program designers, a running game format may be preferable to lap runners if the goal of the ASP is to solely maximize MVPA. In contrast, however, it is easier to manage lap running than to implement games, so that structure may be preferred if ASP personnel are not familiar with or comfortable selecting, modifying, and teaching games. Results of the psychological assessments substantiate that children in ASP programs have different PA needs and interests. Thus, ASP providers should avoid exclusively providing only one running format, especially if recruiting to programs and maintaining them in programs is a priority. Having participants wear pedometers is not only a way to evaluate a program but can be a way to facilitate children learning self-management strategies (eg, goal setting, monitoring). Children in the current investigation were not asked which format they preferred, but a study of the SPARK elementary school PE curriculum indicated that students preferred game play to straight exercise activities.[56] This preference may also hold true for ASPs; nonetheless, we recommend that program providers assess children's liking for the activities they offer.

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