

Abstract

The purpose of this study was to evaluate the impact of an extra-curricular school sport program to promote physical activity among adolescents. Students ($N = 116$), mean age = $14.2 \pm .5$, were assigned to intervention ($n = 50$) or comparison groups ($n = 66$) for the study duration. The 8-week intervention involved structured exercise activities and information sessions. Four days of pedometer monitoring and time spent in non-organised physical activity and sedentary behaviours were measured at baseline and posttest. At baseline, participants were classified using steps/day as low-active (girls $< 11,000$, boys $< 13,000$) or active (girls $\geq 11,000$, boys $\geq 13,000$) and the effects of the intervention were assessed using these subgroups. Adolescents in the intervention group classified as low-active at baseline, significantly increased their step counts across the 8-week intervention (baseline mean steps/day = $7,716 \pm 1,751$, posttest mean steps = $10,301 \pm 4,410$, $p < .05$) and accumulated significantly more steps ($p < .05$) than those in the comparison group (baseline = $8,414 \pm 2,460$, posttest = $8,248 \pm 3,674$, $p = .879$). The findings from this study provide further evidence that physical activity monitoring using pedometers is an effective strategy for increasing activity among low-active adolescents.

Evaluation of an Extra-Curricular School Sport Program Promoting Lifestyle and Lifetime Activity for Adolescents

Regular participation in physical activity is associated with a myriad of positive outcomes for young people, including increased physical fitness and reduced risk for a number of lifestyle diseases (Hillsdon & Foster, 2003; Strong *et al.*, 2005). A physically active lifestyle during childhood and adolescence is also related to good mental health and may positively effect self-esteem and self concept (Ekeland, Heian, Hagen, Abbott, & Nordheim, 2004; Steptoe & Butler, 1996). Due to the benefits of an active lifestyle and concern regarding low levels of physical activity, the promotion of activity during childhood and adolescence has been identified as a global health priority (Pushka, Benaziza, & Porter, 2003).

Schools have been identified as key institutions for the promotion of physical activity among youth as they provide access to virtually all of the target population and have the existing infrastructure to facilitate physical activity (Department of Health, Physical Activity, & Health Improvement & Prevention, 2004; U.S. Department of Health & Human Services, 2000). Although there is empirical support for the effectiveness of school-based programs in promoting physical activity among youth (Cale & Harris, 2006; Kahn *et al.*, 2002; Stone, McKenzie, Welk, & Booth, 1998), two criticisms of previous interventions have been noted in the literature. First, the majority of school-based physical activity interventions have involved the evaluation of modified health-related physical education (PE) with limited long-term impact (Cale & Harris, 2006; Timperio, Salmon, & Ball, 2004). While the PE curriculum is commonly recognized as the major vehicle for the promotion of physical activity in schools (Biddle & Mutrie, 2001), physical activity recommendations for children and adolescents cannot be

met through PE alone (Sallis *et al.*, 1997; Simons-Morton, Taylor, Snider, Huang, & Fulton, 1994). Second, many interventions involve programs in addition to already timetabled PE, which may be difficult to sustain in schools due to an already crowded curriculum (Biddle, Gorely, & Stensel, 2004). As such, additional strategies for promoting physical activity in the school setting need to be more fully explored. Break periods, the physical environment of schools, active transportation and extra-curricular school sport have been identified as additional opportunities for the promotion of activity in schools (Wechsler, Devereaux, Davis, & Collins, 2000). For example, interventions have demonstrated that modifying the physical environment of the school can have a positive effect on the physical activity behaviour of students, in both primary (Stratton, 2000) and secondary school settings (Sallis *et al.*, 2003).

Despite their potential, the impact of extra-curricular school sport programs on physical activity levels have not been studied extensively (Pate *et al.*, 2006). Intramural and interscholastic extra-curricular school sport programs are offered by many schools outside of formal lessons (Daley, 2002) and are generally timetabled during school hours. Interscholastic programs usually involve team or individual competition between schools. Intramural programs can be competitive or non-competitive and consist of sports and recreational activities which involve students within one school. Intramural programs provide an ideal opportunity for the promotion of physical activity through the provision of lifetime activities because they are designed for students with a range of abilities (Wechsler *et al.*, 2000). Lifetime activities generally only involve one or two people and require little organization (e.g. swimming, tennis and gym-based activities). Individuals who develop a routine of participating in lifetime activities that can be easily carried

into adulthood are more likely to become active adults (Corbin, 2002). Gym-based activities (e.g. weight training, aerobics, circuit training etc.) are an important subset of lifetime activities because they are designed specifically to develop health-related fitness (HRF). Previous studies have shown that programs combining gym-based HRF activities with behavioural modification strategies can be effective in increasing the short-term (Lubans & Sylva, 2006; Schneider-Jamner, Spruijt-Metz, Bassin, & Cooper, 2004) and long term (Dale & Corbin, 2000) physical activity levels of adolescents.

Although it remains contentious whether physical activity or physical fitness is more important to health status (Blair, Cheng, & Holder, 2001; Boreham & Riddoch, 2001), activity of vigorous intensity (i.e. enough to increase physical fitness) is important for young people (Cavill, Biddle, & Sallis, 2001; Strong *et al.*, 2005). Vigorous intensity physical activity is necessary to develop components of HRF, particularly muscular strength and cardio-respiratory fitness (CRF) (Warburton, Nicol, & Bredin, 2007). A major challenge for health professionals and physical educators is to promote enjoyable vigorous activity, because research suggests that program adherence is often inversely associated with exercise program intensity (Dishman, 1988; Hillsdon & Thorogood, 1996). This finding, along with evidence supporting the benefits of moderate intensity physical activity (e.g. Boreham, Wallace, & Nevill, 2000), has contributed to the public health shift from physical activity to develop physical fitness, to the promotion of moderate intensity lifestyle activity (Dunn, Andersen, & Jakicic, 1998). Among adults, programs promoting walking and lifestyle activity report high levels of participant adherence (Hillsdon & Thorogood, 1996) and appear to hold considerable promise for sustainable behaviour change.

More recently, goal setting and activity monitoring using pedometers has been offered as a strategy for increasing lifestyle physical activity (Tudor-Locke & Corbin, 2002). Physical activity interventions incorporating pedometers as motivational tools have been evaluated among child (Pangrazi, Beighle, Vehige, & Vack, 2003), adolescent (Schofield, Mummery, & Schofield, 2005) and adult populations (Brown, Mummery, Eakin, & Schofield, 2006), and appear to have potential for physical activity behaviour change. For example, Schofield *et al.* (2005) found that a simple pedometer intervention focusing on daily step targets was an effective way of increasing short-term lifestyle physical activity among a sample of low-active adolescent girls. In a study involving primary school students (Butcher, Fairclough, Stratton, & Richardson, 2007), information sessions and step-count feedback using pedometers contributed to increases in school-based physical activity over a one-week intervention period.

Previous interventions with adolescents have focused on the promotion of lifestyle activity (e.g. Schofield *et al.*, 2005; Zizzi *et al.*, 2006) or the promotion of lifetime activities and the development of HRF components through enhanced physical education programs (e.g. Pate *et al.*, 2005; Schneider-Jamner *et al.*, 2004). To the authors' knowledge, this is the first study to incorporate a pedometer monitoring component to promote lifestyle activity into a HRF program for adolescents. The aim of this paper is to describe the impact of the *Learning to Enjoy Activity with Friends* (LEAF) program on physical activity (pedometer and self-report) and sedentary behaviour (i.e. TV watching, computer use and electronic games) in adolescents. Bandura's Social Cognitive Theory (SCT) (Bandura, 1986) was used as the theoretical framework for the program which was delivered as an extra-curricular school sport program.

Method

Participants

The study aimed to recruit four schools. To achieve this number, eight secondary schools in Newcastle, New South Wales (NSW), Australia were invited to participate. Due to timetable restrictions only three schools agreed to participate. At each school the program was offered as a school sport option to students in years 8 and 9. The study aimed to recruit 50 students from years 8 and 9 (14 and 15 year olds) from each school. Approval was obtained from school principals, the University of Newcastle and the NSW Department of Education and Training ethics committees. Following initial recruitment, information leaflets and parental consent forms were sent home with students. Students who returned signed consent forms were permitted to participate in the study. The program was made available as an extra-curricular, weekly school sport option for secondary school students ($N = 116$, mean age = $14.18 \pm .71$ y). The sample population represented a response rate of 77%.

Design and Procedure

The original study design required the recruitment of 60 participants per treatment arm (120 in total). This number was selected to provide at least 80% power to detect a difference between groups of .5 standard deviations of change in pedometer steps/day, assuming one-sided tests at a significance of 5%.

The LEAF study involved a quasi-experimental design. Two 8-week programs were offered to each school as extra-curricular school sport options (LEAF intervention & exercise only comparison group). The LEAF intervention consisted of three components; structured exercise activity, information component focusing on behavioural modification strategies and self monitoring using pedometers. The comparison group was only provided with the identical structured

exercise activities. Due to practical and ethical issues, randomizing students at the school or individual level is not always possible. To avoid treatment contamination, the allocation of condition occurred at the year level. At Schools 1 and 2, students in year 8 were allocated to the treatment group and students in year 9 acted as the comparison groups. At School 3, students in year 9 were assigned to the intervention group and year 8 students acted as the comparison group. The baseline assessment was administered in the second last week of term 3 (September, 2006) in each of the schools before the allocation of treatment. The intervention was evaluated over a 10-week term. The posttest was completed following the intervention, in the final week of term 4 (December, 2006). The intervention was delivered at the University of Newcastle health and fitness centre. The practical components for all students were delivered by trained instructors from the health and fitness centre. A training day was provided for instructors before the commencement of the program and the researchers met regularly with the instructors to ensure program fidelity. The information component for the intervention group was delivered by a member of the research team in a university classroom adjacent to the health and fitness centre.

Intervention

The LEAF program was designed for secondary school students to promote lifestyle (e.g. walking/riding to school) and lifetime (e.g. strength training, aerobics) physical activity. SCT (1986) provided the theoretical framework for the development of the program. The program components are presented in Table 1. SCT proposes that behaviour change is influenced by environmental factors, personal factors, and attributes of the behaviour itself. This interaction is referred to as ‘reciprocal determinism’ as each factor may affect, or be affected by the

others. The primary personal components of SCT addressed in the LEAF study were: practical skills (students were provided with exercise skill development such as weight training techniques), self-efficacy (students were taught goal setting techniques & self-management strategies) and outcome expectancy (the program involved the identification of physical activity benefits & strategies to make exercise more enjoyable). Outcome expectancy is the primary motivational variable in SCT and refers to an individual's desire to achieve positive outcomes and avoid negative consequences (Baranowski, Cullen, Nicklas, Thompson, & Baranowski, 2003). The program included strategies to make physical activity more enjoyable, such as exercising with friends and listening to music while being active. Key environmental components of SCT were also incorporated into the LEAF program and included modelling (students trained with partners, providing them with vicarious learning experiences) and social support (the program involved strategies to elicit support for physical activity from family & friends). The promotion of peer support for physical activity was included in the current study because research has identified a positive relationship between activity and peer support among adolescents (Sallis, Taylor, Dowda, Freedson, & Pate, 2002).

Students in the intervention group participated in an 8-week health-related fitness (HRF) program, with each session lasting approximately 70 minutes (15 minutes information component, 55 minutes participation in physical activity). The information component focused on health/fitness concepts and physical activity behaviour modification strategies (e.g. identifying barriers to physical activity). Additionally, students in the intervention group were provided with pedometers and training handbooks for the study period. The pedometers and handbooks provided the opportunity for physical activity monitoring and goal setting. Goal

setting and physical activity monitoring were the primary behaviour modification strategies espoused by the intervention and these were reinforced at the start of each weekly session. Individual barriers were discussed and specific strategies for increasing steps (e.g. taking a walking break at recess and lunch) were identified and promoted every week. The acceptance of pedometers as a feasible measure of physical activity has been accompanied by the use of step count thresholds for physical activity guidelines (Beighle & Pangrazi, 2006). The President's Council on Sports and Exercise (2002) has suggested 11,000 steps/day for girls and 13,000 steps/day for boys. These guidelines were discussed with students in the study who used their own baseline step counts to set physical activity goals for the study period and beyond.

Students in the comparison group participated in a modified 8-week HRF program designed by the research team. The structured exercise sessions were identical to the practical sessions for the intervention students and lasted a similar duration. Students in the comparison group were provided with training booklets which provided an outline of all sessions with suggested intensities and descriptions of techniques involved.

Instruments

Physical activity: Yamax SW701 pedometers were utilized in the LEAF study, as they are considered to be more reliable than other pedometer brands (Le Masurier, Lee, & Tudor-Locke, 2004). Eston, Rowlands and Ingledew (1998) found Yamax pedometers have high correlations with oxygen consumption ($r = .81$) and *Caltrac* accelerometer counts ($r = .99$). The accuracy of the pedometers was assessed by research assistants, using a brief walking test recommended by Tudor-Locke and Meyers (2001). From the total of 150 pedometers tested, no

pedometer was found to have an error exceeding 5%.

In addition to mean steps/day recorded by pedometers, participation in physical activity was measured using an abridged version of the *Adolescent Physical Activity Questionnaire* (APAQ) (Booth, Okely, Chey, & Bauman, 2002). The APAQ is a seven day self-report questionnaire and was used to measure time spent in physical activity in the recent *New South Wales Schools Physical Activity and Nutrition Study* (SPANS) (NSW Centre for Obesity & Overweight, 2006). The APAQ was found to have good reliability and acceptable convergent validity (Booth et al., 2002). The APAQ provides total minutes of moderate-to-vigorous physical activity (MVPA) for organised and non-organised physical activity. As the aim of the LEAF study was to increase incidental lifestyle and lifetime physical activity, only non-organised physical activity was included in this evaluation.

Sedentary behaviour: The study also sought to evaluate the impact of the intervention on sedentary behaviour. The sedentary behaviour measure focused on three components; hours per day spent watching television, using the computer (for non-school purposes) and playing electronic games (e.g. X-box, Nintendo). These items were adapted from the New South Wales SPANS study measures (NSW Centre for Obesity & Overweight, 2006).

Procedure

Students were asked to wear sealed pedometers for four consecutive school days (students were given the pedometers on Monday morning which were then collected on Friday morning). Previous research has established that four days of consecutive pedometer monitoring are necessary to provide a reliable measure of habitual physical activity among adolescents (Le Masurier *et al.*, 2005). At baseline assessment, students were provided with detailed instructions on how to wear the pedometers and

were asked to complete their usual activity and refrain from tampering with the devices. Students were instructed on how to attach the pedometers and asked to remove the pedometers only when sleeping or when entering water (e.g. showering, swimming). During the baseline assessment, students were instructed to leave their pedometer off for the day if they forgot to wear it in the morning. On the Friday morning, research assistants collected the pedometers, cut the cable ties and recorded the steps. Upon return of the pedometers, students were asked to record any days they had forgotten to wear their pedometers.

Data Analysis

The data were analyzed using the SPSS software (version 12.0). Total pedometer counts recorded by students were divided by the number of days worn to provide mean steps/day. Students who had completed at least two days of pedometer monitoring were included in the analysis. At baseline, 70% of students completed four days of monitoring, 13% completed three days and 12% completed two days, similar patterns were noted at posttest.

To determine the effect of the intervention on low-active adolescents, the data file was split based on baseline results. Existing pedometer guidelines (President's Council on Physical Fitness & Sports, 2002) were used to classify the participants as low active (girls < 11,000 steps/day, boys < 13,000 steps/day) or active (girls \geq 11,000 steps/day, boys \geq 13,000 steps/day) at baseline. Separate analyses were conducted for each group. Independent samples t-tests were used to examine the effect of the intervention on objectively measured physical activity and self-reported outcomes. Change scores (posttest scores minus baseline scores) were the dependent variables in these analyses. Within-treatment group change was assessed using paired t-tests. Following these calculations, intervention effect sizes were calculated for

mean change scores using Cohen's d and the pooled standard deviation of the group

$$(d = M_1 - M_2 / \sigma_{\text{pooled}}) .$$

Results

The study flow is displayed in Figure 1. The majority of students were born in Australia (95%) and spoke English at home (98%). At baseline, the average age of the students in the comparison ($14.1 \pm .7$ y) and intervention group ($14.3 \pm .7$ y) was similar. Fifty two percent of students in the intervention group and 66% of those in the comparison group were female. Of the students who completed all measures and at least two days of pedometer monitoring at baseline, 62 adolescents (29 intervention group versus 33 comparison group) were classified as low active (girls $< 11,000$, boys $< 13,000$). Thirty five adolescents (16 intervention group versus 19 comparison group) were classified as active at baseline (girls $\geq 11,000$, boys $\geq 13,000$).

The results for the low-active adolescents are displayed in Table 2. At baseline, there were no statistically significant differences between low-active adolescents in the intervention and comparison groups for mean steps/day and all self-reported variables. Mean steps/day for low-active adolescents in the intervention group was $7,716 \pm 1,751$ steps/day. Students in the comparison group recorded $8,414 \pm 2,460$ steps/day. At baseline, low-active adolescents in the intervention group reported 355 ± 256 mins/week in non-organised physical activity, 2.9 ± 1.4 hours/day watching TV, 1.9 ± 1.2 hours/day using the computer and $1.3 \pm .8$ hours/day playing electronic games. Those in the comparison group reported similar amounts of time in each activity.

At posttest, low-active adolescents in the intervention group increased their physical activity by $2,341 \pm 3,959$ steps/day (Figure 2). This was a significant

increase from their baseline measures ($p < .05$) and was significantly different to those in the comparison group ($p < .05$). Low-active adolescents in the intervention group decreased their time spent playing electronic games by $-.2 \pm .9$ hours/day. However, this result was not statistically significant ($p < .289$). There was a within group change for adolescents in the comparison group who decreased their time watching television from baseline to posttest ($p < .01$). There were no other within, or between group differences for any of the other variables assessed.

Results for adolescents classified as active at baseline are reported in Table 3. Mean steps/day for adolescents in the intervention and comparison groups at baseline, was $14,531 \pm 3,562$ and $13,519 \pm 1,837$ steps/day, respectively. Intervention and comparison groups reported similar amounts of time spent in non-organised physical activity and sedentary behaviour at baseline. Adolescents in both the intervention ($-1844 \pm 4,359$) and comparison groups ($-2184 \pm 2,618$) reduced their steps/day from baseline to posttest. However, this decrease was only significant for those in the comparison group ($p < .01$). There were no significant ($p < .10$) differences between the intervention and comparison groups for any of the variables assessed.

Considering that effect sizes can be interpreted as small ($d = .20$), medium ($d = .50$) or large ($d = .80$) (Cohen, 1988), the LEAF intervention was found to have a medium effect on mean steps/day ($d = .59$) among low-active adolescents. Additionally, the intervention had a small effect on time spent in non-organised activity ($d = .23$) and playing electronic games ($d = -.24$). Interestingly, the intervention was found to have a medium effect ($d = -.61$) on time spent using the computer, among adolescents identified as active at baseline.

Discussion

The primary objective of the LEAF intervention was to increase lifestyle

and lifetime physical activity among a sample of secondary school students. The intervention was found to have a significant effect on adolescents classified as low-active at baseline, but not on individuals classified as active. Low-active adolescents increased their mean steps/day from $7,716 \pm 1,751$ to $10,301 \pm 4410$, from baseline to posttest. Low-active adolescents in the intervention group also increased time in non-organised activity and decreased their time spent watching television and playing electronic games. However, these differences were not statistically significant.

Goal setting and activity monitoring using pedometers were the central behaviour modification strategies employed by the LEAF intervention. While the literature depicting the impact of goal setting for physical activity among youth populations is limited (Shilts, Horowitz, & Townsend, 2004), two previous studies found that goal setting with pedometers contributed to increases in lifestyle physical activity (Pangrazi *et al.*, 2003; Schofield *et al.*, 2005). Two additional studies found that brief interventions using pedometers were unsuccessful in changing the short-term physical activity behaviour of students (Butcher *et al.*, 2007; Zizzi *et al.*, 2006). It is not surprising that two of the four studies were unsuccessful in changing behaviour, as the first intervention was three weeks long (Zizzi *et al.*, 2006) and the second only lasted for one week (Butcher *et al.*, 2007). Similar to the current study, the *Girls Stepping Out Program* (GSOP) targeted low-active adolescents (Schofield *et al.*, 2005). Schofield and colleagues found that goal setting with pedometers was effective in increasing physical activity over a 12-week study period and concluded that pedometers were a useful tool for increasing activity among low-active adolescent girls.

Low-active intervention adolescents increased their physical activity by

over 2000 steps from baseline, representing a medium effect size, $ES = .59$.

Although estimating the relationship between steps counts and time is problematic, according to a recent study, this increase represents approximately 25 minutes of additional physical activity per day (Beighle & Pangrazi, 2006). Considering current physical activity recommendations (60 minutes of physical activity per day) (Cavill *et al.*, 2001), it can be concluded that the increases in physical activity attributable to the intervention are clinically significant. It is however, important to note that the posttest measurements were completed immediately following the completion of the intervention and evidence from previous interventions suggests that behaviour often regresses after long-term follow-up (Dzewaltowski, Estabrooks, & Glasgow, 2004).

While the intervention had a significant impact on physical activity among the low-active, physical activity decreased slightly among those classified as active at baseline. It is possible that the activity counts for all adolescents were slightly inflated at baseline, due to the novelty of wearing the devices, and by posttest, the more active adolescents had become bored of the pedometers. Results indicated that pedometers may be a more appropriate motivational tool for low-active individuals, than currently active ones. Despite increases among low-active adolescents in the intervention group, the majority of students in both intervention (60%) and comparison (72%) groups did not meet the U.S. step recommendations for youth (President's Council on Physical Fitness & Sports, 2002) at posttest. The guidelines used in the current study (President's Council on Physical Fitness & Sports, 2002) and more recent guidelines (Duncan, Schofield, & Duncan, 2006; Tudor-Locke *et al.*, 2004), suggest step targets should be as high as 16,000. However, the guidelines were developed among children who are known to be

more active than adolescents. Due to a number of factors (e.g. academic demands), existing step guidelines may not be appropriate for adolescent populations.

No student in either the intervention or comparison groups met the current Australian Government recommendations for small screen recreation (including TV, computer games & other electronic media) of less than two hours per day at posttest. While it is often assumed that physical activity and TV viewing share an inverse and causal relationship (Biddle, Gorely, Marshall, Murdey, & Cameron, 2004), sedentary behaviour is multifaceted and it is important that researchers identify and measure the numerous components. The LEAF study included strategies to decrease afternoon TV viewing, computer and game time, because previous interventions have found that targeting sedentary behaviour can be effective in treating childhood obesity (DeMattia, Lemont, & Meurer, 2006; Robinson, 1999). Unfortunately, the intervention was unable to impact upon these behaviours and it appears that a more intensive and targeted approach is needed.

While there are few studies that have incorporated a pedometer feedback component into a gym-based health-related fitness program for adolescents, previous studies have evaluated the impact of HRF programs and pedometer interventions to promote lifestyle activity separately. Researchers have evaluated the impact of health-related fitness programs incorporating lifetime activities and behaviour modification strategies with some success. *Project FAB*, modelled on the *Project GRAD* intervention (originally designed for college students) (Sallis *et al.*, 1999) was successful in increasing cardiovascular fitness and lifestyle physical activity among a small sample of adolescent girls (Schneider-Jamner *et al.*, 2004). Unlike the LEAF study, the intensive *Project FAB* intervention required students to meet five days per week for 60 minutes each day. Although the outcomes of

Project FAB are promising, the feasibility and sustainability of the intensive program in a secondary school is questionable. Lubans and Sylva evaluated a more succinct HRF program among a sample of senior school students in the United Kingdom (Lubans & Sylva, 2006). The *Lifetime Activity Program (LAP)* included content similar to that of *Project FAB*. However, fitness was not assessed, as students met only once a week. Following the program, students in the intervention group reported higher levels of physical activity and greater exercise self-efficacy. Limitations of both *Project FAB* and the *LAP* include the use of small sample sizes and the failure of the intervention to include components to promote lifestyle physical activity.

Similar to the LEAF intervention, the *New Moves* program (Neumark-Sztainer, Story, Hannan, & Rex, 2003) was a multi-component intervention that focused on increasing lifestyle and lifetime physical activity. Although the intervention was time intensive (students met four times a week for a 16 weeks), the study found few statistically significant differences between the intervention and control groups at follow-up. As in the current study, students in the intervention group reported a reduction in time spent in sedentary behaviours, however, these changes were not statistically significant.

Limitations of this study include the non-random allocation of individuals to treatment conditions, the exclusion of weekend monitoring and the lack of long-term follow-up. Students were not randomly allocated to control or intervention groups but were allocated by year group to minimize the possibility of treatment diffusion. This ensured that the groups were accurately matched and there were no significant differences between groups at baseline. An additional limitation of this study was the monitoring of week days only. Although studies have

established that four days of monitoring is enough to establish a representation of habitual physical activity, studies have identified differences in the step counts of individuals between week days and weekend days (Gavarry, Giacomoni, Bernard, Seymat, & Falgairette, 2003; Hands, Parker, Glasson, Brinkman, & Read, 2004; Rowe, Mahar, Raedeke, & Lore, 2004; Trost *et al.*, 2002). However, the monitoring of weekend physical activity is problematic and researchers often resort to relying on student reports of steps taken (Rowe *et al.*, 2004). The lack of a medium-term follow-up is another limitation of the current study. Although many interventions demonstrate a significant effect at posttest, substantial relapses in behaviour are generally observed when the intervention ends and the external support is withdrawn (Dzewaltowski *et al.*, 2004).

Conclusions

This study provides evidence that interventions targeted at low-active adolescents should focus on the promotion of lifetime and lifestyle physical activity using behavioural modifications strategies such as goal setting and activity monitoring. Extra-curricular school sport provides an ideal opportunity for the delivery of these programs, because students have greater choice and activities can be provided off-campus. Due to the competition for curriculum time in the school setting, it is important that researchers develop and evaluate feasible and sustainable programs that may be implemented in the school setting. While extra-curricular school sport has been identified as a valuable opportunity for the promotion of physical activity among adolescents, few programs have evaluated its impact on the behaviour of adolescents (Pate *et al.*, 2006). This study has provided evidence that extra-curricular school sport holds potential for the promotion of physical activity among adolescents.

Secondary school students should be provided with opportunities to engage in lifetime activities that reflect the physical activity choices and opportunities available to individuals once they leave school. These activities should be accompanied with appropriate behavioural modification strategies so that students are provided with the knowledge and skills that may assist in reducing the decline in activity associated with adolescence. Future research should focus on the design and evaluation of innovative extra-curricular school sport interventions that incorporate inclusive, engaging and theoretically driven approaches to the promotion of physical activity for all adolescents regardless of athletic ability.

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Table 1: LEAF Program Components

<i>Session</i>	<i>Information component</i>	<i>Practical component</i>
1	Introduction to program Physical activity guidelines for adolescents LEAF strategy: Setting goals for physical activity	Circuit training class
2	Exercise myths LEAF strategy: Being active with friends	Body Combat fitness class
3	Physical activity intensity and heart rate (HR) Frequency, intensity, time, type (FITT) for cardio-respiratory fitness (CRF) LEAF strategy: Keeping a physical activity diary	Cardio-respiratory fitness (CRF) session (rower, stepper, cross-country skier, treadmill & bike)
4	Incorporating lifestyle activity into daily lives LEAF strategy: Physical activity contract	CRF session - gym-based triathlon (row, run, cycle) & core stability
5	FITT for flexibility LEAF strategy: Ways to make physical activity fun	Spinning cycle session & flexibility session
6	Introduction to strength training techniques FITT for strength training LEAF strategy: Identifying barriers to physical activity	Strength training- introduction to machine weights & abdominal exercises
7	Strength training (continued) LEAF strategy: Encouragement and rewards	Strength training- introduction to basic free weights exercises
8	Reducing sedentary behaviour Conclusion of program Review of LEAF strategies	Cardio-resistance training- combination of machine weights & CRF exercises

Table 2: Baseline, Posttest, and Change Scores for Low-Active Adolescents by Treatment Group

<i>Variable</i>	<i>Intervention Group</i>				<i>Comparison Group</i>				<i>Between-group</i>	<i>Effect size</i>
	<i>Baseline</i>	<i>Posttest</i>	<i>Change scores</i>	<i>p value</i> ¹	<i>Baseline</i>	<i>Posttest</i>	<i>Change scores</i>	<i>p value</i> ¹	<i>p value</i> ²	<i>Cohen's d</i>
Mean steps/day	7,716 (1,751)	10,301 (4,410)	2,341 (3,959)	<.05	8,414 (2,460)	8,248 (3,674)	-113 (4,036)	.879	<.05	.59
Non-organised MVPA mins/week	355 (256)	377 (294)	30 (327)	.681	365 (433)	320 (325)	-65 (461)	.439	.764	.23
TV hours/day	2.9 (1.4)	2.2 (1.2)	-.3 (1.4)	.285	2.9 (1.1)	2.5 (.9)	-.4 (.8)	<.01	.748	.09
Computer hours/day	1.9 (1.2)	2.0 (1.3)	.0 (1.0)	.833	2.2 (1.2)	2.1 (1.3)	.0 (1.1)	1.000	.875	.00
Electronic games hours/day	1.3 (.8)	1.1 (.2)	-.2 (.9)	.261	1.4 (.8)	1.4 (.8)	.0 (.8)	1.000	.327	-.24

Note. Data file was split based on baseline results, adolescent girls were classified as low active if mean steps/day girls < 11,000 and adolescent boys were classified as low active if mean steps/day < 13,000.

MVPA = Self-reported moderate to vigorous physical activity.

Means reported (standard deviations).

¹ *p* values are given for paired *t*-tests within group change.

² *p* values are given for independent samples *t*-tests for difference of change between treatment groups for each variable.

Table 3: Baseline, Posttest, and Change in Physical Activity and Sedentary Outcomes in Active Adolescents by Treatment Group

<i>Variable</i>	<i>Intervention Group</i>				<i>Comparison Group</i>				<i>Between-group</i>	<i>Effect size</i>
	<i>Baseline</i>	<i>Posttest</i>	<i>Change scores</i>	<i>p value</i> ¹	<i>Baseline</i>	<i>Posttest</i>	<i>Change scores</i>	<i>p value</i> ¹	<i>p value</i> ²	<i>Cohen's d</i>
Mean steps/day	14,531 (3,562)	12,688 (2,743)	-1,844 (4,359)	.111	13,519 (1,837)	11,315 (3,383)	-2,184 (2,618)	<.01	.786	.10
Non-organised MVPA mins/week	459 (656)	446 (656)	-28 (657)	.878	304 (302)	261 (209)	-42 (333)	.587	.933	.03
TV hours/day	2.0 (1.1)	1.9 (.9)	-.1 (.9)	.753	2.3 (1.1)	2.3 (1.3)	.0 (1.0)	1.000	.823	-.11
Computer hours/day	1.5 (.8)	1.4 (.6)	-.3 (.9)	.264	1.5 (1.0)	1.8 (1.0)	.3 (1.0)	.262	.011	-.61
Electronic games hours/day	1.1 (.5)	1.1 (.5)	.0 (.8)	1.000	1.1 (.2)	1.1 (.5)	.1 (.5)	.667	.825	-.15

Note. Data file was split based on baseline results, adolescent girls were classified as active if mean steps/day $\geq 11,000$ and adolescent boys were classified as active if mean steps/day $\geq 13,000$.

MVPA = Self-reported moderate to vigorous physical activity.

Means reported and standard deviations in brackets.

¹ *p* values are given for paired *t*-tests within group change.

² p values are given for independent samples t -tests for difference of change between treatment groups for each variable.

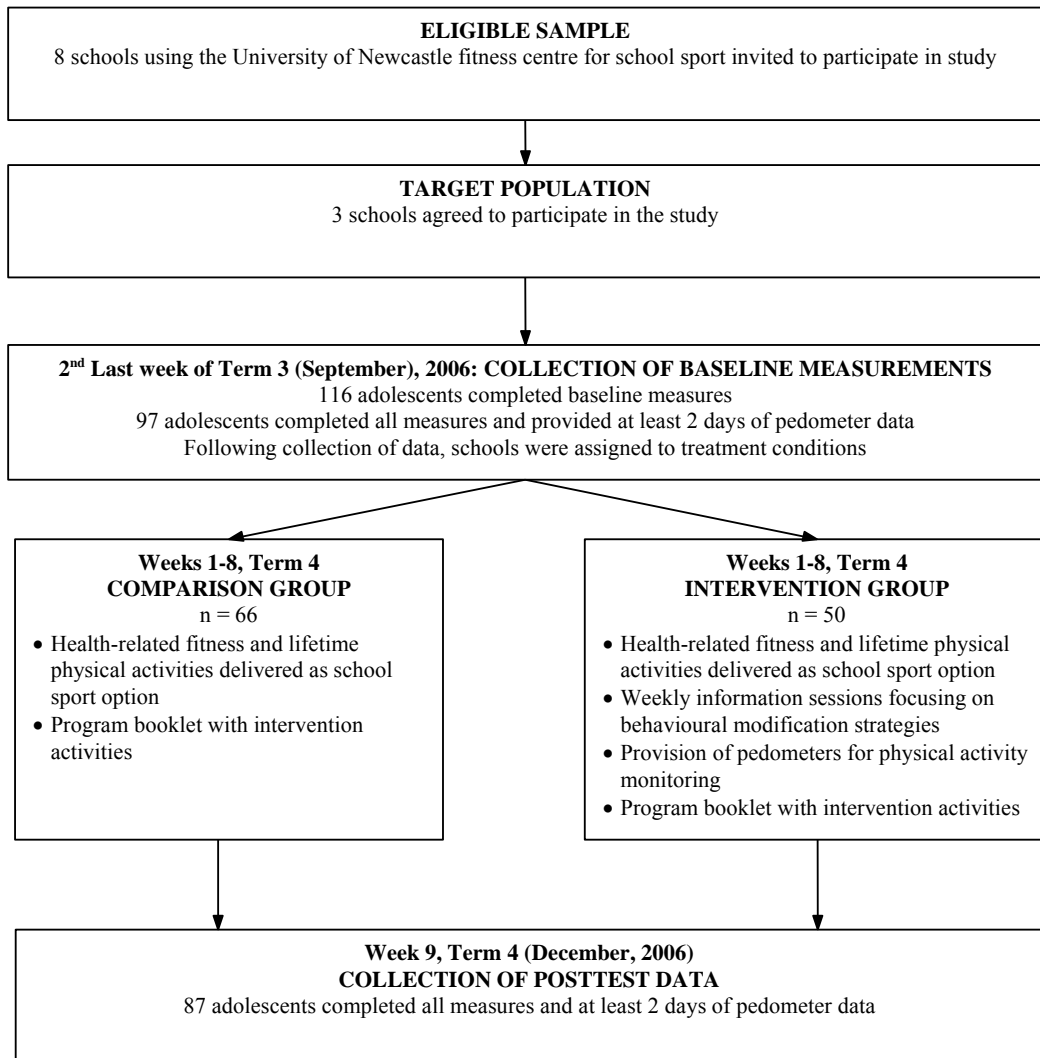
Figure 1: Participant Study Flow Diagram

Figure 2: Mean Steps/day for Low-active Adolescents by Treatment Group