

PEDAGOGY

Effects of Classroom-Based Energizers on Primary Grade Students' Physical Activity Levels

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Abstract

The primary aim of this study was to determine the effects of classroom-based exercise breaks (Energizers; Mahar, Kenny, Shields, Scales, & Collins, 2006) on students' physical activity levels during the school day. A multiple baseline design across first grade (N = 3) and second grade (N = 3) classrooms was used to examine the effects of the Energizers program. Approximately 15 students per classroom had parental consent to participate. D-index effect sizes were calculated between baseline and intervention phases for each classroom. Classroom activity levels were graphed over time, and percentage of nonoverlapping data (PND) values were calculated between baseline and intervention phases for each classroom. Implementation of the Energizers program significantly increased participants' school-based steps, which were measured using accelerometer activity monitors. In addition, participating teachers indicated that Energizers did not adversely affect academic instructional time and planned to continue using Energizers activities in their classrooms beyond the study.

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Children in today's society face unique challenges in maintaining a healthful, well-balanced lifestyle. Among other barriers, changes in the food market have inundated children and adolescents with advertisements for prepackaged, empty calorie foods and sugar sweetened beverages (Berkey, Rockett, Field, Gillman, & Colditz, 2004; Welsh et al., 2005). Furthermore, fewer children engage in daily physical activity (PA), and more engage in sedentary entertainment, such as watching television or playing video games (Certain & Kahn, 2002). Such sedentary lifestyles, coupled with an overly high intake of caloric content, result in an excessive energy balance for children and weight gain over time (Agras, Hammer, McNicholas, & Kraemer, 2004).

Schools are a practical site for identifying child health-related concerns and implementing interventions to promote increased PA. Without daily school-based PA (i.e., opportunities for PA during the normal school hours, including physical education [PE]), approximately 50% of children do not have much of a chance of achieving the minimum recommended PA level (Trudeau & Shephard, 2005). Unfortunately, such opportunities have not been provided in many schools because of concerns about taking time away from academic instruction (Sibley & Etnier, 2003).

Although various school-based health promotion frameworks exist, behavioral interventions, environmental changes, and tenets of social cognitive theory are incorporated into the most successful. Given that few students use leisure time for engaging in PA, policy and environmental changes are imperative, particularly for female students (McKenzie, Marshall, Sallis, & Conway, 2000). Although increasing students' nutritional eating choices and engagement in PA have positive effects, the same approaches have been less successful in preventing obesity or reducing body weight (i.e., BMI) and adiposity (see Goran & Sothorn, 2006). Harris, Kuramoto, Schulzer, and Retallack (2009) completed a meta-analysis of 18 empirical studies on the outcomes of elementary school-based PA interventions. Not only did BMI rates not improve across studies, but also high rates of consistency were reported between intervention and control conditions ($r = 0.97$).

Sports, Play, and Active Recreation for Kids (SPARK; Sallis et al., 1997) is one of the most effective school-based PE programs in terms of implementation and outcomes to date. In a controlled trial,

two approaches to implementation (i.e., teacher led or specialist led) were used to investigate the effects of a class-management program to increase the percentage of moderate to vigorous physical activity in elementary school PE classes. Results of both conditions were compared to control schools' PE classes (i.e., all occurred during noninstructional time). Each PE class included a health-fitness (e.g., aerobic dancing, jogging) or skill-fitness (e.g., organized sports) component. The treatment group students also learned skills for behavioral change, such as goal setting, self-management, and principles of self-reinforcement in weekly 30-min classes.

According to Sallis et al. (1997), PE classes with SPARK incorporated yielded greater student moderate to vigorous physical activity engagement time when taught either by classroom teachers (33 min) or by PE specialists (40 min) relative to control classes (18 min). Furthermore, girls in the specialist-led group showed significant improvements in fitness levels after 2 years, which was measured using timed cardiovascular and abdominal exercises. Across both treatment groups, no significant effects were observed in out-of-school PA, however. As a result of the SPARK program's success, the program has been adopted in approximately 270 schools across seven states to improve the PE curricula. Of these schools, nearly 80% continued the SPARK program after 4 years of implementation, with no significant implementation differences observed between school districts of high and low socioeconomic status (Dowda, Sallis, McKenzie, Rosengard, & Kohl, 2005).

Mahar, Murphy, et al. (2006) implemented the Energizers program, which involves brief (10–20 min) classroom-based PA sessions, in kindergarten through fourth grade classrooms. Students in the Energizers implementation group completed more daily pedometer steps than control group students (Cohen's $d = 0.49$). Furthermore, systematic increases in on-task classroom behaviors were observed after students engaged in Energizers activities ($d = 0.60$). The least on-task students during baseline experienced the greatest increase in on-task behaviors at postintervention ($d = 2.20$). Although Mahar, Murphy, et al. did not directly measure academic outcomes, similar on-task behaviors (e.g., engagement and motivation) have been shown to be predictive of enhanced levels of academic achievement (DiPerna, Volpe, & Elliott, 2002).

The primary aim of this study was to determine the effect of classroom-based exercise breaks (Energizers; Mahar, Kenny, Shields, Scales, & Collins, 2006) on young students' PA levels. We expanded upon the work of Mahar, Kenny, et al. (2006), and the primary hypothesis for this study was that implementation of the Energizers program would increase students' school-based PA levels. Given that the Energizers program was designed as a low-cost method of incorporating effective PA sessions into the classroom with relative ease and minimal disruption, an additional hypothesis was that teachers and students would view Energizers as acceptable. Previous studies support the effectiveness of school-based PA interventions (Luepker et al., 1996; Sallis et al., 1997; Sallis et al., 2003) and classroom-based Energizers (Mahar, Murphy, et al., 2006) to promote greater levels of student PA throughout the school day.

Method

Participants

Data were collected in a rural elementary school in the Northeast. Students in three first grade classrooms and three second grade classrooms participated in the study. A mean of 16 first grade and 14 second grade students participated per classroom. Approximately 50.3% of students were female. Ninety-seven percent of the students were Caucasian, 2% were African American, and 1% were Hispanic/Latino. Within the school, 37% of students received free or reduced-price lunch. All of the six participating teachers were female and identified their ethnicity as Caucasian.

Instrumentation

Physical activity. To measure PA levels, students wore New-Lifestyles Accelerometer Activity Monitors (Model NL-800) throughout the school day. Each NL-800 accelerometer retained a 7-day memory of steps taken. In contrast to pedometers, accelerometers show higher levels of overall measurement accuracy, including reliability and validity of steps measured (Tryon, Pinto, & Morrison, 1991; Tudor-Locke & Myers, 2001). Furthermore, computer chips measuring the amplitude and frequency of movement deduct inconsistent activities (e.g., shaking the model) from the accumulated "steps."

Treatment fidelity. Implementation of classroom-based Energizers was observed once per week in each classroom. The lead author completed a structured checklist of intervention implementation for each observation. In addition, classroom teachers completed a weekly self-report on integrity of Energizers activity implementation.

Teachers reported implementing an Energizers activity twice per day during the intervention phase. They also reported completing activities immediately prior to or following academic instruction and at least 30 min before or after scheduled breaks (e.g., lunch, recess, PE). Students' recess and PE times were not altered, but rather Energizers activities were implemented within the daily classroom schedule. Teacher reports were corroborated via formal observations completed by trained research assistants. Energizers activities were scheduled to last 10–20 min per session. Based on the observation data, the average length of an Energizers session was 11.42 min ($SD = 3.54$ min). During observation sessions, a mean of 91.48% of students were engaged in the activity (i.e., head and eyes oriented toward the teacher, performing movements as directed). Overall, systematic observations and teacher reports of integrity were consistently very high (i.e., > 90%) across fidelity indicators. Planned booster training sessions (e.g., structured practice sessions) for teachers were unnecessary because of high implementation integrity.

Intervention acceptability. Teachers and students completed brief, anonymous intervention acceptability ratings on their perceptions of the Energizers program and classroom-based PA. Teachers rated statements regarding ease of Energizers implementation and incorporation of classroom-based PA on a scale from 1 (*strongly agree*) to 5 (*strongly disagree*). Students also completed a brief intervention acceptability questionnaire regarding Energizers that included five questions using a 3-point response format (*a lot*, *some*, *a little*, or *not at all*). Students completed the questionnaire individually; however, if they experienced difficulty with unfamiliar words, teachers provided assistance.

Procedures

The K–5 Energizers program (Mahar, Kenny, et al., 2006) consists of a series of 10- to 20-min activities that can be incorporated twice daily into the regular classroom routine. Participating teachers com-

pleted a 2-hr training session before implementing the Energizers program. As in the procedures described by Mahar, Kenny, et al. (2006), a brief overview of the childhood obesity epidemic and importance of school-based PA was provided at the outset of the training session. The Energizers program rationale and implementation process then were reviewed, and each teacher had the opportunity to lead a PA session and receive constructive feedback from the facilitator. Following the training, each teacher was provided with a packet of Energizers classroom-based physical activities. Each teacher participated in weekly consultation sessions with the lead researcher throughout the implementation phase of the study.

During intervention implementation, teachers led two daily Energizers activities following a detailed script verbatim. Every participating student wore an accelerometer throughout each school day, including during the baseline period. At the end of each week, researchers recorded the total daily steps tracked on each student accelerometer. Classroom teachers assisted students with attaching accelerometers before the opening bell each morning and removing accelerometers prior to the ending bell each afternoon. (Students wore the accelerometers for 2–3 school days prior to the beginning of the study to reduce reactivity effects.)

Research Design

A multiple baseline design (Watson & Workman, 1981) was used to determine the effects of the Energizers program on PA. This design has been used in previous studies (Katz & Singh, 1986; Mahar, Murphy, et al., 2006; Shimabukuro, Prater, Jenkins, & Edelen-Smith, 1999) to allow systematic manipulation of intervention conditions to infer causal relationships with outcome variables. Based on this design, one classroom from each grade level was randomly assigned to one of three conditions. Conditions varied by the length of baseline observation (2, 4, or 6 weeks). Teachers continued the Energizers program throughout the end of the 11-week study. Thus, classrooms implemented the program for 5, 7, or 9 weeks.

Results

Physical Activity Outcomes

Descriptive statistics for PA are reported by grade level, classroom, and condition in Table 1. Two metrics were used to test the

Table 1
Mean (Standard Deviation) of Daily Steps per Week of Study

Classroom	Week 1	Week 2	Week 3	Week 4	Week 5	Week 6	Week 7	Week 8	Week 9	Week 10	Week 11
Grade 1											
1A	6782.83 (689.53)	6891.29 (969.01)	7159.15 (999.93)	6544.00 (831.44)	6631.57 (852.75)	7139.29 (1032.36)	6947.36 (696.18)	6866.86 (718.13)	6792.21 (1016.54)	9206.46 (1008.83)	6722.71 (1077.03)
1B	5785.00 (1074.12)	6131.64 (915.78)	5933.91 (998.13)	6874.82 (1278.76)	6879.36 (1334.43)	6809.91 (1558.56)	7989.45 (3325.39)	7158.60 (1166.42)	6422.55 (1254.65)	8808.45 (1732.09)	6501.82 (1803.71)
1C	5269.70 (894.73)	5683.73 (1024.47)	5444.09 (1243.97)	5983.36 (1298.67)	6362.45 (1313.52)	6293.56 (1284.48)	7507.09 (1455.03)	6632.82 (1295.34)	7049.82 (968.17)	6493.70 (1099.02)	7679.36 (1239.17)
Grade 2											
2A	5580.37 (609.22)	6363.86 (633.24)	5426.71 (666.60)	5728.88 (751.20)	5256.76 (738.50)	6029.07 (561.98)	5901.47 (662.08)	5787.88 (664.84)	6926.07 (949.06)	6102.24 (729.93)	7289.35 (1070.04)
2B	6764.18 (1126.74)	6207.00 (1230.47)	6074.33 (1317.64)	7517.75 (2130.84)	7301.17 (1740.01)	7057.17 (1263.86)	7094.08 (1443.80)	7625.17 (1665.42)	7301.00 (1866.00)	8815.45 (2466.76)	8020.91 (1452.54)
2C	4795.69 (758.29)	5133.94 (667.99)	4141.63 (585.07)	5591.50 (862.60)	4454.38 (888.24)	5046.00 (819.13)	5701.00 (1206.44)	5440.63 (823.30)	5736.31 (2605.12)	5751.13 (1054.40)	6139.56 (948.00)

Note. Shading indicates intervention implementation phase for Group A (Weeks 3–11), Group B (Weeks 5–11), and Group C (Week 7–11).

primary hypothesis that the Energizers program would increase students' school-based PA levels. First, *d*-index effect sizes were calculated between baseline and intervention phases for each classroom. Based on the recommendations of Cohen (1988), *d*-index effect sizes span to infinity (i.e., may exceed 1.0) and can be interpreted as follows: ≥ 0.8 (large), ≥ 0.5 (medium), and ≥ 0.3 (small). Based on these criteria, the effects of Energizers on students' daily school-based accelerometer steps were large in two of the first grade classrooms (1B, 1C) and medium in the other classroom (1A). In the second grade classrooms, effect sizes for students' daily school-based accelerometer steps were large in all three classrooms (Table 2).

Table 2
Cohen's d Effect Sizes and Percentage of Nonoverlapping Data (PND) for Average Daily Accelerometer Steps by Classroom

Classroom	<i>d</i>	PND %
Grade 1		
1A	0.71	44.44
1B	1.18	57.14
1C	1.17	100
Grade 2		
2A	1.26	88.89
2B	0.80	42.86
2C	1.05	80

Second, classroom activity levels were graphed over time (Figures 1 and 2), and percentage of nonoverlapping data (PND) values were calculated between baseline and intervention phases for each classroom (Table 2). Based on the guidelines established by Scruggs, Mastropieri, and Castro (1987), PND values may be categorized as very effective ($> 90\%$), effective (70% to 90%), questionable (50% to $< 70\%$), and ineffective ($< 50\%$). Based on these criteria, PND values in the first grade classrooms fell within the very effective range (1C), the questionable range (1B), and the ineffective range (1A; Table 2). In the second grade classrooms, PND values fell within the effective range in two classrooms (2A, 2C) and the ineffective range in one classroom (2B).

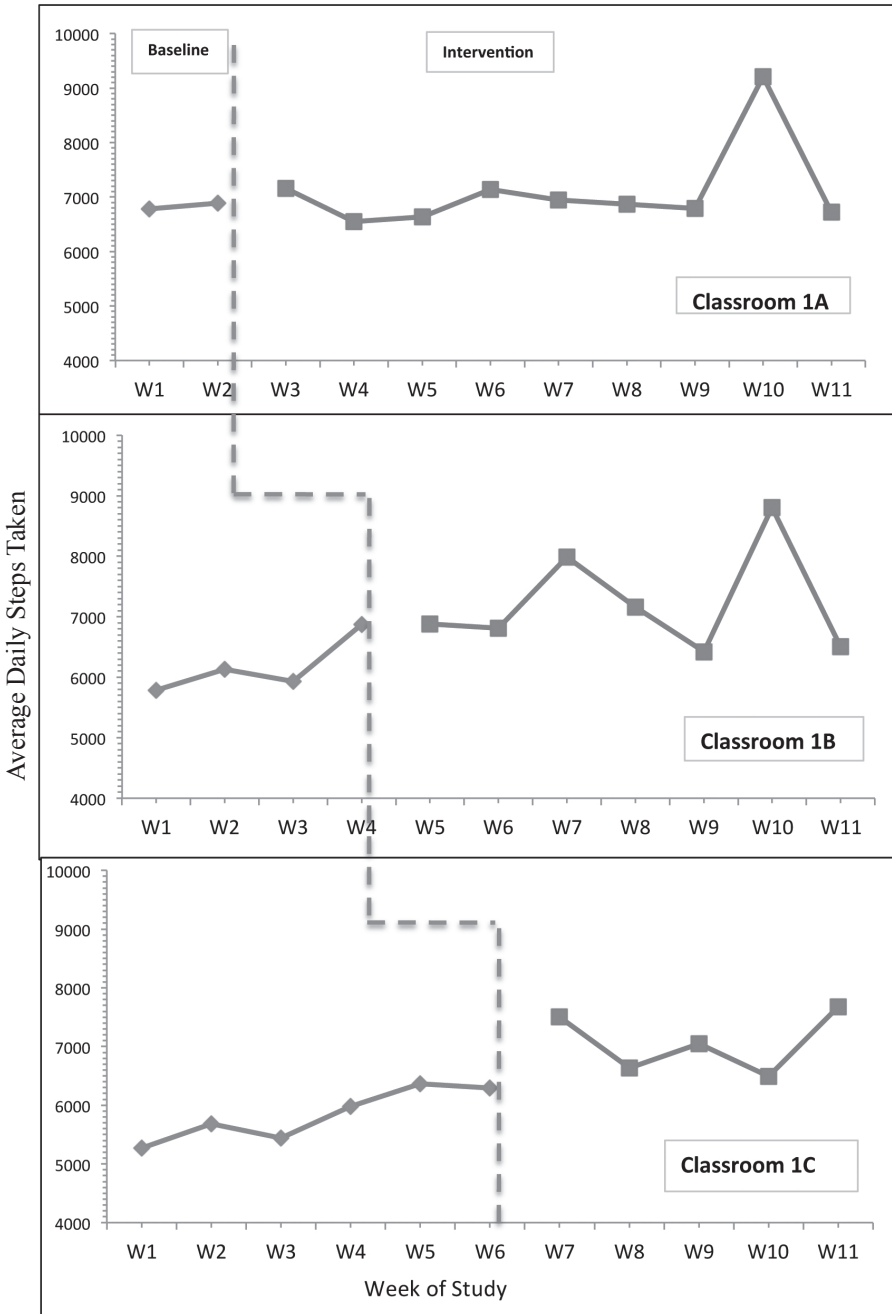


Figure 1. Average daily accelerometer steps by first grade classroom and week of study.

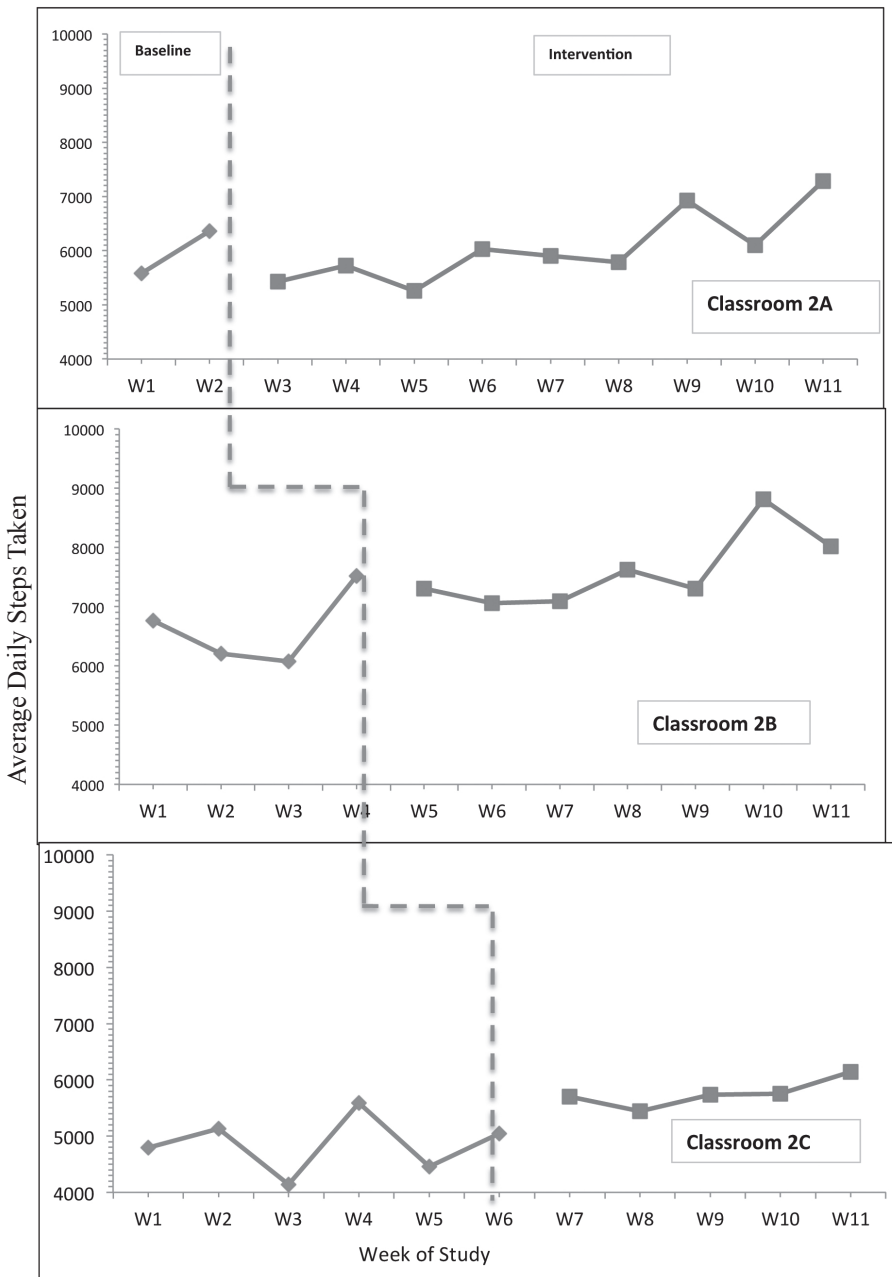


Figure 2. Average daily accelerometer steps by second grade classroom and week of study.

Intervention Acceptability

All six participating teachers indicated strong agreement (56%) or agreement (44%) regarding their enjoyment of leading Energizers activities. In addition, all teachers strongly agreed (11%) or agreed (89%) that Energizers did not adversely affect academic learning in the classroom. Teacher perceptions of students' ability to pay attention following Energizers activities varied, ranging from strongly agree (11%), agree (67%), and somewhat agree (22%). Finally, all teachers strongly agreed (67%) or agreed (33%) that they planned to continue incorporating PA in the classroom, via Energizers or another school-based program.

Eighty-two percent of participating students reported having a lot of fun participating in the Energizers activities. When asked if Energizers activities made students feel more physically fit, 63% indicated a lot. Only 33% of students indicated they felt tired after Energizers activities, and 76% reported being able to pay better attention in class after engaging in an Energizers activity. Finally, 63% of students indicated that Energizers made them significantly more excited about school.

Discussion

The purpose of this study was to determine the immediate effects of brief teacher-led exercise breaks (Energizers; Mahar, Kenny, et al., 2006) on students' PA throughout the school day. Implementation of the Energizers program significantly increased participants' activity levels (school-based) steps in five of the six participating classrooms, with questionable effects in the remaining classroom. Teachers reported that the Energizers program was implemented with relative ease and minimal disruption, and all teachers disagreed or strongly disagreed the exercise breaks negatively affected classroom instructional time.

Throughout participation in the Energizers program, students' daily school-based accelerometer steps increased following phase changes in a majority of the participating classrooms. All but one first grade classroom (1A) had effect sizes within the large range. One first grade classroom and two second grade classrooms had PND values within the very effective or effective ranges. Overall,

systematic observations and teacher reports of integrity were consistently very high (i.e., > 90%) across fidelity indicators. Finally, all teachers agreed that Energizers did not adversely affect instructional time and planned to continue incorporating PA in the classroom following completion of the Energizers study.

Mahar, Murphy, et al. (2006) reported similar effects for Energizers, with experimental group participants completing more daily pedometer steps than control group students. Several large-scale studies have indicated mixed effectiveness of school-based interventions for increasing childhood PA, such as the Childhood and Adolescent Trial for Cardiovascular Health (CATCH; Luepker et al., 1996), Middle School Physical Activity and Nutrition (MSPAN; Sallis et al., 2003), and SPARK (Sallis et al., 1997).

In other studies, researchers have reported nonsignificant results between intervention and control students in daily accelerometer steps (e.g., Lohman, Thompson, & Going, 2003; Webber et al., 2008). Furthermore, whether these effects translate to improvements in students' overall physical health and body mass index (BMI) or adiposity rates continues to be questioned (see Goran & Sothorn, 2006).

Given that the classroom was the unit of analysis, conducting a true randomized controlled trial was not feasible with the resources available to conduct the study. Students were nested within an intact classroom within a school, which did not allow for considering effects at the participant level due to random assignment violations. Conversely, not enough classrooms were available ($N = 6$) to truly test classroom effects within a between-group design.

In addition, single-case effect sizes violate several assumptions for parametric analyses (Riley-Tillman & Burns, 2009). For example, data within baseline and intervention phases must be free from autocorrelation, that is, independently and normally distributed (Van den Noortgate & Onghena, 2003). Cohen's d criteria were developed to interpret comparisons between groups (i.e., in contrast to within subjects; Baron & Derenne, 2000), whereas single-case effect sizes often exceed 2.00 (Burns & Wagner, 2008). As such, single-case effect sizes should be interpreted with caution. Finally, as Mahar, Murphy, et al. (2006) noted in a previous investigation of Energizers that classroom teacher characteristics beyond treatment fidelity (e.g., enthusi-

asm, social modeling of healthful behaviors, motivation) could play a significant role in the effectiveness of classroom-based activity.

Researchers should continue to investigate PA in the school environment from a broader ecological standpoint, such as the differential effects and acceptability of school-based PA across ethnic groups and socioeconomic status. This is important given parental influences in the home environment for young students. In addition, a few researchers have suggested school-based PA is associated with improved levels of academic achievement, even when instructional time is decreased (see Mahar, Murphy, et al. (2006); Shephard, 1997; Sibley & Etnier, 2003). As such, researchers should examine the effects of implementing classroom-based PA programs like Energizers on instructional time, student engagement, and academic achievement. Researchers investigating the relationship between student activity levels and academic performance also should consider the effects of healthful nutrition in the school environment. For example, a pilot study on the EatFit program (Shilts, Lamp, Horowitz, & Townsend, 2009) showed increases in academic outcomes, in addition to promotion of healthful nutritional choices and PA engagement. Researchers should also examine how quickly changes in engagement result in corresponding increases in academic performance.

Schools offer a prime environment for providing opportunities to increase students' health and wellness knowledge, nutritional choices, and engagement in PA. Despite that classroom-based activity has been proposed as a key facet of schoolwide health and wellness promotion, limited research has been conducted in this area (Cale, 2000; Fox, 2004). Results of the current study indicate that teachers can incorporate structured, low-cost, effective PA sessions into the classroom with relative ease and minimal disruption. Energizers significantly increased students' daily steps taken in a majority of classrooms, with questionable effects in the remaining classrooms. The teachers and students also viewed the activities favorably. As such, teachers and administrators should consider incorporating classroom-based PA when possible, particularly in conjunction with schoolwide health and wellness programming and PE.

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