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Controlled Evaluation of a Physical Activity Intervention for Senior School Students: Effects of the Lifetime Activity Program

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This study describes the development, implementation, and evaluation of a structured physical activity intervention designed for high school students (years 11 and 12). A sample of 78 students was randomly allocated to control or intervention conditions for a period of ten weeks. Students in the control group (n = 40) participated in unstructured physical activity in a health and fitness center. Students in the intervention group (n = 38) participated in a ten-week structured health and exercise program based on Bandura's social learning theories. At the initial posttest, a number of statistically significant group differences were found using analysis of covariance. The intervention group reported more physical activity and improved exercise self-efficacy in comparison to the control group. At the 3-month follow-up, no statistically significant differences in physical activity were found. Results from this study suggest that a well-organized exercise-based program can be effective in increasing physical activity behavior of adolescents on a short-term basis.

Key words: adherence, exercise, adolescents

Among adults, physical inactivity is associated with a range of lifestyle diseases, including diabetes, obesity, and cardiovascular disease (U.S. Department of Health and Human Services, 1996). Although documenting the consequences of physical activity during youth is challenging (Baranowski et al., 1992; Cavill, Biddle, & Sallis, 2001; Welk, Corbin, & Dale, 2000), evidence is accumulating that the onset of many chronic diseases of adulthood lies in youth (Boreham, Twisk, Savage, Cran, & Strain, 1997; Twisk, Kemper, van Mechelen, Post, & van Lenthe, 1998). Unfortunately, physical inactivity has become a global problem, with more than half of the world's population not achieving modest physical activity recommendations (World Health Organization, 2005). It is of particular concern that physical activity levels decline drastically during adolescence. This decline

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in physical activity has been identified from longitudinal studies (Aarnio, Winter, Kujala, & Kaprio, 2002; Aaron, Storti, Robertson, Kriska, & Laporte, 2002; Kelder, Perry, Klepp, & Lytle, 1994; Maia et al., 2001) and U.S. and U.K. national surveys (Gordon-Larsen, Nelson, & Popkin, 2004; Sproston & Primatesta, 2003).

Despite the knowledge that the age-related decline in physical activity is steepest between the ages of 13 and 18 (Sallis, 2000) or grades 9 through 12 (U.S. Department of Health and Human Services, 2000), the majority of school-based physical activity interventions have been conducted in primary schools (Biddle, 2001). Few interventions have been completed in secondary schools and even fewer have involved students in their final school year. This may be due to competition for curriculum time, lack of student interest, or a combination of reasons. Despite these difficulties, recent secondary school interventions—New Moves (Neumark-Sztainer, Story, Hannan, & Rex, 2003; Neumark-Sztainer, Story, Hannan, Tharp, & Rex, 2003), Project FAB (Schneider-Jamner, Spruijt-Metz, Bassin, & Cooper, 2004), and the Lifestyle Education for Activity Program (Dishman et al., 2004, 2005)—have demonstrated that secondary schools are appropriate settings for intervention.

This study describes the development and evaluation of the Lifetime Activity Program (LAP), a 10-week conceptual physical education program developed by the researchers with reference to Bandura's social cognitive theory (SCT) and self-efficacy theory (SET) (Bandura, 1977, 1986, 1997). The overarching aim of the LAP was to encourage positive changes in physical activity by increasing individual knowledge and the confidence to be active and by developing techniques to enhance social support for activity from friends. Social support has been identified as a potential determinant of youth physical activity behavior, and previous interventions have involved components to enhance family support for physical activity in primary schools (McKenzie et al., 1996; Saakslahti et al., 2004; Stevens et al., 2003; Vandogen et al., 1995), secondary schools (Simon et al., 2004) and environments other than in schools (Fitzgibbon, Stolley, Dyer, VanHorn, & KauferChristoffel, 2002). Even though cross-sectional research has provided evidence for a positive relationship between social support and adolescent physical activity behavior (Prochaska, Rodgers, & Sallis, 2002; Sallis, Taylor, Dowda, Freedson, & Pate, 2002; Saxena, Borzekowski, & Rickert, 2002), to the authors' knowledge, no previous school-based intervention has provided students with guidelines to augment peer support for physical activity.

Methodology

Subjects

The study methodology was approved by the University of Oxford's Department of Educational Studies Ethics Committee, and all students and parents/guardians provided informed consent. The study sample was drawn from high school students (aged 16–18) who had selected a health and fitness school sport option. Students involved in the study were of particular interest to the research community as they were individuals who elected to participate in a unit focusing on health and fitness, rather than the traditional team sports offered by the school. This was the only alternative available to students who did not wish to participate in the team

sports option. From the target population of 105 students, 78 students volunteered to be involved in the LAP ($N = 78$). As there were considerably more girls in the eligible sample, before randomly allocating students to conditions, the sample was stratified by gender to ensure equal numbers of males and females in control ($n = 40$) and intervention ($n = 38$) groups.

Treatment conditions

Constructs or determinants from Bandura's theories have been identified as important for understanding and intervening in health behavior (Baranowski, Perry, & Parcel, 1997). Self-efficacy is central to Bandura's theories and deals with ideas of confidence, competence, and capability with reference to a specific task. In physical activity research, self-efficacy refers to an individual's confidence in their ability to be physically active on a regular basis (Nahas, Goldfine, & Collins, 2003). Cross-sectional research has revealed a positive relationship between adolescent physical activity and self-efficacy (Allison, Dwyer, & Makin, 1999; Garcia, Pender, Antonakos, & Ronis, 1998; Strauss, Rodzilsky, Burack, & Colin, 2001) and interventions based on Bandura's work have demonstrated that targeting self-efficacy can result in increased physical activity (Dishman et al., 2004; Neumark-Sztainer, Story, Hannan, Tharp et al., 2003; Sallis, Calfas, Alcaraz, & Gehrman, 1999). The key constructs from Bandura's theories (self-efficacy, social support, perceived barriers, behavioral capability, and perceived benefits) were used to develop the content of the intervention. The program addressed socioenvironmental factors by providing the students with guidelines to increase their social support and guidance and modeling from the teacher. The guidelines included information regarding the selection of training partners, the planning of training sessions, the identification of perceived barriers, and the importance of motivation and feedback. These guidelines were revisited at the start of each LAP session, when students were given an opportunity to record the number of completed sessions and evaluate the relationship with their training partner. Behavioral factors were enhanced through goal-setting techniques, participation in exercise training, exercise program development, and the use of training diaries.

The program was designed for senior high school students (ages 16–18) and was delivered by a member of the research team. Owing to competition for curriculum time in high schools, the program involved minimal contact time with the researcher. Students in the intervention group met once a week, and each LAP session lasted approximately 90 min. In addition to their scheduled session, students were encouraged to participate in 60 min of moderate to vigorous physical activity (MVPA) daily, as suggested by U.K. (Department of Health, 2004) and U.S. (U.S. Department of Health and Human Services & U.S. Department of Agriculture, 2005) guidelines.

Each LAP meeting consisted of a didactic component and participation in practical lifetime exercise activities. The LAP curricular content included benefits of physical activity, physical activity guidelines, goal setting for fitness, types of cardiovascular training and heart rate zones, nutritional guidelines, components of physical fitness, principles of training, and weight training theory. The LAP practical content included a variety of cardiovascular activities, circuit training, a spinning class, and resistance training sessions.

All sessions were completed in a health and fitness center that was used by the general public but was available free to students outside of normal classes. The health and fitness center consisted of a small pool, weights room, cardiovascular training room, and two dance/studio rooms used for various physical activities. Those in the treatment group were required to meet twice a week for the duration of the term. One session per week involved a researcher-led workout; for the other session, students completed their own training. The intervention group was divided by gender and met separately, on Tuesdays for girls and Thursdays for boys. Students in the control group were required by the school to attend the same health center and complete their own activity for two sessions of 90 min each week. Students in the control group were provided with access to weight training equipment, and cardiovascular equipment such as treadmills, ergometers, and stationary bikes. During the program, both control and intervention students were provided with exercise information cards with details of sample training sessions, abdominal exercises, warm-ups, and cool-downs. The training cards described sample workouts with examples of exercises, warm-ups, and cool-downs, along with suggested intensities. At the completion of the study, students in both groups were provided with an exercise training booklet.

Measures

All students in the study were asked to complete a questionnaire (Table 1) three times over the study period (in the first week of the program, in the final week of the 10-week program, and three months after the completion of the program). The study started in the second week of term and the baseline measurements were completed on the Monday or Tuesday of the first week of the study, before students started the intervention (study flow is illustrated in Figure 1). This enabled students to report their activity from a normal school week rather than the school holidays. All questionnaires were administered during roll call (registration). The questionnaire used in the study measured physical activity, along with a number of psychosocial factors. The physical activity behavior of the students was measured using the Oxford Physical Activity Questionnaire (OPAQ), which is a self-administered, seven-day questionnaire designed to assess the MVPA of adolescent school students. The psychometric properties of the OPAQ were evaluated among a sample of 94 students with mean ages of 12.2 (year 7) and 13.8 (year 9). The OPAQ displayed strong test-retest reliability (0.63–0.91) and moderate concurrent validity (0.45–0.63) through its relation to Caltrac movement counts.

It has been argued that the determinants of physical activity should be assessed along with the behavior itself (Baranowski, Anderson, & Carmack, 1998; Calfas, Sallis, Oldenburg, & Ffrench, 1997; Lewis, Marcus, Pate, & Dunn, 2002; Sallis et al., 1999) because these are thought to mediate the targeted behavior change (Van Sluijs, Van Poppel, Twisk, Brug, & Van Mechelen, 2005). As the current intervention was developed with reference to Bandura's social learning theories, the study was particularly interested in the mediating influences of exercise self-efficacy and peer support. Self-efficacy (Taylor et al., 2002) and peer support (Prochaska et al., 2002) were measured using existing scales, as were parent support for activity (Prochaska et al., 2002), body image (Hart, Leary, & Rejeski, 1989), and perceived benefits of physical activity (Taylor et al., 2002). Students were also

Table 1 Description of Variables Assessed in Intervention

Variables	Description	Range (No. of items)	Source	Psychometric properties
		Behavioral		
Physical activity	Oxford Physical Activity Questionnaire (OPAQ). Students report min spent in moderate to vigorous physical activity 20 min or longer in duration.	0 to unlimited (1)	Developed by researcher and validated against Caltrac monitoring.	1 week test-rest = 0.75 Concurrent validity = 0.59 (Caltrac)
Television watching	Number of hours watching television per day.	0 to 6+ (1)	Researcher developed.	N/A
Computer usage	Number of hours spent using a computer per day.	0 to 6+ (1)	Researcher developed.	N/A
		Social		
Family support	Questions regarding social support for physical activity participation offered by family.	5–25 (5)	Existing scale (Prochaska et al., 2002).	Test-retest $r = 0.88$ $\alpha = 0.68$
Peer support	Questions regarding social support for physical activity participation offered by friends.	5–20 (4)	Existing scale (Prochaska et al., 2002).	Test-retest $r = 0.86$ $\alpha = 0.73$

Psychological				
Perceived benefits of physical activity	Statements regarding the benefits of physical activity.	13–65 (13)	Existing scale (Taylor et al., 2002).	Test-retest $r = 0.65$ $\alpha = 0.83$
Perceived athletic competence	Students were asked to rate their athletic coordination compared to others of the same age and gender.	1–5 (1)	Existing scale (Taylor et al., 2002).	Test-retest $r = 0.80$
Personal physical activity rating	Students rated their own physical activity involvement compared to others of the same age and gender.	1–5 (1)	Existing item (Sallis et al., 1993).	Test-retest $r = 0.89$
Exercise self-efficacy	Rating of how sure subject is that he or she can exercise in certain adverse circumstances.	1–25 (5)	Existing scale (Taylor et al., 2002).	Test-retest $r = 0.89$ $\alpha = 0.75$
Body image	Students are asked to respond to a number of statements regarding how they would feel about their body in certain situations.	5–45 (9)	Social Physique Anxiety Scale (SPAS); (Hart et al., 1989).	Test-retest $r = 0.90$ (original 12-item scale) $\alpha = 0.89$

Note. α = Cronbach's alpha.

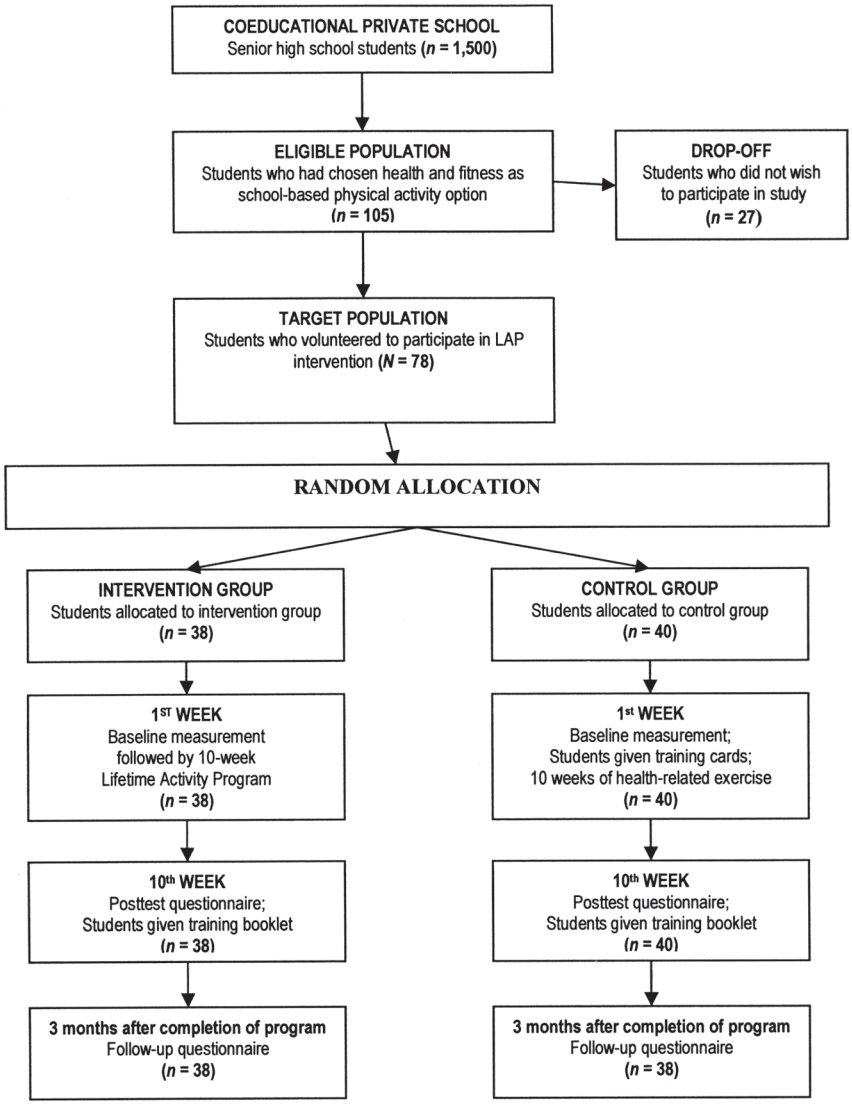

Figure 1 — LAP intervention design and sample flow.

asked to assess their own physical activity in comparison to others of their same age and gender (Sallis, Buono, Roby, Micale, & Nelson, 1993). Although there is limited evidence that parent support, body image, and perceived benefits of activity work as mediators, these variables were measured to identify whether students responded more positively on all psychosocial outcomes, even those not targeted by the intervention. Furthermore, the intervention did not include a family component (i.e., parents were not required to provide additional support for activity) and it was

hypothesized that this outcome would remain stable. It has been suggested that filter questions may help to overcome social desirability bias (Oppenheim, 1992). In this instance, these potentially redundant constructs were included in an attempt to identify this threat to validity.

Data Analysis

The data were analyzed using the SPSS software (version 12.0). Number of minutes spent in MVPA was calculated for each student along with totals for the various psychosocial scales. For the variables to be considered normally distributed, they were required to satisfy skewness and kurtosis criteria, whereby skewness/kurtosis divided by the standard error of skewness/kurtosis must be between –2 and +2 (National Institute of Standards and Technology & Sematech, 2005). Variables that did not satisfy this criterion were successfully transformed using the log or square root functions.

The control and intervention groups were compared at baseline using independent sample *t* tests. At posttest and follow-up, analysis of covariance (ANCOVA) was used to examine the effect of the intervention on the self-reported outcomes. All *t* tests and ANCOVAs used a two-tailed hypothesis with the α-levels set at $p < 0.05$. Marginally significant results were also reported ($0.05 \leq p \leq 0.10$). Separate ANCOVAs were calculated for each of the variables at posttest and follow-up. In each of these equations, the ANCOVAs controlled for the baseline measurement (covariate) of the posttest or follow-up variable. Following the calculation of ANCOVAs, partial η^2 was used to establish the effect size or proportion of total variability attributable to each variable.

Results

A total of 78 students participated in the study; this included 48 girls and 30 boys distributed approximately equally across treatment and control conditions (Table 2). The average age of the students was 16.7 years. The majority of students lived with both parents (77.2%) and had siblings (91.1%). Most students (83.3%) came from English-speaking households and like others in the school they were from predominantly high socioeconomic backgrounds. The students reported an average of 190 min of MVPA from the previous week and an average of 90 and 70 minutes per night of watching television and using a computer, respectively.

Independent samples *t* tests used to compare the intervention and control groups at baseline revealed no statistically significant differences between the two groups. The intervention effects after 10 weeks are reported in Table 3. At the end of the intervention, the time × condition interaction for minutes spent in MVPA was statistically significant ($F = 9.69$, $p = 0.001$) and is illustrated in Figure 2. The time × condition interaction for the support variables were marginally significant ($0.05 \leq p \leq 0.10$); family and peer support levels were higher in the intervention vs. the control group at postintervention. Students in the intervention group reported significantly better results for exercise self-efficacy ($F = 5.92$, $p = 0.02$) and personal physical activity ratings ($F = 8.16$, $p = 0.01$). There were no significant effects for perceived benefits of activity, perceived athletic competence, or body image between treatment groups ($p > 0.10$).

Table 2 Descriptive Statistics at Baseline

Variables	Total *N* = 78	Control *n* = 40	Intervention *n* = 38	*p*-value
		Mean (SD)		
Age (years)	16.7 (0.5)	16.80 (0.5)	16.74 (0.5)	0.54
Watching TV (min/day)	90.1 (0.8)	83.4 (0.8)	97.8 (0.9)	0.17
Using the Computer (min/day)	78.2 (0.7)	83.4 (0.8)	75.6 (0.6)	0.41
Moderate to Vigorous Physical Activity (min/week)	190.2 (125.2)	191.6 (132.7)	188.8 (123.6)	0.92
		N (%)		
Female	48 (61.5)	25 (61.0)	23 (60.5)	0.96
Living with Both Parents	61 (78.2)	32 (80.5)	29 (73.7)	0.51
Students with Siblings	71 (91.0)	36 (90.2)	35 (92.1)	0.75
English-Speaking Household	65 (83.3)	32 (80.5)	33 (86.8)	0.42

Note. The p-value was based on an independent samples *t* test using a two-sided hypothesis.

The statistically significant difference in MVPA found between control and intervention groups at the end of the treatment was not present at the three-month follow-up (intervention mean = 289 vs. control mean = 306, $p = 0.67$). Similar to the postintervention results, no statistically significant differences were found between groups for peer support or family support, although students in the intervention group (mean = 9.25) reported more peer support than those in the control group (mean = 8.14) at the 3-month follow-up. Exercise self-efficacy ($F = 4.26$, $p = 0.04$) and personal physical activity rating ($F = 15.96$, $p < 0.01$) were significantly better in the intervention group. The remaining psychological variables (body image, perceived benefits of physical activity, and perceived athletic competence) did not differ significantly between the two conditions.

Discussion

The primary objective of this study was to examine the effects of the Lifetime Activity Program on adolescent physical activity behavior. It also sought to determine whether the intervention impacted the potential determinants of activity. Although the effect size was small ($d = 0.12$, $p < 0.01$), at the end of the intervention period the treatment group reported spending 78 min more activity per week on average,

Table 3 Intervention Effects at Post-Intervention

Outcomes	Assessment	Intervention $n = 38$	Control $n = 40$	Time × condition	Effect size
		Mean (SD)		p-value	
Behavior					
MVPA (min/week)	Baseline	188.82 (123.6)	191.63 (132.7)	0.01	0.12
	Post	250.53 (113.4)	172.50 (123.3)		
Social					
Family support	Baseline	9.08 (3.4)	8.73 (3.9)	0.08	0.001
	Post	8.30 (4.1)	7.98 (4.2)		
Peer support	Baseline	7.45 (3.1)	6.71 (2.9)	0.06	0.05
	Post	8.89 (2.4)	7.38 (3.4)		
Psychological					
Benefits	Baseline	49.79 (6.6)	49.66 (5.8)	0.49	0.01
	Post	51.87 (6.0)	50.90 (7.1)		
Self–efficacy	Baseline	17.74 (3.0)	16.49 (4.0)	0.02	0.07
	Post	18.84 (2.7)	16.58 (4.1)		
Perceived athletic competence	Baseline	2.87 (1.1)	2.51 (1.0)	0.30	0.01
	Post	2.92 (0.9)	2.48 (1.3)		
Personal physical activity rating	Baseline	2.71 (1.0)	2.68 (1.1)	0.01	0.10
	Post	3.11 (0.8)	2.65 (1.1)		
Body image	Baseline	26.11 (7.8)	26.37 (8.2)	0.31	0.02
	Post	24.65 (7.9)	25.71 (7.7)		

Note. The analysis of covariance was used to compare the means between treatment and control conditions. Effect size was determined by partial η^2.

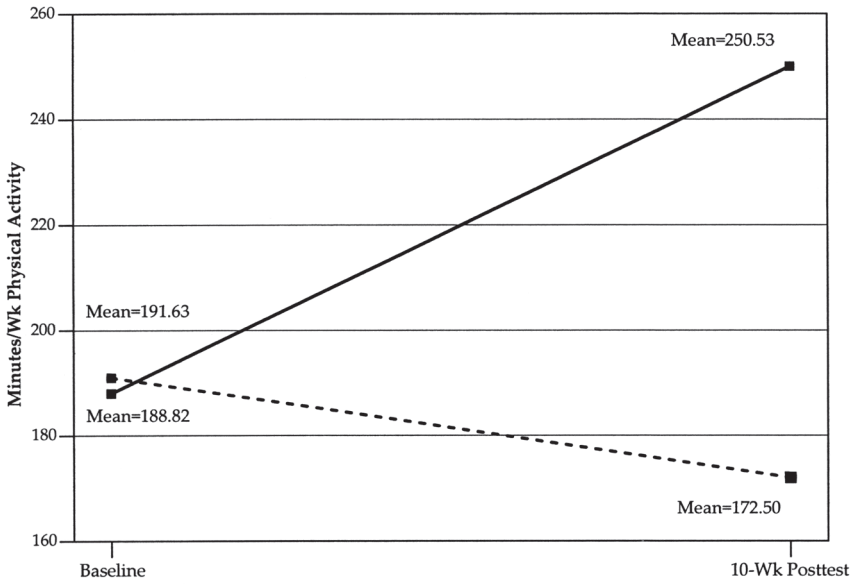

Figure 2 — Intervention effects at 10 weeks posttest ($p = 0.001$). Dashed line indicates control; solid line indicates treatment.

compared to the control group. In addition to short-term changes in MVPA, students in the intervention reported better exercise self-efficacy and personal physical activity rating compared to those in the control group. Although some interventions with adolescents and young adults have found statistically significant improvements in MVPA at postintervention (Epstein, Paluch, Gordy, & Dorn, 2000; Leslie, Fotheringham, Veitch, & Owen, 2000; Patrick et al., 2001; Schneider- Jamner et al., 2004; Simon et al., 2004), others have not (Cardinal, Jacques, & Levy, 2002; Fardy et al., 1996; Goldfine & Nahas, 1993; Saelens et al., 2002). Furthermore, recent reviews of physical activity interventions identified the failure of most studies to include follow-ups (Hillsdon, Foster, & Thorogood, 2005; Reilly & McDowell, 2003; Timperio, Salmon, & Ball, 2004) to determine whether behavior change was sustained. Those that have included longer-term follow-ups often find that group differences no longer exist (Calfas et al., 2000; Deforche, De Bourdeaudhuij, Tanghe, Hills, & De Bode, 2004). Project Active Teens (Dale & Corbin, 2000; Dale, Corbin, & Cuddihy, 1998) provides evidence for the long-term effectiveness of physical activity interventions in the senior school years. Unfortunately, the results from Project Active Teens should be treated with caution as the study involved a quasi-experimental design, with the comparison group consisting of students who had transferred to the school after the intervention had been implemented.

In the current study, the activity levels of the intervention group were sustained at the three-month follow-up. However, the control group, had also increased their physical activity levels and there was no longer a statistically significant difference

between the two groups. One possible explanation for this result is that the week in which the follow-up took place did not represent a normal school week, as the students had finished class and were preparing for exams. In addition, the final assessment took place in the summer, a time when students are often more active (Booth, Okely, Chey, Bauman, & Macaskill, 2002; Rifas-Shiman et al., 2001). Considering evidence from previous studies examining the seasonality of physical activity and the current intervention's findings, the authors suggest that the winter months are an ideal time for intervention with the adolescent age group.

It has been argued that interventions are most effective when they alter the underlying factors that influence physical activity behavior (Trost, Owen, Bauman, Sallis, & Brown, 2002). This appears promising as most studies that have evaluated the effects of interventions on potential mediators of behavior have found statistically significant changes (Dishman et al., 2005; Fardy et al., 1996; Goldfine & Nahas, 1993; Patrick et al., 2001; Saelens et al., 2002; Simon et al., 2004; Van Sluijs et al., 2005). However, not all interventions have initiated positive changes in determinants of behavior (Calfas et al., 1997; Neumark-Sztainer, Story, Hannon, Tharp et al., 2003; Schneider-Jamner, Spruijt-Metz, Bassin, & Cooper, 2004), and changes in behavior do not always accompany changes in self-reported variables. The current study found that only one potential mediator of MVPA (self-efficacy) was impacted by the intervention. Even though changes in personal physical activity rating were sustained after three months, this variable should only be considered as a behavioral self-report, not a potential mediator of behavior. There were no statistically significant differences between groups in any of the other psychosocial variables, despite the intervention's focus on peer support. However, marginally significant differences were found for peer support at postintervention and three-month follow-up. One possible explanation is that the intervention did not do enough to improve social support from peers or to change their perceptions about support from others.

Reilly & McDowell (2003), in their review of physical activity interventions, concluded there is a lack of simple, effective, and generalizable interventions. Because individuals making decisions about the adoption of evidence-based physical activity programs can rarely choose intense interventions delivered by highly trained personnel in controlled settings (Dzewaltowski, Estabrooks, & Glasgow, 2004), programs should be realistic and situation specific. School-based physical activity promotion programs should be suitable for the school environment and designed to be implemented by physical education (PE) teachers. These considerations influenced the design of the LAP, which included student workbooks and an easy-to-follow teacher manual. The results of this study provide evidence that physical activity interventions can be implemented in the final years of high school and that programs need not be intensive and time consuming to be effective on a short-term basis.

Considerations

Limitations of the study include a reliance on self-reported data, participant selection criteria that may limit external validity, and the possibility of treatment diffusion. Although the study may have benefited from the use of a physical measurement of MVPA (e.g., accelerometer, heart rate monitor, pedometer), these devices have

their own limitations. Despite suggestions that self-report methods are unsuitable for use with younger children (Kohl, Fulton, & Caspersen, 2000; Sallis & Owen, 1999), the students involved in the LAP study were older adolescents, who are capable of recalling physical activity behavior at a satisfactory level.

Because students involved in the LAP evaluation were aware of their treatment allocation, this was a potential threat to the validity of the findings. In an attempt to overcome respondent bias, the researcher provided the control group with exercise information through the use of exercise cards at the start of the study and training booklets at the completion of the intervention. Although a small degree of socially desirable reporting cannot be completely discounted, the intervention group did not report more favorably on all variables, only those that were targeted by the intervention (information the students were not aware of).

The sample used in the study was not a socioeconomic representation of British youth because only one independent (private) school in Oxfordshire was involved. Nevertheless, the type of students involved in the study are of particular interest to researchers as they were individuals who had chosen not to participate in traditional team sports. Adolescents uninterested in team sports at school may be at risk for dropping out of all types of activity when schools do not provide alternatives. It has been suggested that the decrease in time allocated to PE in recent years is a direct result of student and parent dissatisfaction with PE programs that continue to focus on team sports rather than lifetime activities (Corbin, 2002). Literature depicting the impact of such activities on student level outcomes is limited, particularly in the United Kingdom. Finally, the researchers cannot discount the possibility of some diffusion of treatment. The study was conducted at one school and students used the same fitness center. Leakage may have attributed to the lack of statistically significant differences at follow-up.

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