Building solutions for preventing childhood obesity

Module 6

Interventions to increase physical activity in adolescents
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Prepared on behalf of the Prevention Research Centres:
NSW Centre for Overweight and Obesity
NSW Centre for Physical Activity & Health
NSW Centre for Public Health Nutrition

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This is one of a set of modules in the series Building solutions for preventing childhood obesity. Other modules are:

- Overview module
- Module 1: Interventions to promote consumption of water and reduce consumption of sugary drinks
- Module 2: Interventions to increase consumption of fruit and vegetables in children
- Module 3: Interventions to reduce consumption of energy-dense, nutrient-poor foods
- Module 4: Interventions to promote eating breakfast
- Module 5: Interventions to increase physical activity in children 5 - 12 years
- Module 7: Interventions to reduce sedentary behaviours

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1 Overview of Background and Methodology

This research report is one of a series presenting a synthesis of the recent evidence on the effectiveness of interventions to prevent weight gain and promote healthy weight among children and adolescents. This series of reports is designed to update the proposed approaches for children and families presented by the Centre for Public Health Nutrition report, ‘Best options for promoting healthy weight’.1

The “Building solutions for preventing child obesity” report has been presented as a series of modules to reflect clusters in the evidence base, allow clear comparisons between similar interventions, and highlight promising approaches as well as gaps in the evidence. The methods used in preparing the report are also described in the ‘Overview Module’. The specific methods used in preparing this module on interventions to increase physical activity in adolescents are outlined below.

1.1 Search strategy

Studies and interventions promoting physical activity among adolescents published between January 2003 and April 2007 in peer-reviewed journals were identified by searching the Medline, PubMed and Cinahl databases and by consulting a recent systematic review2. To identify additional intervention evidence for this module, databases were searched using the following search strategy:

Search terms:

(Physical activity OR exercise OR inactivity) AND (child OR children OR adolescent OR adolescent behaviour OR adolescent psychology) AND (intervention OR intervention studies OR research design).

Inclusion criteria:
- Studies which had participation in physical activity as an outcome measure with or without a weight-related outcome measure.
- Studies with population-level focus.
- Studies with individual-based approaches.
- Studies with randomised controlled trial or quasi-experimental designs.
- Post-only designs or studies with no controls were considered on a case-by-case basis.

Exclusion criteria:
- Studies with less than sixteen participants.
- Studies focused on the treatment or management of overweight/obesity.
- Studies based in a hospital setting.
- Studies which included groups with special needs (e.g., physically disabled) or specific health conditions (e.g., diabetes).
2 Problem analysis and rationale for intervention

Engaging in regular physical activity confers numerous physical, social and psychological health benefits for children and adolescents\(^5\). Being physically active plays a role in achieving and maintaining a healthy weight and maximising bone strength\(^4\). Physical activity also improves blood pressure, cholesterol and insulin sensitivity all of which are risk factors for developing coronary heart disease and type 2 diabetes in adults. In addition, evidence suggests that children and adolescents who are active are less likely to become depressed or anxious and physical activity provides opportunities to connect socially with peers and develop important social skills\(^5\). Current recommendations are that children and adolescents between 5 and 18 years of age participate in at least 60-minutes of moderate-to-vigorous activity daily, and engage in no more than 2-hours of electronic media entertainment\(^7\).

It has been suggested that, like adults, adolescents are less physically active than in the past\(^5\). There is concern that adolescents are adopting a less physically active lifestyle and their leisure time pursuits have become more sedentary in nature\(^5\). In fact, relatively little is known about the prevalence of physical activity in children and adolescents\(^5\). In New South Wales, the most recent data on physical activity patterns of adolescents was collected as part of the NSW Schools Physical Activity and Nutrition Survey (SPANS), which describes the self-reported physical activity levels among children and adolescents in school years 6, 8 and 10\(^6\). Encouragingly, SPANS showed self-reported moderate-to-vigorous activity had increased by 15-25% between 1985 and 2004. The survey found that, in 2004, 80-90% of students achieved the recommended 60-minutes or more moderate-to-vigorous physical activity each day during the summer months, with the exception of girls in Year 10 where only 60% met this recommendation. During the winter months, the activity levels of boys remained the same, but girls reported being less active. In addition, SPANS reported that overall: girls were less active than boys; older students less active than younger students; those living in cities less active than those living in rural areas; girls from lower socioeconomic background were less active; and adolescents from Middle Eastern backgrounds were less active.

Travel to and from school was also measured by SPANS\(^6\). In 2004, approximately 20% of secondary school students reported walking to school, 50% used public transport and 20% travelled by car.

Fundamental movement skills provide the foundation for lifelong participation in structured and unstructured activity. The process by which children and adolescents develop fundamental movement skills is sequential, beginning in childhood and carrying on through to adolescence. This process will be influenced by a range of environmental and social factors. Additionally children as well as adolescents need to be taught and given opportunities to practise these skills\(^6\). Interventions that aim to develop and improve fundamental movement skills may have promise as a strategy to increase physical activity levels with age\(^6\). SPANS found that, across all grades, proficiency in fundamental movement skills was greater in 2004 than in 1997\(^6\). Boys were found to be more proficient in running, kicking and throwing while girls were more proficient in the vertical jump, side gallop and leap. Proficiency also increased with socioeconomic status, particularly in girls.

There are a number of barriers to participation in physical activity including lack of knowledge of the benefits of being active, lack of time and motivation to be active, social norms and pressures during adolescence, lack of adult support to be active, parental concerns about safety or injury, lack of facilities or places to be active and a lack of confidence to be active\(^8-12\). It is therefore important that physical activity programs address barriers to adolescents engaging in activity. Overall SPANS found that participation in physical activity had increased between 1997 and 2004, as had proficiency in the core fundamental movement skills. However, there remains room for continued improvement in physical activity participation and proficiency in fundamental movement skills of adolescent boys and girls\(^6\).
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3 Available intervention evidence

In total 23 studies to increase physical activity participation in adolescents have been identified and reviewed as part of this module. These studies, which are summarised in tables 1-5, have been categorised in the following manner.

- Brief counselling with tailored feedback, advice and follow-up.
- Creating physical environments and developing policy within schools to increase opportunities to be physically active.
- Adapting the structure, planning and delivery of physical education classes to maximise opportunities for physical activity.
- Developing adolescents’ skills to be physically active.
- Pedometer interventions providing feedback and encouraging goal setting.

3.1 Brief counselling with tailored feedback, advice and follow-up

3.1.1 Office-based physician advice on exercise

This 12-month Spanish randomised controlled trial examined the effects of physician provided advice on physical activity levels of 448 adolescents and young adults between 12 to 21 years of age in a primary care setting. At baseline, all participants completed a short questionnaire on their school related and recreational physical activity levels. The results were used to classify participants as physically active (more than 30-minutes each day or 3 sessions a week of moderate to vigorous intensity sport/exercise); partially active (less than 3 sessions of sport or exercise a week or less than 30-minutes / each day session or mild intensity activity); or inactive (no reported exercise or sport). The intervention group received a 10-minute physician led counselling session based on the ‘ask, assess and advise’ model tailored to their physical activity classification (reinforce, increase or initiate activity). The same procedure was followed at 6 and 12-months follow-up visits. Participants in the control group were not given counselling. The physicians involved in this study did not receive training but were provided with written guidelines on how to provide the stage-based counselling.

Changes in physical activity classification, duration, frequency and intensity from baseline to 6-months and 12-months were recorded. The proportion classified as active was significantly higher in the intervention group than the control at 6-months (43.1% versus 33.7%) and 12-months (49.8% versus 34.9%). Changes in physical activity duration, frequency and intensity were greater in the intervention group than those in the control group and greater differences were found at 12-months than at 6-months to baseline.

Appraisal

While the results of this primary health care program were positive, the study limitations should be noted. Physical activity was measured as exercise or sport during school or leisure time and it is not clear whether this includes for example, physical activity for transport or leisure time walking etc. Participants were considered active if they reported “exercising or practising sport outside of or at school 3 or more days a week, for 30-minutes or more per day, and at a moderate to vigorous intensity”. The authors referred to activity recommendations but there appeared to be an incorrect application of the recommended levels. Also, there was a possible bias in the physician assessed activity levels because blinding was not possible. Should this approach be implemented in NSW it would be advisable to measure total activity and use Australian physical activity recommendations for young people as the standard by which to judge achievement of activity levels.
3.1.2 Patient-centered Assessment and Counselling for Exercise + Nutrition intervention (PACE+)\(^14\)

This randomised controlled trial investigated the effects of counselling, delivered through primary health care, on promoting the adoption and maintenance of improved diet and physical activity behaviours in 878 adolescents aged 11-15 years from the United States. The adolescents were recruited from 45 primary care providers across 6 clinic sites. The intervention in this 12-month study was based on the Behavioural Determinants Model, Social Cognitive Theory and the Transtheoretical Model of behavioural change. Adolescents in the intervention group completed an initial computer assisted assessment of their physical activity behaviours. They were then guided through the process of developing a plan to set physical activity behaviour goals. This was followed by a brief counselling session (3-5 minutes) with their physician, in which these plans were endorsed or modified and adolescents received encouragement to achieve their goal. The physician provided counselling was supplemented with a printed take home manual and monthly mail contact and telephone counselling throughout the duration of the study. The take home guide provided information and rationale for specific behaviours and the telephone and mail contact was stage-based. An additional parent manual was provided at the physician visit to help parents encourage and support behaviour change and model appropriate behaviours. Physicians taking part in this study received training. The control group received a sun protection behaviour program using a similar process.

At the end of the 12-months there were no differences in average weekly minutes of moderate-to-vigorous activity between the intervention and control groups, measured by self-report or accelerometry. However, boys in the intervention group increased the number days each week they were active compared to boys in the control group, but this increase was small. Hours of television viewing reduced by about 1-hour each day in boys and girls in the intervention group, while remaining constant in the control group. Regardless of whether they received a high or low dose of counseling phone calls, boys in the intervention group had a greater likelihood of meeting physical activity recommendations.

Appraisal

The effects of this intervention on moderate-to-vigorous physical activity were small and greater in boys than in girls. The combination of computer, health care provider counselling, mail-out and telephone follow-up may be more effective among adolescent boys than girls. Despite the limited effect on physical activity, this intervention did produce encouraging results for sedentary behaviours (refer to module of sedentary behaviours). There was no follow-up beyond the 12-month intervention period so the longer-term maintenance of intervention effects is not known.

3.1.3 Patient Centred Assessment and Counselling for Exercise Plus Nutrition\(^15\)

This 3-month school-based randomised controlled trial investigated the effects of a modified version of the Patient Centred Assessment and Counselling for Exercise Plus Nutrition (PACE+) similar to the study above. The aim of this study was to evaluate the efficacy of targeting physical activity as a single behaviour compared to a multi-behavioral intervention targeting both physical activity and nutrition. One hundred and thirty eight students from grades 6 to 8 who attended one middle school in the United States were randomly allocated within classrooms to 1 of 3 groups: physical activity and nutrition (multi-behavioural); physical activity only (single behaviour); or control. As part of the modified PACE+ study students in both the multi-behavioural and single behaviour groups received a once only, brief intervention of up to 30-minutes duration that included tailored advice and developing individual plans for behaviour change. After 3-months greater effects on physical activity were measured in boys than girls. After 3-months daily physical activity of boys had increased by an average of 2-minutes in the multi-behavioural group and 9-minutes in the single behaviour group, while it decreased by 33-minutes in the control group. After 3-months, daily physical activity had decreased in girls across each of the intervention groups as well as the control group. The program was well received by adolescents with 70% intending to follow their behavioural plans, 77% indicating they liked the program and 82% indicating they would recommend it to others.
Appraisal

This school-based intervention was found to be more effective in boys than in girls and in fact girls physical activity had decreased across all groups. Once-only brief counselling, tailored feedback and developing individual plans may be an effective approach to promoting physical activity in adolescent boys. One of the positive aspects of this program was that it was well-received by participants, with 70% indicating an intention to follow their PACE+ plans. The majority of the participants (77%) liked the program and further 82% would recommend it to others. A potential disadvantage of the program may be its length, as almost half (44%) of the multi-behavioural group rated it as too long. In contrast only 26% of the single-behaviour group felt that the program was too long.

3.1.4 Girls on the Move

Girls on the Move was a 12-week quasi-experimental randomised study designed to determine the feasibility of a computer-based program combined with nurse counselling in increasing activity levels in an inactive population. Seventy-seven inactive girls in grades 6 to 8 from 2 middle schools in the USA, who were in the contemplation or preparation stage of change, were enrolled in this study. Girls in one school received the intervention strategy and girls in the other school received the control strategy. The intervention was delivered through each school’s wellness centre. At baseline girls completed a computer assisted questionnaire on physical activity behaviours, influences, barriers and benefits. They were then asked to complete the questionnaire again after a 3-weeks and after 9-weeks. After each assessment girls in the intervention received individual 10-minute counselling sessions with the school nurse to develop physical activity goals. Girls in the intervention received computer-based tailored feedback messages and counselling 3 times during the 12-weeks and were contacted by telephone 3 times to assess progress towards meeting physical activity goals. The purpose of this feedback was to facilitate setting and monitoring of personal physical activity goals. Parents of girls in the intervention group received a sheet of tips to assist them in supporting their daughter to become more physically active. Girls in the control group received a pamphlet on age-specific physical activity guidelines. Staff from each school’s wellness centre who were involved in delivering aspects of the intervention received training prior to the commencement of the study.

After 12-weeks both groups reported participating in activity at least 1 more day each week compared to baseline and increased the time they spent engaging in moderate-to-vigorous activity. The differences were not significant. The intervention group reported significantly more social support for physical activity over time. The program was well received by the girls with 95% indicating they would both use the program again and recommend it to their friends and 63% reporting that the time spent with the school nurse was useful.

Appraisal

At the end of this study no differences were measured in moderate-to-vigorous activity between the intervention and control groups but this may have been influenced by the study design as the control was really an alternate physical activity intervention. The intervention had a small sample size, short implementation time frame and no long-term follow-up. The authors hypothesised that social desirability for physical activity in adolescent girls may have led to an over-estimation of moderate-to-vigorous activity and this too may have influenced the study results. This intervention may not translate to NSW as it relies on the provision of counselling from a school nurse. In the absence of a school nurse, counselling would need to be provided by either a health professional or a teacher employed by the school, which may be neither feasible nor sustainable. This approach may be suited to longer-term implementation in the community or primary health care settings.

3.1.5 School-based sports consultations

In this 5-week randomised study, a program to promote physical activity and prevent alcohol abuse among adolescents was investigated with 454 students in the 8th grade from 3 schools in the USA. Students were randomly allocated to receive one of: a 10-minute individual sports consultation (152 adolescents); a sports consultation plus an alcohol consultation (150 adolescents); or a sports and alcohol consultation plus parent materials (152 adolescents). There was no non-intervention control group. The sports consultation component consisted of a health and fitness screen, followed by tailored prevention messages (including alcohol and
protective factors) from the school nurse. These messages promoted a healthy lifestyle and resulted in the development of a student contract. Parents of students allocated to the parental support group received a postcard each week promoting a healthy lifestyle. At the conclusion of the intervention, self-report moderate and vigorous physical activity in all groups had increased significantly.

3.1.6 Project SPORT

A similar approach to the one outlined above was adopted in Project SPORT, a randomised controlled trial conducted with 604 students in 9th and 11th grades from one high-school in the United States. Students exposed to the intervention completed a health behaviour screen, received a face-to-face consultation with a school nurse, received a take-home fitness prescription that targeted protective and risk behaviours and had information on the consultation mailed home as a means of reinforcing the health messages delivered. The control group received a wellness brochure at school and general adolescent health promotion material was also sent home. After 3-months, when compared to the control group, students exposed to Project SPORT participated in significantly more moderate physical activity while after 12-months no difference was detected between the intervention and control.

Appraisal

Both of these studies were similar sports based interventions that aimed to reduce alcohol use and promote physical activity in high-school students. Both Werch et al which targeted students in the 8th grade and Werch et al in which participants were in the 9th and 11th grades found that participation in activity increased with time. Therefore this approach might be effective across a number of age groups. In Project SPORT the intervention was compared to a control group and the effect was maintained one year post intervention, demonstrating the potential sustainability of its effects over time. However, implementing this program within NSW may be neither feasible nor sustainable given the difference in education systems.

3.2 Creating physical environments and developing policy within schools to increase opportunities to be physically active

3.2.1 Using the Health Promoting Schools framework

The Health Promoting Schools framework was applied in this 3-year NSW study. The aim of using this approach was to create environments and policies which would facilitate and encourage increased physical activity in girls who were predominantly from a non-English speaking background. Within one high-school, 111 girls in Year 7 (all students) were allocated to the intervention group and 127 Year 10 students were used as controls. A comprehensive needs assessment was conducted to identify barriers to activity and strategies to increase girls’ participation in activity. The results of this needs assessment informed the strategies implemented as part of the study. These strategies focused on curriculum, the physical, social and organisational environments of the school, as well as partnerships with parents and outside agencies. The effects of this intervention were seen mainly in girls who were inadequately active at baseline. After 3-years, the proportion of inadequately active girls in the intervention group (21%) was significantly lower than the historical control group (40%). Girls in the intervention group participated in significantly more moderate physical activity than the historical control group.

Appraisal

One of the major limitations of this study was that it used a historical control group and this prevented monitoring of the external and contextual factors which may have influenced the outcomes in this group of girls. However, the health promoting schools approach reflected good practice and was somewhat effective in increasing activity of girls during school hours particularly those classified as inactive at baseline. The model is applicable across NSW, as Health Promoting Schools activities have been conducted for some time. Unfortunately the intervention was studied in only 1 school and therefore it unclear whether this approach would be successful in a wide cross-section of schools with varied student populations. Nonetheless, the approach reflects good practice, is flexible and potentially sustainable and warrants further, more rigorous research.
3.2.2 Lifestyle Education for Activity Program (LEAP)²⁰

The Lifestyle Education for Activity Program (LEAP), based on the social ecological model, targets teaching practices and school environments to increase support for adolescent girls to participate in physical activity. A 12-month clustered randomised controlled trial studied effects of this program in 2744 girls in the 8th grade attending 24 schools in the USA. Schools were paired according to location, class structure and cultural demographics before being randomised to either the intervention (1523 girls across 12 schools) or control condition (1221 girls across 12 different schools). The program comprised 6 components: physical education; health education; school health services; staff health promotion; and family/community involvement. Intervention activities which focused on teaching practices included incorporating girl-friendly, choice based instruction to increase enjoyment of activity, improve self-efficacy to be active and achieve participation in moderate activity for at least 50% of class time. Environmental strategies included staff role modelling positive activity behaviours, promotion of activity by the school nurse, and family and community-based activities. Within each school intervention, activities were coordinated by a working group of school staff, convened specifically for this program and supported by research staff. After 12-months participation, in vigorous activity was significantly greater in the intervention group (44.5%) than in the control group (36.4%). Participation in moderate-to-vigorous physical activity was found to be relatively high in both the intervention group (72.3%) and control group (70.3%) after 12-months.

**Appraisal**

This intervention applied a whole of school approach to address the specific physical activity needs of girls by influencing teaching practices, addressing school environments and involving parents. While the effects of LEAP on physical activity were modest, at follow-up the levels of participation in vigorous physical activity were significantly higher in girls attending intervention schools. Additionally well over 50% of the intervention and control groups reported participating in at least 60-minutes of activity each day. In both groups, physical activity participation was quite high at baseline and it would be interesting to investigate the effects of this program on less active or inactive girls. The intervention also reflected good practice with detailed process evaluation carried out on ‘high’ and ‘low’ implementation schools. This program is applicable to NSW, is sustainable and if targeted at whole year groups would have a wide reach.

3.2.3 Middle-School Physical Activity and Nutrition Study (M-SPAN)²¹,²²

A 2-year randomised controlled trial to increase energy expenditure during the school day was undertaken across 24 schools in the USA. The Middle-School Physical Activity and Nutrition (M-SPAN) program aimed to provide students in intervention schools with increased opportunities to be active by changing school policies and environments. Twelve schools were randomly assigned to the intervention and 12 schools to the control. On average each school had 1109 students enrolled. To encourage increased activity during physical education classes, strategies designed to alter the context or structure of the lesson as well as change teacher behaviour were implemented in the intervention schools. This included accessing community providers, providing teachers with professional development and promoting physical education across the school. Schools were also required to deliver physical education lessons each day. Additionally, a number of strategies were implemented to achieve policy change within schools. Each year, schools were responsible for identifying policies they wished to improve (approximately 2-4) and prepared action plans to achieve the desired improvements. Student health committees were established to promote physical activity and parent education was delivered through the usual communication channels within the school. Both intervention and control schools enrolled in the study received funding to support the purchase of physical education equipment and intervention schools also received additional funding to support the program.

At the end of the 2-years, the amount of time spent in moderate-to-vigorous activity while in physical education classes had increased significantly more in the intervention than the control schools, but the effects in terms of additional minutes of activity were quite small. At the end of the 2-years, boys in the intervention schools significantly increased participation in school-based physical activity (physical education lessons and break times), but in girls the effects were small, limited to physical education lessons and non-significant. There was no impact on self-reported total physical activity or time spent in sedentary behaviours.
Appraisal
Targeting the entire school population potentially reaches large numbers of adolescents at any given time. In addition, modifying policies and environments within schools need not be resource intensive or expensive and has the flexibility to address the needs of individual schools which renders this approach more sustainable in the longer-term. After 2-years, significant intervention effects were found in boys and not girls; this is interesting given that this intervention represents good practice. One possible explanation is that the policy and environment changes made at the individual school level were more conducive to facilitating physical activity in boys than in girls. Girls may benefit more when intervention activities specifically address their needs, physical activity preferences and barriers to activity. While this study was implemented in the United States, the processes and principles are such that it would be applicable in NSW. One caveat is that achieving intervention effects similar to the M-SPAN may be more challenging for schools with less than daily physical education programs.

3.2.4 Creating opportunities to be active during the school day

The effects of a 2-year program to increase physical activity and promote healthy eating were studied in 2840 students in the 7th and 8th grades in 15 Belgian schools. In this clustered randomised controlled trial, schools were allocated to either the intervention alone (5 schools); intervention with parental component (5 schools) or control (5 schools). The 10 schools allocated to the intervention arms modified aspects of the physical environment to create opportunities for students to be more active within the course of their school day, by providing more equipment and organising additional activities. During class-time, students received an age appropriate computer-based physical activity intervention, which provided personal advice on how to achieve an active lifestyle. Five of the 10 intervention schools had an additional parent component to promote supportive environments for activity outside of school. Parents were invited to a meeting on physical activity and health, received written information and a computer-based physical activity intervention, suitable for adults.

After the first year there were small but non-significant increases in the proportion of students in both the intervention only (5%) and intervention with parental support (7%) achieving the recommended 60-minutes of activity each day. After 1-year, daily school-related physical activity increased by 6-minutes in the intervention plus parental support group and by 4-minutes in the intervention only group. At the 2-year follow-up, daily school related physical activity in boys in the intervention groups had increased significantly more than boys in the control group (7 minutes versus 1 minute). In girls, at the 2-year follow-up, the intervention groups had increased their daily school-related physical activity by 4-minutes while it decreased by 1-minute in the control group. This intervention had no impact on leisure-time physical activity of boys or girls.

Appraisal
As well as supporting schools to provide opportunities for students to be active each day while at school, this program included additional classroom and parental strategies as part of their intervention; this reflects good practice. While the program has a potentially very good reach, it appears potentially slightly more effective in boys than in girls, and the effects on boys were minimal. Again, strategies to address policy and environment within the schools may have been more suited to the needs of boys than girls. One major limitation of the study, which may have impacted on the results after 2-years, was the high loss to follow-up of approximately 25%, although the authors claim that those lost to follow-up did not differ from those on whom data was collected.
3.3 Adapting the structure, planning and delivery of physical education classes to maximise opportunities for physical activity

3.3.1 New Moves

New Moves was a 16-week school-based obesity prevention program, based on Social Cognitive Theory, which targeted adolescent girls from the USA in the school setting. The feasibility of this program was investigated in a study involving 201 girls from the 9th to 12th grades who attended 6 schools. Schools were randomly allocated to either the intervention (89 girls from 3 schools) or the control (112 girls from 3 schools). Girls in schools randomised to the intervention participated in the New Moves program for 16-weeks and a maintenance component of lunch-time meetings for 8-weeks. As part of this program, “girls-only” physical activity sessions were delivered 4-times each week with a fifth session alternating between nutrition and social support lessons. The physical activity component focused on promoting life-long participation in activity within a supportive and non-competitive environment to increase enjoyment of activity and self-efficacy to be active. Each week, physical activity sessions involved inviting a community guest instructor, strength training activities, and activities chosen by the physical education teacher in consultation with the intervention coordinator. During the maintenance component, girls were provided with a healthy lunch and were able to discuss relevant topics in an informal atmosphere. There was a parental component to increase support provided to girls to be physically active, but this was minimal. Training and support was also provided for teachers involved in program delivery within the intervention schools.

Prior to the intervention, the average time spent in moderate-to-vigorous activity outside of physical education classes each week was 3-hours in both the intervention and control groups. After 16-weeks, this had increased to just over 6-hours a week in the intervention group, an increase that was maintained at the 8-month follow-up. Also, in the control group, moderate-to-vigorous activity outside of physical education classes reached just under 6-hours per week after 16-weeks and was slightly over 6-hours per week at the 8-month follow-up. A significantly greater proportion of the intervention group also moved along the stages of change at post-intervention and the 8-month follow-up, which may augur well for their future physical activity participation. Additionally, girls taking part in the program, and their parents, reported high levels of program satisfaction.

Appraisal

The strategies included in this program were flexible and catered to the needs of students - which is good practice. Providing support and resources for teachers to deliver the program increases its sustainability and supports integration into the existing curriculum. While the changes in physical activity were modest, albeit non-significant, the activity levels of a group of inactive girls increased and their stage of change status improved, which was encouraging. It would be interesting to investigate the longer-term effects of this program and the intensity of the physical activity component on activity levels and stages of change in inactive adolescent girls. Incorporating a family component into the intervention may enhance program effectiveness and sustainability.

3.3.2 Project FAB

Project FAB is a school-based intervention designed to increase physical activity in sedentary adolescent females. The effectiveness of this program was investigated in a 4-month study of 47 girls in the 10th and 11th grades from 2 high-schools in the USA. Allocation to intervention or control was on the basis of school, with 25 girls from the intervention school and 22 from the control school participating. Girls in the school assigned to the intervention were enrolled in a single-sex physical education class, available only to study participants. This class met for 60-minutes each day, 5-days a week for the duration of the study and during these lessons there was approximately 40-minutes of activity time. Specific activities offered to the girls during this time reflected responses from focus groups and included aerobics, swimming, dance and basketball. Once each week, girls in the intervention school took part in a discussion lesson focusing on the benefits of activity and strategies for becoming more active e.g. goal setting and self-monitoring. The focus groups also resulted in policy changes, including the involvement of outside activity providers and exemptions from the physical education uniform. After 4-months, total energy expenditure was greater in the intervention group than in the control, as measured by 2-day recall of light, moderate and vigorous physical activity.
Additionally, the proportion of girls in the intervention group who reported participating in vigorous physical activity increased from 48% at baseline, to 84%. While their participation in moderate physical activity decreased, the extent to which this occurred was less than in the control group. Girls exposed to the intervention also reported increased participation in physical activity outside of school hours.

Appraisal

Project FAB identified the needs and interests of girls, then implemented innovative and potentially sustainable strategies in response to these, including creating a special physical education class for the 4-month intervention period, policy change and providing girl-friendly physical activity options. Since this class met daily, the time available for activity accounted for more than half of that recommended for young people in Australia. The effects of this study, which were measured using self-report, indicate its potential for increasing participation in light and vigorous activities and preventing a decline in moderate-to-vigorous activity. This approach might also have potential for increasing leisure-time physical activity in girls. It should be noted that the study had a small sample size, allocation to intervention and control was not random, was implemented in 2 schools and the intervention and follow-up time frames were relatively short. This may affect the generalisability of this program, but it certainly warrants future research in a larger, more representative sample of schools.

3.3.3 Physical Activity and Teenage Health (PATH)

Cardiovascular risk factors were the focus of the Physical Activity and Teenage Health (PATH) program. The effects of PATH were investigated in a 2-year study of 442 teenage girls from various cultural backgrounds, attending 3 inner-city high schools in the USA. In the first year of the study girls were individually allocated to the intervention or control groups. In contrast, in the second year of the study this allocation was on the basis of class as a result of scheduling difficulties at the end of the first year. In total 310 girls were included in the intervention group, but only 132 in the control. The physical activity outcome of interest in this study was participation in activity outside of school. The intervention was a personal wellness course that included components of vigorous physical activity, health education and behaviour modification. Girls in the intervention group attended 5 lessons of 30-minutes duration each week for 12-weeks. Each lesson began with an introductory lecture and discussion (5-10 minutes) on a range of topics including cardiovascular health and behaviour modification, followed by about 20 to 25 minutes of vigorous physical activity designed to increase strength, develop endurance or improve fitness. The control group took part in usual physical education classes without the introductory lecture. Student manuals were developed to support the program components and teacher manuals provided guidance on teaching and assessing the program components. Girls in the intervention group increased their average number of weekly physical activity sessions (minimum of 15-minutes) outside of school from 4.5 to 5.3 while girls in the control group increased their number of weekly sessions of activity outside school from 4.9 to 5.5. These differences were not significant.

Appraisal

This intervention targeted a racially diverse group of girls, which is one of its advantages as this improves the generalisability of the results. In addition, it was integrated into the existing curriculum, delivered by physical education teachers and support materials were provided, all of which reflect good practice. The effects on activity outside of school were not significant and total activity time was not measured, therefore the overall effects of the program were not reported. The small sample size, the intervention to control ratio, and manner in which activity was measured are likely to have contributed to this lack of effect. Also, while allocation to study groups was random, in the first year it was by individual and second it was by class, which may have affected the dose delivered to and received by girls in the study and could have resulted in contamination of the results. The model would be worth repeating with more rigorous study methods.
3.3.4 Encouraging Health enhancing physical activities through gymnastics

In the United Kingdom, a 6-week study was conducted to investigate the effects of a program designed to increase the amount of cardio respiratory health-enhancing physical activity delivered as part of a gymnastics unit being taught in an a single-sex girls’ school. The study involved 2 classes of year 7 girls (11-12 years) from 1 co-educational school. The aim of the intervention was to influence the manner in which teachers planned and organised their lessons so that increased physical activity levels became an integrated lesson objective, without altering content. The teacher of the intervention class was informed of the study objective to increase physical activity and asked to include modified lesson objectives including organisation of the space, pacing of the lesson, student-centred strategies and minimising the impact of teacher focused activities. The teacher of the control class was instructed to plan and deliver lessons in the same manner as usual and was not informed of the objective of the study. At the conclusion, the intervention class engaged in moderate-to-vigorous physical activity for 18.5% of class time, which was significantly greater than the 13.5% of class time moderate-to-vigorous activity of the control group. The teachers of the intervention class also provided significantly more time for skill development than the teacher of the control class.

Appraisal

This 6-week program was delivered through lessons taught as part of a unit on gymnastics, which is a good way of integrating a program into the curriculum. The intervention resulted in positive changes to the manner in which the intervention teacher planned and ran practical lessons, which increased the moderate-to-vigorous activity of students while participating in these lessons. Changes such as those to lesson structure and management may well be sustainable in the longer-term and could reach large numbers of teachers and students if implemented broadly. Disadvantages of this study included sampling of 2 classes from the same school which may not provide an indication of how applicable this intervention would be with other teachers and across a range of schools and there may have been some contamination of results. While the control teacher was blinded to the aims of the study, the intervention teacher was not; and therefore the effect may very well be due to this rather than the actual intervention. The advantage of this study is that the activities were designed to integrate with existing programs and reflect recommended teaching approaches.

3.4 Curriculum, environment and policy interventions with parental/community components

3.4.1 Intervention centred on adolescents’ physical activity and sedentary behaviours (ICAPS)

The Intervention Centred on Adolescents’ Physical activity and Sedentary behaviours (ICAPS), is a multi-level program designed to affect the intrapersonal, social and certain environmental determinants of physical activity and sedentary behaviours among early adolescents. The program involves partnerships across a range of agencies including schools, families, communities, transport health and recreation. ICAPS is a 4-year cluster randomised controlled trial which commenced in 2002/3 and is being conducted in 8 French schools. Four schools (475 adolescents) were randomised to the intervention and 4 schools (479 adolescents) to the control. The intervention includes an educational component focusing on physical activity as well as promotion new opportunities for physical activity during and outside of school hours. There is an emphasis on ensuring that activities are fun, pleasurable and inclusive. The intervention also encourages local sporting groups, parents and teachers to become involved through regular contact, meetings, training and support. The control group follows the usual health curriculum. The program is still underway and only the first 6-months of the intervention had been evaluated. Significant increased participation in leisure-time physical activity was detected in both boys and girls at the 6-month interim analysis. The proportion of girls in the intervention group reporting leisure-time physical activity increased from 59% to 83% while in boys the proportion increased from 69% to 81%. Little difference was detected in participation in leisure time physical activity in the control schools. At the same time, improvements were detected in the amount of time spent in sedentary behaviours (see module on sedentary behaviours) in the intervention group.
Appraisal

This 4-year study still in progress and therefore only the preliminary effects of the intervention are available. Nonetheless, the results are already very promising. The advantages of this study are the rigorous methods and the measurement of the longer-term effects of the intervention. Girls in this study in particular appeared to respond well to the intervention. Should the effects of this intervention be maintained or improved over time, it augurs well for similar interventions to increase physical activity in adolescents from a range of socioeconomic backgrounds. The ICAPS model is unique in that it has successfully (at this stage) engaged a number of agencies external to the school setting who are important partners in achieving increased participation on physical activity. Importantly ICAPS actively engages with and involves parents, rather than providing only written information, which is the standard approach. The provision of support and training for staff in intervention schools is a key strategy to foster program sustainability. While this is a French study, the participants represent a broad range of socioeconomic and cultural backgrounds which increases its generalisability and process evaluation at 6-months reported very good program fidelity and a reasonable reach. The final results of this intervention will be of interest to those working in health promotion.

3.5 Developing adolescents’ skills to be physically active

3.5.1 Fit for Life Boy Scout Badge

Boy scouts aged 11-14 years from the USA were recruited to this study which investigated the effects of Fit for Life, a 9-week intervention to increase physical activity levels in adolescent boys. A total of 473 scouts from 42 troops were randomly assigned to either the intervention or control by troop. The program was run in 2 waves in the spring (16 troops) and fall (26 troops) of 2003. Data was collected at baseline, at the conclusion of the intervention (9-weeks) and after 6-months of follow-up. The Fit for Life physical activity intervention involved skill building activity for boy scouts at troop meetings, internet-based role modelling, goal setting, goal review and problem-solving activities. Trained staff led 20-minute physical activity sessions with boys as part of weekly troop meetings and boys in the intervention also received a drills booklet to encourage them to be more active outside of troop meetings. A study website was established and the boys were encouraged to log onto this website at least twice each week. Logging onto the website exposed boys in the intervention group to the behaviour change program and allowed them to report their personal goal attainment for that week. Boys received points for attending troop sessions and for logging onto the website. Those who obtained 70% of available points at the end of the program were awarded with Fit for Life Badges. Boys were monitored with accelerometers and also reported their physical activity self-efficacy and preferences. Boys in the control group received a fruit and vegetable intervention that mirrored the physical activity one.

Results indicated that, after 9-weeks, a significant 12-minute increase in light intensity physical activity and a trend toward a 12-minute reduction in sedentary behaviours was detected in the spring intervention group only. However, these changes were not maintained and there were no differences in sedentary minutes or light intensity activity minutes at 6-months post-intervention compared to baseline. The intervention had no effect on minutes of moderate-to-vigorous physical activity.

Appraisal

This program had limited impact on boy scouts’ physical activity, but was also of very low intensity (only 20-minute weekly physical activity and twice weekly internet sessions). It had no effect on boy scouts’ minutes spent in moderate-to-vigorous physical activity and the effects it did have on sedentary behaviour and light intensity activity were not maintained beyond the post-intervention period. It is possible that once the reward was earned there was no longer any motivation to be physically active. Thus intrinsic motivation does not appear to have been achieved from this intervention. Also, this intervention would not reach adolescent boys who do not participate in the Boy Scouts program or another leisure time pursuit is run in a similar manner. The changes were only seen in the spring season which may be more conducive to physical activity.
3.5.2 Comparing web and print media

This 2-week study compared the effects of using web based intervention to encourage physical activity with an identical print version in a home-based intervention. A total of 319 girls in 6th to 8th grades with home telephone and internet access were recruited from 4 middle schools within 1 school district in the United States. Girls were randomly allocated to either the web group or print group. Girls in the web group were given access to a password-protected physical activity website, which included interactive games, downloadable daily activity planning charts and interactive demonstrations of different types of activities. Girls in the print group were posted a printed workbook containing identical content and graphics from the website. This study involved considerable formative research to identify and modify a suitable website for promoting physical activity to adolescent girls and ensure that the website and printed workbook were comparable. Girls in both groups showed significant increases in physical activity intentions and physical activity self-efficacy. Girls in the print group showed significantly greater changes in physical activity intentions than girls in the web group, and only girls in the print group reported significantly increased participation in physical activity. Process evaluation indicated that girls provided with print media spent significantly more time using the materials and were significantly more likely than web group girls to recall all sections of the intervention materials.

Appraisal

The 2-week implementation period and lack of a true control group were limitations of this intervention and make it difficult to determine the degree to which it was effective in increasing girls’ physical activity participation, although the print group showed greater effects than the web-based group. Nonetheless, the study suggests that print resources may be more effective in encouraging girls to spend time looking at and thinking about information to promote physical activity compared to web-based resources. The level of formative research undertaken in the development of both the web-based and print materials is one of the stronger aspects of this intervention. Given that the intervention materials were well planned but the intervention time frame was short, more rigorous research, including assessment of web usage, is required in this area before its potential to increase physical activity becomes clearer.

3.5.3 Life skills education through school

The effects of an 8-month randomised controlled trial of a life-skills intervention, designed to increase physical activity in adolescent girls was investigated with 211 students in the 9th grade from one single-sex high-school in the USA. Approximately 83% of the girls were African American. The intervention, which was based on Social Action Theory, consisted of two components in addition to the regular physical education curriculum. Girls were randomly allocated to the intervention (116 girls) or control (105 girls) class. Girls allocated to the intervention group participated in a life-skills course designed to assist students in making informed decisions about the benefits of being active, develop problem-solving skills and obtain support from others in being active. In addition the intervention also sought to maximise physical activity time in physical education classes (delivered 5 days each week) by teaching active units with a focus on team sports and individual sports over the course of the year. The school-based components of this program were supported by family activities including a workshop, newsletters and adult-child homework. The intervention was delivered by a teacher hired specifically for the project. Girls allocated to the control group participated in the standard physical education curriculum and their parents also received a newsletter each month on various health topics. There were no differences measured in daily energy expenditure within or between groups at the conclusion of this program. However, it is worth noting, the intervention class/es spent significantly more class time engaged in moderate-to-vigorous physical activity (47%) than the control classes (30.5%).

Appraisal

This intervention resulted in increased time spent in moderate-to-vigorous activity during physical education classes but did not impact on total physical activity, when measured by daily energy expenditure. This may reflect how physical activity was measured rather than a lack of effectiveness of the strategies implemented. Also, this program was implemented in only one school which limits its generalisability, but it could potentially have a very good reach. One advantage of this program was that it was integrated within the school’s existing physical curriculum. While a teacher was hired specifically for the study, it would be more feasible and sustainable for existing physical education teachers to deliver life skills education. In this study, participants were predominantly African American
and therefore it may not be culturally appropriate to NSW. Replication of this approach in the future may require program modification to ensure applicability and relevance to the target population group.

3.5.4 Planning to be Active

A quasi-experimental study of Planning to be Active was conducted with 240 students in the 9th to 11th grades from 2 rural high-schools in the USA. The program, based on Social Cognitive Theory, aimed to increase leisure time physical activity among students and was integrated with regular physical education lessons. One school (143 students) received the intervention while the other school (97 students) acted as the control. Both the intervention and control groups were exposed to similar physical education curriculum delivered by specialist teachers within the school. In addition to this, students in the intervention school were exposed to the program during 1 physical education class each week, for 8-weeks. The focus of this skill building program included highlighting the benefits of being active, goal setting as well as planning and monitoring personal activity levels. At baseline, none of the intervention group and 3% of the control group achieved the recommended 5 or more days of moderate-to-vigorous activity during leisure time. After 8-weeks the proportion of the intervention group reporting moderate-to-vigorous leisure time physical activity on 5 or more days of the week increased to 19% while in the control it increased to 12%. The effects on moderate-to-vigorous leisure activity in the intervention group were significant. Changes in leisure time vigorous activity were detected in both the intervention and control groups and the intervention group had a smaller proportion of students reporting no leisure time physical activity (9%) than the control group (54%).

Appraisal

Emphasising personal responsibility for planning and monitoring activity levels appeared effective in increasing participation in leisure time activity, particularly in those who were inactive. However, to be eligible to take part in this study, students were required to be enrolled in physical education, which may limit its reach, and may miss some students who are inactive, although activity levels in both groups at baseline were quite low. A disadvantage of this study is that the intervention was delivered by the investigator who developed the program which might limit its longer-term sustainability and could also have biased the results. The program was only implemented in two schools, and therefore it is unclear whether it would achieve similar results in a wider cross-section of schools. This program is applicable to the NSW context and warrants future research in a larger, more representative sample of schools.

3.5.5 Internet and video sessions delivered through school

This 12-month quasi-experimental study, which targeted physical activity and fat consumption, was delivered to 341 students in 7th and 8th grades from 2 urban low to middle-income schools in the United States. The intervention, based on the Transtheoretical and Health Promotion models, consisted of 4 Internet/video sessions and 1 healthy snack session. One intervention class (allocation to intervention or control was based on class) was also exposed to a single additional gym class 50-minutes in duration. Each of the Internet/video sessions was tailored to reflect the students’ stage of change. Therefore the sessions for students in the pre-contemplation and contemplation stages focused in increasing awareness of current activity as well as identifying benefits of and barriers to being active and solutions to overcome the barriers. Students in the planning, active and maintenance stages of change were trained as ‘peer models’. These students then led the healthy snacks and gym sessions with the assistance of teachers or a school nurse. Students in the intervention groups also received feedback as part of each Internet/video session. At the end of the intervention moderate-to-vigorous activity had decreased in both the intervention (9 minutes) and control groups (38 minutes) but the decrease in the intervention groups was less marked.

Appraisal

While this intervention was delivered in a school setting, the extent to which it was integrated into the existing curriculum is unclear. Also, it appears that there were no supporting strategies which targeted school level factors or parents and families of the students allocated to the intervention group. Best practice principles suggest that ‘one-off’ activities such as these which do not target whole of school factors are less likely to have an effect or be sustained in the longer-term. While the study was conducted over 12-months, it is not clear what the time-frame was for participation in the actual intervention. Also, while 341 students were enrolled in the study, only
130 (38%) were included in the final analysis and it has not been possible to identify the numbers of students in each class allocated to the intervention and control for this study. The authors suggested that the instruments used to measure activity did not have good reliability which is another limitation of the study. This study was conducted in the United States and therefore may not be applicable to the NSW setting. Given the limitations of the study and the lack of a positive effect on physical activity, there are likely to be other interventions more appropriate for implementation in NSW.

3.5.6 Internet and video sessions delivered through the formal curriculum

This 4-week quasi-experimental study, modified from the study described above, was conducted with 132 students in 7th grade from one urban high-school in the USA. As part of this study students in the intervention group were exposed to 8 Internet/video sessions (each 40 minutes long) that were delivered as part of their Science class. During each session students watched 4 short videos (2-3 minutes each) via an Internet platform. These delivered stage-based messages on physical activity and healthy eating. Students also received tailored stage-based feedback for each session after responding to 16 questions and 10 discussion items related to physical activity. Students in the intervention received a workbook to support the sessions. The control group participated in their regular Science classes and the intervention was password protected to prevent any contamination of effects. At the end of the 4-week study, students in the intervention group who had completed more than half of the sessions increased their moderate-to-vigorous activity by 22-minutes compared to a decrease of 42-minutes in the control group. Those in the intervention group who completed all the physical activity sessions (39 students) increased their activity by 33-minutes.

Appraisal

Increasing the number of Internet/video sessions appears to have had more positive effects on physical activity than those reported in the previous study. While integrating the intervention into the school curriculum was one of the positive aspects of this study, there were no other strategies aiming to influence school systems, staff or target the parents and families of adolescents. Best practice principles suggest that ‘one-off’ activities such as these, which do not target whole of school factors, are less likely to have an effect or be sustained in the longer-term. Again the number of students included in the analysis is one of the limitations of this study. While 132 students were enrolled, only 103 were included in the analysis which may bias the results. This was a short-study and the authors suggested the sample size may have been too small in some cells to detect a change. This study was conducted in the United States and therefore may not be applicable to the NSW setting. Given the limitations of the study, there are likely to be other interventions more appropriate for implementation in NSW.

3.6 Pedometer interventions providing feedback and encouraging goal setting

3.6.1 Pedometers with weekly goals related to minutes of activity or step counts

An Australian quasi-experimental study of the Girls Stepping Out Program, investigated the effects of a pedometer intervention on activity levels in 85 inactive older adolescent girls in Years 11 and 12 from three rural schools in Queensland. Participants were allocated on the basis of school to one of 3 groups: pedometer (27 girls); minutes (28 girls); or control (30 girls). Girls in the pedometer and minutes groups participated in weekly meetings (30-minutes) for 6-weeks and were encouraged to gradually increase their daily step counts (pedometer group) or minutes of activity (minutes group) until they reached specified targets of 10,000 steps or 30-60 minutes of physical activity each day respectively. These meetings, which were facilitated by a member of the research team, provided an opportunity for girls to review their weekly progress and identify activity goals for the coming week. The project also included a 6-week maintenance period in which girls received 3 postcards providing tips for being physically active and individualised encouragement from their group facilitator. There was a significant effect on the daily step counts of both intervention groups (pedometer and minutes), with the greatest effect detected in the pedometer group. At the end of the 12-week study, girls in the pedometer intervention group took significantly more steps over four days than girls in the control group. An increase in moderate-to-vigorous physical activity and vigorous physical activity over a 3-day period was detected in both the pedometer (33-minutes MVPA and 39-minutes VPA) and minutes (84-minutes MVPA and 36-minutes VPA) intervention groups, but this was not significant.
Appraisal

This intervention was implemented in Australia and therefore would be applicable to NSW. Establishing targets of steps or minutes per day may encourage older adolescents to take personal responsibility for being active and allows a degree of self-determination. While the increases in moderate-to-vigorous physical activity of both intervention groups were not statistically significant, they may well make a good contribution to achieving recommended daily levels of activity. The lack of statistical effect likely reflects the small sample size, the use of a measurement tool that was not sensitive enough to detect change, the short implementation period and a lack of follow-up rather than a lack of effectiveness of this intervention. The significant increases in daily step counts of both the intervention groups in comparison to the control group might well be considered clinically important and could make a contribution to meeting daily physical activity recommendations. This is a relatively inexpensive and low intensity approach, with encouraging results that warrants further investigation.

3.6.2 Pedometers with weekly goals related to step counts

This 3-week quasi-experimental study investigated the impact of pedometers on the number of steps taken daily and perceptions of physical activity in adolescents. A total of 165 adolescents (56 boys and 109 girls), from 4 high-schools were randomly allocated by recent physical activity history, to either the pedometer only group or the pedometer and goal setting group. Students in the pedometer only group received a pedometer which they wore for 3-weeks but took part in no other activities. Adolescents in the pedometer and goal setting group established a daily step count goal after wearing their pedometer for a 1-week trial, and received a health related handout designed to support the goal setting process. All participants were given a pedometer as incentive to take part in the study. While there was an increase in steps taken by participants in both groups, few students in this study met the daily target, which was set at 11,000 steps. At the conclusion of the intervention, the average steps taken by the pedometer group had reached 9,486 and steps taken by the goal setting group had reached 9,014.

Appraisal

The 3-week intervention period in this study was extremely short and a longer intervention and follow-up period may well have brought about real and measurable change in daily step counts and the proportion of adolescents meeting recommendations. Another disadvantage of the study was the lack of a true control group, as the improved step counts of students in both the pedometer only and goal-setting groups may well be making a considerable and important contribution to their overall activity levels. The authors also found that the school which students attended was a mediating factor in the achievement of recommended step counts, and suggested that some schools may have facilitated walking more than others. This is nonetheless a relatively inexpensive and low intensity approach, with encouraging results that warrants further investigation.
4 Evidence Appraisal

4.1 Brief counselling with tailored feedback, advice and follow-up

From the studies reviewed in this module, evidence regarding the effectiveness of brief counselling as a means of increasing adolescents’ participation in physical activity is inconsistent and unclear. However, this may reflect study limitations rather than the potential of brief counselling as a means of encouraging increased participation in physical activity in adolescents.

Physician delivered brief counselling with regular follow-up was studied by Ortega-Sanchez and colleagues. It appeared to have some promise in increasing physical activity participation in adolescents. Regular face-to-face follow-up may be more effective in increasing physical activity than extended outreach contact and follow-up. The extended outreach and follow-up had only small effects on physical activity, and even then this was predominantly in boys. However, regular face-to-face follow-up is likely to be more resource and time intensive than outreach follow-up and thus may not always be suited to implementation through primary health care or targeting large populations.

General practitioners are familiar with brief counselling and if they are provided with information to support key physical activity messages, this represents a potentially flexible and sustainable approach to promoting positive lifestyle behaviours. However, this type of intervention will not reach adolescents who rarely visit their general practitioner.

In contrast, school-based brief counselling can reach large numbers of adolescents, and may be effective in targeting those who do not visit their general practitioner. The intervention studied by Prochaska and Sallis was delivered by teachers and reflected good practice, but was more effective in boys than girls. The limitations of the study by Robbins and colleagues in which girls were delivered stage-based counselling by the school nurse, meant the efficacy of the intervention was unclear. In contrast, the school-based screening and nurse counselling model investigated by Werch and colleagues appeared to have promise, particularly in the short-term. The programs of Werch and colleagues and Robbins and colleagues would require some adaptation for the NSW context. However, they could be amenable to implementation in primary health care or community settings, such as through gyms or personal trainers.

Brief exposure interventions with counselling and/or tailored feedback appear to be somewhat effective in boys, but the evidence of their effectiveness in girls is less consistent. This approach is worthy of further research, with more rigorous implementation and evaluation of the interventions.

4.2 Creating environments and developing policy within schools to increase opportunities to be physically active

School-based interventions that create environments and develop policies to increase opportunities to be physically active can reach large populations and are potentially more sustainable in the longer-term. The evidence from the studies reviewed in this module suggests that they may be effective in increasing adolescents’ participation in physical activity.

The specific strategies included as part of any environment or policy intervention ideally need to be tailored to meet the differing needs of boys and girls. The two-year M-SPAN study achieved significant effects in boys but not girls. The reverse was true for interventions reported by Cass and Price and Pate and others whose studies measured positive changes in physical activity in girls. This may have been because these latter studies targeted girls and as a consequence included specific girl-friendly activities and approaches.
Strategies to modify school policies and environments appear to have greater effect on activity of boys than girls when implemented in co-educational schools. Policy and environment changes made at the individual school level that work well with boys may not be conducive to facilitating increased activity in girls. Girls appear to respond best when their specific physical activity needs and interests, as well as their barriers to activity, are identified and addressed with innovative and flexible strategies. In contrast, boys respond well to creating environments which provide them with more options and opportunities to be active.

While the majority of these studies were conducted overseas, their underlying processes and principles are such that they would be applicable in NSW.

4.3 Adapting the structure, planning and delivery of physical education classes to maximise opportunities for physical activity

A number of interventions focused on adapting the structure, planning and delivery of physical education lessons to maximise opportunities available for adolescents to be active during this time. The reach of these interventions is potentially very good. The interventions reviewed in this module were found to have some impact on girls’ physical activity.

The approaches and strategies adopted in these interventions varied and were often combined in the one program including creating girls’ only physical education classes, delivering theory based lessons on physical activity or personal wellness, combining theory and activity components into all lessons or modifying the manner in which teachers planned, delivered and managed practical lessons.

Modifying the manner in which teachers plan, deliver and organise their lessons appears to be an effective, feasible and sustainable approach to increasing time adolescents spend being active during physical education lessons. Within the context of physical education lessons making the best use of the time available for activity may make a significant contribution to meeting daily activity recommendations, as well as developing skills needed to engage in activity throughout life.

Girls-only physical education classes also appear to have positive effects on activity levels of adolescent girls. Although the effects were quite small and non-significant, combining information and activity in a short session may play contribute to increasing physical activity of girls outside of school hours. These strategies are potentially feasible and sustainable when integrated into school curriculum and teaching practices, and implemented in girls only schools. However, girls’ only physical education classes may not be feasible or sustainable in all co-education schools. Approaches which aim to adapt the manner in which physical education classes are structured, delivered or planned are promising. Further investigation of longer-term or larger-scale implementation, as well as monitoring of activity levels in and outside of school would be beneficial.

4.4 Curriculum, environment and policy interventions with parental/community components

The French ICAPS intervention has several components. In addition to school-based curriculum and environment and policy change at the school level, there are activities to encourage active parental and community involvement. These strategies represent good practice when working with schools. This intervention also targets a number of activity domains external to the school setting, which encourages participation in leisure-time physical activity. Initial results of the ICAPS study have demonstrated increased physical activity participation in boys and girls. This appears to have promise as a potentially very effective approach to increasing physical activity in adolescent boys and girls. The longer-term effects of this study will be of interest.
4.5 Developing adolescents skills to be physically active

These interventions aimed to encourage and support adolescents to accept personal responsibility for being physically active through developing the skills required to achieve and maintain an active lifestyle.

Studies of programs to develop adolescents’ skills in goal setting, planning to be active and overcoming barriers to activity have produced some limited and inconsistent results. While the school-based intervention of Hortz and Petosa achieved some positive change, the sample size of this study was small and it was conducted in a rural area, which may limit the generalisability of the results. In contrast, the intervention of Young and colleagues, also limited in its generalisability, produced no measurable difference in physical activity.

When implementing these or similar programs integrating strategies into the formal curriculum, including a parental component represents good practice and should be encouraged. The effects of such approaches may be enhanced when augmented with whole of school activities.

The results of the home-based intervention comparing web and print media are interesting given the increased role of web-based information in the life of many adolescents. The results of this study suggested that providing adolescent girls with information in print format may be more effective than providing information over the Internet. Internet/video sessions implemented within the school setting resulted in mixed results. While one study suggested this approach may be somewhat effective, another failed to achieve an increase in activity in adolescents. The approaches used in both studies did not reflect ideal practice when working with schools and the limitations of the analysis of data suggest that other school-based studies reviewed in this module may be more appropriate than these.

It makes good conceptual sense to implement programs external to the school-setting because adolescents are able to make discretionary choices about how they allocate their leisure-time and ideally some of this time would be devoted to being physically active. However, the community-based intervention reviewed in this module that aimed to develop skills to be physically active only targeted boys and the effects were limited.

When supplemented with whole of school activities, schools may be an appropriate setting to implement programs to develop adolescents’ skills to be active, and teachers are generally well placed to deliver such programs. Home-based life-skills interventions require further larger scale and longer-term research to investigate their effectiveness. At this stage, there is no evidence to support the efficacy of community-based interventions which aim to develop adolescents’ skills to be physically active. This is an area in which future research is warranted.

4.6 Pedometer interventions providing feedback and encouraging goal setting

While small in number, the pedometer interventions reviewed in this module present some interesting and promising results. These 2 studies of short-term interventions showed increased steps, but had limited effectiveness compared to other goal setting approaches.

There is growing evidence of the efficacy of pedometers as a means of encouraging activity in adults, and therefore they may also encourage adolescents to be more physically active. Pedometer interventions have produced some encouraging results for both boys and girls and have been shown to be effective in increasing daily step counts and possibly total daily activity. While these studies were conducted in schools, the approaches used would be equally suited to other settings.

Pedometer interventions warrant further research and are worthy of consideration in a portfolio of interventions. Providing support and resources as part pedometer interventions, regardless of the setting in which they are implemented, may enhance their effectiveness.
## 5 Promising and appropriate strategies

A range of interventions to increase adolescents’ participation in physical activity have been outlined and discussed in this module. A number of these appear to be promising and while most studies were conducted outside of Australia, many are appropriate for implementation in NSW. Decisions about which programs and strategies to include in any portfolio of interventions will depend on the needs of the target population as well as the capacity of the organisations implementing the programs.

The following table outlines strategies that are promising, or may have some promise, in increasing physical activity in adolescents, and are applicable to the NSW context. Current gaps in the evidence and priority areas for research have also been outlined in this table.

<table>
<thead>
<tr>
<th>5.1 Promising strategies based on the available evidence</th>
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<tbody>
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<td>Multiple component school interventions which combine curriculum, environment and policy strategies with parental/community involvement.</td>
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<tr>
<td>Creating environments, policies and curriculum delivery that address the activity needs of girls.</td>
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<tr>
<td>Modifying school policy and environments to create more opportunities for boys to be physically active.</td>
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<td>Adapting the structure, planning and delivery of lessons to maximise opportunities for physical activity.</td>
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<tr>
<th>5.2 Strategies worthy of consideration (may require modification and/or additional evidence)</th>
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<tbody>
<tr>
<td>Developing adolescents’ skills to be physically active, as a component of whole of school strategies.</td>
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<tr>
<td>Pedometers as a means of encouraging activity, especially with older adolescents.</td>
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<tr>
<td>Brief counselling with tailored advice and feedback, delivered through community or primary health care settings and tailored to meet the specific needs of boys and girls.</td>
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<tr>
<th>5.3 Gaps in evidence and priority areas for future research</th>
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<tr>
<td>Interventions to increase physical activity by decreasing time spent in sedentary behaviours.</td>
</tr>
<tr>
<td>Community-based interventions to increase adolescents’ participation in physical activity during their leisure time, such as organised activities and recreational programs.</td>
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6 Implication for policy and practice

6.1 Implementation considerations
The interventions reviewed in this module suggest that during adolescence different strategies may be required to increase physical activity in boys and girls. The dissimilar needs, interests and barriers to activity in boys compared to girls should be taken into account in program planning and implementation.

Schools can facilitate and encourage activity through providing relevant education, modifying their physical and social environments, their policies, and the manner in which health and physical education lessons are structured, planned and delivered. While school-based approaches show promise for increasing physical activity in both boys and girls, the specific activities required appears to differ between boys and girls. Consideration should be given to the needs of both boys and girls to ensure that neither sex is adversely affected by activities that will increase activity in the other.

Counselling with tailored feedback, advice and follow-up is certainly worthy of consideration in boys, but the evidence of its effectiveness in girls is less consistent. Again the follow-up mechanisms and intensity may need to be different for boys and girls. In contrast, while small in number, pedometer interventions have shown to have some efficacy in both boys and girls in increasing minutes spent engaging in activity, as well as total step counts.

When working with schools, strategies should reflect good practice as well as being feasible and sustainable. This includes adopting a whole of school approach, integrating activities into the curriculum, using with trained teachers as well as providing professional development and ongoing support.

When implementing interventions to increase physical activity through developing skills to be active, counselling with advice, feedback and follow-up or use of pedometers, it would be advantageous to work with schools, families and/or communities to ensure environments and policies to facilitate increased activity. This would help overcome any mediating role school or community or family environments might have on the effects of the intervention.

The majority of the studies reviewed in this module were conducted overseas and many were tailored to specific communities and cultural groups. Therefore modifications may be required to ensure that these approaches are applicable to NSW. Thorough expert and stakeholder consultations and pilot testing of resources will ensure that modified approaches are feasible and appropriate for implementation in NSW.

6.2 Portfolio approach
There is convincing evidence that engaging in sufficient physical activity on a regular basis can protect against overweight and obesity and therefore it would be reasonable to focus efforts in this area. However, it is unlikely that any single intervention alone will bring about a sufficient increase in physical activity in adolescents at the population level. It will be necessary to apply a variety of strategies in order to achieve this outcome. Taking multiple and complementary approaches will help to address physical activity in a range of domains in adolescent’s lives from different settings to different developmental stages. This is consistent with recommendations for best practice such as Getting Australia Active.5

Generally, program effectiveness will be enhanced by supplementary initiatives, such as communication and public education through local media and other channels, promotion and reinforcement through health professionals’ capacity to opportunistically provide accurate information and consistent advice.
6.3 Gaps and clusters

The majority of interventions reviewed in this module were delivered in school settings. Schools are an obvious and appropriate setting for targeting this age group as large groups can be reached in a sustainable, flexible and cost effective manner.

The scope and potential to implement strategies aiming to increase physical activity across a range of settings should not be overlooked. While interventions delivered through schools can be effective in increasing activity, more often than not they impact on activity during school hours only and participation in leisure-time physical activity remains relatively unchanged. It is unlikely that the recommended sixty minutes of moderate-to-vigorous physical activity each day will be achieved during school hours. Interventions aiming to increase leisure time physical activity as a means of increasing total physical activity should not be ignored. There is potential to develop and implement innovative strategies delivered in a range of settings including the family, sporting organisations, community groups and primary care. While some of the interventions reviewed in this module have been implemented in settings other than school, this is an area in which more concentrated research is required.

6.4 Translating evidence into cross sector actions

Approaches identified as promising and worthy of consideration have been interpreted into practical actions/programs that may be relevant to areas within New South Wales and Australia. The relevant sectors that could contribute to implementation have also been identified.

<table>
<thead>
<tr>
<th>Physical activity in adolescents</th>
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<tr>
<td><strong>DO</strong></td>
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<tr>
<td>School policy and environments to promote activity for boys and girls (gender-specific arrangements)</td>
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<td>Combine curriculum, environment and policy interventions with parental/community involvement</td>
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<td>Teacher professional development on lesson structure, planning and delivery to promote activity</td>
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<td><strong>CONSIDER</strong></td>
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<td>Life-skills education related to activity in PDHPE</td>
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<td>Pedometers as part of walking promotion programs</td>
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<td>Brief counselling with tailored advice and feedback</td>
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<td>Active transport &amp; supporting infrastructure, incl. public transport</td>
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<td>Access to places and facilities for physical activity</td>
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<td><strong>GAP</strong></td>
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<td>Strategies to increase physical activity by decreasing sedentary behaviours</td>
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<td>Community-based interventions to increase leisure-time activity</td>
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<th>Sectors</th>
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<td>C - Community services</td>
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<td>P - Planning</td>
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7 References


8. Appendix. Tables summarising the available intervention evidence for increasing physical activity in adolescents

Table 1. Summary of studies of brief counselling with tailored feedback, advice and follow-up

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<th>Ref</th>
<th>Design</th>
<th>Participants</th>
<th>Intervention description</th>
<th>Outcome variables</th>
<th>Key findings/Outcomes</th>
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<tr>
<td>Ortega-Sanchez et al 2004</td>
<td>Spain</td>
<td>RCT with controls matched on sex and age. 12 months duration Primary care setting</td>
<td>448 12-21 year old adolescents from 6 family physicians' offices Intervention: 222 (123 boys, 99 girls) Control: 226 (138 boys, 88 girls). At baseline, there were significantly more boys classified as active than girls (48.3% vs. 21.9%).</td>
<td>Physical activity measurement was based on exercise and/or sport activities. Change in activity classification, duration (mins), frequency (days/wk), and intensity (mild, moderate, vigorous) from baseline to six months and twelve months. Being physically active was defined as reporting engaging in exercise or sport in or out of school on three or more days a week for 30 min or more per day at a moderate to vigorous intensity.</td>
<td>The intervention group had significantly higher increases in the proportions of adolescents classified as active at 6 months (36.8%) and at 12-months (42.78%) than control group (P=0.003). There were significant differences over time between intervention and control groups in the proportion of adolescents classed as active (P=0.002 for trend), with greater differences between the groups at 12-months versus 6-months. Average changes in physical activity duration, frequency and intensity were greater in intervention than the control from baseline to 6-months and 12-months. Significant differences between the intervention and control groups were found in trends in duration (P=0.002), frequency (P=0.001) and intensity of activity (P&lt;0.001) over time, with greater differences seen at 12-months than at 6-months. Note: Incorrect use of the US physical activity recommendations: 1) participants physical activity status was assessed based on their exercise and sport participation only (other non-sport activities not included, like walking); 2) participants were active if they exercised more than 3-times per week, rather than the recommended most days or all days of the week.</td>
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<p>| Patrick et al 2006 | USA | RCT 12 months duration Primary care setting with home-based follow-up | 819 adolescent boys and girls aged 11-15 yrs. Recruitment from 45 primary-care provides from 6 clinic sites. Intervention: 438 (202 boys/179 girls) Control: 381(179 boys/216 girls) More non-white adolescents assigned to intervention (45%) than control (38%). | Physical activity measurement was based on exercise and/or sport activities. Change in activity classification, duration (mins), frequency (days/wk), and intensity (mild, moderate, vigorous) from baseline to six months and twelve months. Being physically active was defined as reporting engaging in exercise or sport in or out of school on three or more days a week for 30 min or more per day at a moderate to vigorous intensity. | No difference in weekly minutes of MVPA by self-report or accelerometry was found between intervention and control at 12-months. Boys in the intervention increased their weekly number of active days while it remained the same in the control (P=0.01). The intervention's television viewing decreased by 1 hour a day. This was significantly different to the control where viewing time remained constant. In girls receiving a high intervention dose (over 9 counselling calls) there was increased likelihood of meeting health guidelines for television viewing. In boys both a high and low dose intervention resulted in a significantly greater likelihood of meeting physical activity guidelines. |</p>
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<tr>
<td>Prochaska and Sallis</td>
<td>RCT</td>
<td>138 (48 boys/90 girls) from 6th to 8th grade (average 12.1 years old)</td>
<td>This was a modified version of the Patient-Centred Assessment and Counselling for Exercise Plus Nutrition (PACE+) program. &lt;br&gt; The intervention was a once only brief exposure of up to 30-minutes duration and tailored feedback and individual behavioural plans which students followed for 3-months. &lt;br&gt; The physical activity and nutrition (PAN) group received feedback on physical activity and nutrition and the physical activity (PA) group feedback on physical activity only.</td>
<td>Average minutes of MVPA each day measured by accelerometry data from 1 week &lt;br&gt; Intention to follow behavioural plan &lt;br&gt; Participant satisfaction with program</td>
<td>At 3-months daily physical activity increased by an average of two minutes in boys in the physical activity and nutrition group and 9 minutes in boys in the physical activity group. Daily activity decreased by 33 minutes for boys in the control. &lt;br&gt; At 3-months girls in all groups decreased their average daily activity. &lt;br&gt; Over 70% of participants intended to follow their PACE+ plans. Most students liked PACE+ (77%), and would recommend it to others (82%). More of the physical activity and nutrition group (44%) than physical activity group (26%) rated the program as too long.</td>
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<td>Robbins et al</td>
<td>Quasi-experimental</td>
<td>77 inactive girls in 6th, 7th and 8th grade from 2 middle schools. &lt;br&gt; Intervention: 45 girls in one school. &lt;br&gt; Control: 32 girls in one school. &lt;br&gt; Participants were inactive on most days of the week and self-reported being in the contemplation or preparation stage.</td>
<td>A 12-week intervention targeting inactive girls in the contemplation or preparation stage of change. &lt;br&gt; All girls completed a baseline computer based questionnaire which included physical activity measurement. &lt;br&gt; The intervention group received tailored feedback and 10-minute counselling from a Pediatric Nurse Practitioner (PNP) at 3 points in the study. They were contacted by telephone three times to assess their achievement of activity goals. &lt;br&gt; Parents received information on supporting their daughters to be more physically active. The Nurse Practitioners received training in physical activity counselling. &lt;br&gt; The control group received a pamphlet on age specific physical activity guidelines.</td>
<td>Self-reported number of days of activity each week. &lt;br&gt; Self-reported minutes of MPA plus VPA for 4 days, 2 weekdays, 2 weekend days, yesterday or last weekday. &lt;br&gt; Self-reported total number of minutes in either moderate or vigorous activity for 4 days.</td>
<td>Both groups reported participating in activity one more day each week and increased total participation time after 12-weeks than at baseline. &lt;br&gt; The intervention group reported significantly more social support to be physically active over time (P=0.019). &lt;br&gt; The program was viewed favourably by the majority of intervention: 95% said they would use the program again and 63% rated their time with the nurse as helpful. None of the intervention group made an appointment for contract renegotiation at end of the study period.</td>
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<td>Werch et al 2003</td>
<td>Randomised experimental design with no control 5-weeks duration with 3 month follow-up School setting</td>
<td>454 students in the 8th grade from 3 schools. Brief sport consultation: 152 Sport and alcohol consultation: 150 Sport and alcohol consultation plus parent material: 152</td>
<td>Students were randomly assigned to one of three intervention arms described below for the five week program. The sport consultation consisted of a health and fitness screen which informed tailored prevention messages and the development of a student contract. The sport and alcohol consultation also received an alcohol preventive consultation addressing risk and protective factors for alcohol use. In the sport and alcohol and parent material consultation, a parental SPORTS card was mailed home once a week for five weeks.</td>
<td>MPA and VPA measured by Youth Risk Behaviour Survey MPA was at least 30 minutes of breathing hard and VPA was at least 20 minutes of sweating and breathing hard.</td>
<td>Significant effects were found at 3-months for both moderate (P&lt;0.01) and vigorous (P&lt;0.01) physical activity. That is, the amount of physical activity in which students reported participating increased over time.</td>
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<td>Werch et al 2005</td>
<td>RCT</td>
<td>604 students in the 9th (335) and 11th (269) grades from one high-school Intervention: 302 Control: 302</td>
<td>Students participating in Project SPORT completed a health behaviour screen, received a face-to-face consultation and take-home fitness prescription targeting adolescent health promoting behaviours (including alcohol risk and protective factors). This was reinforced by mailing home key consultation details. The minimal intervention control received a wellness brochure through school and adolescent health promotion materials were sent home.</td>
<td>MPA and VPA in previous 7 days measured by Youth Risk Behaviour Survey MPA was at least 30 minutes of breathing hard and VPA was at least 20 minutes of sweating and breathing hard.</td>
<td>At 3-months post intervention, the intervention group was found to participate in significantly more moderate physical activity of the control (P=0.007). While at the 12-month follow-up, the intervention engaged in more moderate and vigorous physical activity than the minimal intervention control, the difference was not significant.</td>
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### Table 2. Summary of studies creating physical environments and developing policy within schools to increase opportunities to be physically active

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<tr>
<th>Ref</th>
<th>Design</th>
<th>Participants</th>
<th>Intervention description</th>
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<td><strong>Cass and Price</strong>&lt;br&gt;2003</td>
<td>Pre- and post study with comparison to historical controls&lt;br&gt;3-years duration&lt;br&gt;School setting</td>
<td>One high school with 111 year seven students and 127 year ten students acting as controls.&lt;br&gt;Intervention: 111&lt;br&gt;Control: 127&lt;br&gt;Girls were from predominantly non-English speaking backgrounds</td>
<td>A needs assessment informed strategies to increase girls’ participation in physical activity within the Health Promoting Schools framework.&lt;br&gt;A range of strategies addressing the curriculum as well as physical, social and organisational environments of the school and partnerships with parents and outside agencies were implemented.</td>
<td>Self-reported vigorous activity - 20 mins at least 3 times a week and moderate activity – total of at least 3.5 hours over at least 5 sessions a week.&lt;br&gt;Activity measured using the 1997 NSW Schools Fitness and Physical Activity Survey.&lt;br&gt;Environmental audit using 1997NSW Schools Fitness and Physical Activity Survey.</td>
<td>The main influence of the project was on girls who were inadequately active. After 3-years, the proportion of girls reporting they were inadequately active was 21% in the intervention compared to 40% in the historical control (P&lt;0.01).&lt;br&gt;Increases in activity occurred during school hours but no differences were reported in activity outside of school.&lt;br&gt;Girls in the intervention group reported spending less sedentary recreation time each day (3-hours) compared to the historical control (4-hours) (P&lt;0.05).&lt;br&gt;Teachers reported increased use of indoor and outdoor facilities as well as increased provision lunch time activities (P&lt;.05).</td>
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<td><strong>Pate et al</strong>&lt;br&gt;2005</td>
<td>Experimental cohort&lt;br&gt;Schools paired and randomly assigned to control and intervention&lt;br&gt;12- months duration&lt;br&gt;School setting</td>
<td>24 schools (12 intervention and 12 control)&lt;br&gt;Baseline data was collected on 2744 girls in 8th grade&lt;br&gt;Intervention: 1523&lt;br&gt;Control: 1221&lt;br&gt;One year follow-up data available on 1604 girls in the 9th grade&lt;br&gt;Intervention: 863&lt;br&gt;Control: 741</td>
<td>The intervention Lifestyle Education for Activity Program (LEAP) was designed to change teaching practices and school environments to increase support for activity among girls.&lt;br&gt;LEAP consists of 6 components: PE, health education, school environment, school health services, staff health promotion and family/community involvement.&lt;br&gt;The LEAP PE program included gender specific, ‘girl friendly’, choice based instruction with an aim to involve girls in moderate activity for at least 50% of class time. Activities enjoyed by young women were included in PE classes in addition to sports and traditional PE activities. Health education lessons taught the skills needed to adopt and maintain an active lifestyle.&lt;br&gt;Environmental activities included modelling by staff, increased communication about activity, promotion of activity by the school nurse and family based activities.</td>
<td>Participation in one or more 30-minute blocks of vigorous physical activity per day in previous 3 days.&lt;br&gt;Participation in 2 or more 30-minute blocks of moderate to vigorous physical activity per day in previous 3 days.&lt;br&gt;Activity measured with self-reported 3 day recall.</td>
<td>At 12-months, regular vigorous physical activity was approximately 8% greater in the intervention group. This was a significant difference (P=0.05).&lt;br&gt;After 12-months approximately 45% of girls in the intervention had participated in at least 30 minutes of vigorous activity per day over the previous three days compared to 36% of girls in control schools (P&lt;0.05).&lt;br&gt;After 12-months the majority of girls in both the intervention (72.3%) and the control (70.3%) schools reported participating in at least 60 minutes of MVPA over the previous three days. This was similar to baseline measurements.</td>
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<tr>
<td>Ref</td>
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<td>Sallis et al 2003</td>
<td>RCT</td>
<td>24 middle schools each with an average enrolment of 1109 students</td>
<td>This 2-year intervention aimed to increase physical activity by changing school policy and environments so that they provided more opportunities to be active.</td>
<td>Energy expenditure from moderate to vigorous activity while at school.</td>
<td>After 2-years time spent being active at school increased significantly more in intervention schools than control schools (P&lt;0.009).</td>
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<td>McKenzie et. al 2004</td>
<td>Random assignment of schools 2-years duration School setting</td>
<td>Intervention: 12 schools Control: 12 schools 44.5% non Caucasian students</td>
<td>The physical activity component was designed to increase activity during physical education lessons by changing the lesson context and/or structure as well as teacher behaviour. Strategies to achieve this included: using community providers, providing professional development for teachers, funding equipment and promoting physical education within the school. Nine of the schools provided single-sex physical education about 20% of the time. Environmental strategies included: making equipment available to students, increasing supervision, buying additional equipment as well as organising and promoting activities. Parental education was delivered using the existing communication mechanisms and was send as changing the communication environment.</td>
<td>SOFIT was used to observe physical activity in a random sample of PE classes. SOPLAY was used to observe leisure time activity. Data was collected on random days, in all locations for activity before and after school and at recess and lunch. Student seven day self-reported recall of activity and sedentary behaviour.</td>
<td>After 2-years students in the intervention schools increased their MVPA in physical education lessons by approximately three minutes (P=0.02). Boys increased MVPA by about 4-minutes each lesson and in girls the increase was about 2-minutes each lesson. After 2-years, students in intervention schools were active for about 52% of physical education class time, while in control schools, students were active for about 48% of class time. Boys-only (average 19-minutes) and mixed (average 18-minutes) physical education classes provided more MVPA than girls-only (average 13-minutes) classes. Girls were more active in mixed classes than girls-only classes. Boys in intervention schools increased their activity in both physical education and break times (P&lt;0.001). Girls in intervention schools increased their activity in physical education but there was little change in their break time activity. The impact of the intervention on self-reported total physical activity or sedentary behaviours was not significant.</td>
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<td>Haerens et al. 2006</td>
<td>Clustered RCT</td>
<td>2840 7th and 8th grade students (11-15 yrs) from 15 schools</td>
<td>This program, implemented over a period of 2 school years, aimed to increase physical activity and promote healthy eating. Schools created opportunities for students to be active during the day. This included varying activity types, providing extra sports equipment and offering non-competitive activities. In class time, students completed a CD intervention for physical activity. In the first year, intervention schools received guidance from research staff. In the second year schools were required to continue to implement the program more independently. Working groups, in each intervention school, received background information, a manual and educational material. Meetings were held to guide implementation. In schools in which parental support was provided, parents were invited to interactive meetings on physical activity and health, received written information on health and were given a copy of a CD intervention for physical activity tailored to adults.</td>
<td>Total Physical activity – consisting of school related physical activity, leisure time sports and leisure time active transport measured by self-report. Accelerometers measured activity on a sub-sample of 258 students Outcome variables measured at one and two-years.</td>
<td>After 12-months, daily school-related physical activity increased significantly in the parental support (6-minutes) and intervention only (4-minutes) group compared to the control (P&lt;0.05). Separate overall results for boys and girls were not reported at 12-months. The proportion of participants meeting recommendations increased by 7% in the parental and 5% in the intervention only groups, while remaining stable in the control. The changes were non-significant. Leisure time sports decreased in all groups but the decreases were small and not significant. Leisure time active transportation decreased in all groups. In girls in the control group this decrease (4-minutes) was significant (P&lt;0.001). After 2-years, daily school physical activity had increased significantly more in boys in the intervention groups (7-minutes) than the control (1-minute) (P&lt;0.05). After 2-years daily school related physical activity of girls in the intervention groups had increased by 4-minutes (non significant). The daily school related physical activity of girls in the control decreased by one minute. Daily LPA decreased significantly less in boys in the intervention group (6-minutes) than in the control (39-minutes) (P&lt;0.001). MVPA remained stable in intervention groups, but decreased in the control. This result was approaching significance. In girls, accelerometer data showed daily LPA decreased significantly less in the intervention (2-minutes) than the control (20-minutes) (P&lt;0.05).</td>
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<tr>
<td>School-Based Randomized Controlled Trial of a Physical Activity Intervention among Adolescents West Flanders, Belgium</td>
<td>Clustered RCT</td>
<td>2840 7th and 8th grade students (11-15 yrs) from 15 schools</td>
<td>This program, implemented over a period of 2 school years, aimed to increase physical activity and promote healthy eating. Schools created opportunities for students to be active during the day. This included varying activity types, providing extra sports equipment and offering non-competitive activities. In class time, students completed a CD intervention for physical activity. In the first year, intervention schools received guidance from research staff. In the second year schools were required to continue to implement the program more independently. Working groups, in each intervention school, received background information, a manual and educational material. Meetings were held to guide implementation. In schools in which parental support was provided, parents were invited to interactive meetings on physical activity and health, received written information on health and were given a copy of a CD intervention for physical activity tailored to adults.</td>
<td>Total Physical activity – consisting of school related physical activity, leisure time sports and leisure time active transport measured by self-report. Accelerometers measured activity on a sub-sample of 258 students Outcome variables measured at one and two-years.</td>
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<td>2-years duration</td>
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<tr>
<td>Bayne-Smith et al 2004</td>
<td>Controlled trial</td>
<td>442 girls aged 14 – 19 years living in inner city areas. Intervention: 310 Control: 132</td>
<td>PATH is a personal wellness course that includes vigorous exercise, health and nutrition education and behaviour modification. PATH consisted of a single 30-minute class 5 days a week. Lessons consisted of a 5-10 minute lecture followed by 20-25 minutes of vigorous activity. Students in the PATH group were given manuals providing relevant information. Teachers of PE received PATH manuals containing instructions for teaching the program and assessing outcomes. The control group took part in usual PE classes but without the introductory lecture.</td>
<td>Self reported out of school time physical activity - the number of activities each week in which students participated in for a minimum of 15 mins.</td>
<td>The average number of out of school physical activity sessions of the intervention group increased from 4.5 each week to just over 5 sessions each week. The average number of out of school physical activity sessions of girls in the control increased from five times a week to five and a half times a week. These changes were not found to be significant.</td>
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<tr>
<td>Fairclough and Stratton 2006</td>
<td>Clustered RCT</td>
<td>Two classes of year seven girls aged 11 – 12 years from the same coeducational school. Intervention: 1 class Control: 1 class</td>
<td>In this 6-week study, the intervention and control class were taught gymnastics lessons based on the same unit of work. The intervention was based on teachers including enhanced physical activity levels as one of the lesson objectives. The teacher of the intervention class was informed of the purpose of the study. The teacher was instructed to include a range of principles in the delivery of lessons. This included organisation of space, lesson pace, teaching strategies, active learning, minimising teacher talking time and emphasising fun and inclusion. The control participated in lessons planned and delivered in the regular manner. The teacher was not informed of the purpose of the study.</td>
<td>Proportion of class time spent in MVPA. Estimated average energy expenditure (EER) per student. Estimated total energy expenditure (TEE) per student each lesson. SOFIT was used to establish activity levels of students and measure lesson context. Each lesson of the intervention and control were taped.</td>
<td>At baseline, both classes spent the majority of class time in general knowledge and skill based activities. At baseline, the control accumulated more class time MVPA (17.5%) than the intervention (12.9%). At the 6-week follow-up the intervention engaged in significantly more class time MVPA (18.5%) than the control (13.5%) (P&lt;0.05). The class-time MVPA of the control group had decreased at the 6-week follow-up. The estimated TEE was similar in both classes but the estimated EER was 8% greater in the intervention class. The intervention class had significantly more opportunities for skill practice (43.1%) than the control class (34.7%) (P&lt;0.05). The control teacher devoted more time to management tasks (18.4%) than the intervention (13.5%) and included more general instruction (75.4%) than the intervention (66%).</td>
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<td>Ref</td>
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<td>Neumark-Sztainer et al 2003</td>
<td>Cohort</td>
<td>201 girls from 9th to 12th grade (average 14.4 years) from 6 schools (3 intervention and 3 control) Intervention: 89 Control: 112</td>
<td>New Moves aimed to provide classroom environments in which larger girls could feel comfortable engaging in physical activity. Girls in the intervention groups participated in a 'girls-only' physical education class five days a week for sixteen weeks and then weekly lunch time maintenance meetings for eight weeks. Physical activity was offered four times each week. One session was provided by a community guest instructor, one devoted to strength training and the remaining two included a variety of activities chosen by individual PE teachers. The remaining lesson each week was allocated to nutrition and social support in an alternate week basis. A New Moves coordinator supported teachers with weekly visits and resources. A series of postcards were mailed to parents throughout the sixteen week intervention.</td>
<td>Self reported weekly hours of vigorous, moderate and mild physical activity outside of physical education class. Self reported physical activity stage of change.</td>
<td>At baseline the average time spent in moderate-to-vigorous activity outside of physical education class each week across the entire group (intervention and control) was just over 3-hours. Average weekly minutes of activity outside of physical education class increased from 6.21 hours post intervention (16-weeks) to 6.31 hours at follow-up (8-months) in the intervention group. In the control it increased from 5.87 hours post intervention (16-weeks) to 6.24 hours at follow-up (8-months). At 16-weeks, 31% of girls in the intervention moved along the stages of change and 19% had regressed. In the control 20% moved along the stages of change and 24% regressed. At 8-months, the stage of change was unchanged in the control while 38% of the intervention progressed and 11% regressed (P=0.004). Parents and participants reported high levels of satisfaction with the program and its specific components.</td>
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<tr>
<td>Jamner et al 2004</td>
<td>Quasi-experimental</td>
<td>47 sedentary adolescent females in 10th or 11th grade at one of two schools. Intervention: 25 Control: 22</td>
<td>The participants in the intervention school enrolled in a special physical education class only available to those in this four month study. This class met for 60-minutes a day 5-days a week. This equated to approximately forty minutes of physical activity time each day. One day a week was devoted to a lecture and discussion on the health benefits of activity and strategies to become active. Focus groups also resulted in changes being made to activities offered to the girls in physical education lessons and uniform and assessment requirements of the study participants.</td>
<td>Number of METs expended on light, moderate and hard physical activity measured by 2 day recall. Number of 30 mins blocks of light, moderate and hard physical activity. Frequency of non-programmed activity Structured activity measured using a 2 day physical activity recall.</td>
<td>Total energy expenditure increased in the intervention group and decreased in the control after 4-months (P=0.04). In the intervention, participation in any hard activity over the previous two days increased from 48% at baseline to 83.7% at follow-up (P=0.006). In the control little change was seen in participation in hard activity. Daily MPA decreased in both groups, but less so in the intervention, who at the end of the study, participated in significantly more MPA (98-minutes) each day than the control (72-minutes) (P=0.007). By the end of the study, the intervention participated in significantly more LPA than the control (P=0.02). The intervention had a significant effect on leisure time activity participation. The average number of items identified by the intervention group increased from just over 2 at baseline to just over 3 at follow-up (P=0.005).</td>
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### Table 4. Summary of studies combining curriculum, environment and policy with parent/community components

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<thead>
<tr>
<th>Ref</th>
<th>Design</th>
<th>Participants</th>
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<th>Key findings/ Outcomes</th>
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<tbody>
<tr>
<td>Simon et al</td>
<td>Cluster RCT 6-month</td>
<td>954 adolescents (average age 11.4 years) from 8 schools</td>
<td>This presents the 6-month results of an intervention intended to be 4-years duration. ICAPS aims to affect intra-personal, social and certain environmental determinants of physical activity. The intervention includes education on physical activity and sedentary behaviours. In addition, new opportunities to be active during and outside of school hours are offered, taking into account the barriers to activity and sporting events are organised. Teachers, parents and sporting associations are encouraged to participate through meeting and regular contact. Participating schools receive support from ICAPS coordinators through regular visits and staff training. The control group followed the usual health and physical education curriculum.</td>
<td>Body Mass Index</td>
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<td>2004</td>
<td>results of a study of 4-years duration School setting</td>
<td>Intervention: 4 schools (475)</td>
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<td>Leisure organised physical activity for the past year measured with the Modifiable Activity Questionnaire for Adolescents Sedentary activities recorded for each day of a typical week After 6-months of the intervention, the proportion of girls in the intervention reporting participation in leisure time activity increased significantly from 59% to 83% (P&lt;0.01). In boys in the intervention, leisure time activity also increased significantly from 69% to 81% (P=0.01). Girls and boys in the control reported little change.</td>
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### Table 5. Summary of studies to develop adolescents’ skills to be physically active

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<tr>
<th>Ref</th>
<th>Design</th>
<th>Participants</th>
<th>Intervention description</th>
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<tbody>
<tr>
<td>Frenn et al 2003</td>
<td>Quasi-experimental</td>
<td>341 students in 7th and 8th grade from 2 high-schools</td>
<td>In this study 4 Internet/video sessions were supplemented with a healthy snack session. In 1 of the intervention schools there was an additional</td>
<td>Physical activity over 7 days measured by Children and Adolescent Activity Log</td>
<td>At the end of the study both the intervention and control groups had decreased their MVPA. In the intervention weekly MVPA decreased by about 9 minutes while in the control it decreased by 36-minutes (P= 0.02)</td>
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<td></td>
<td>12-months duration</td>
<td>Only 130 were included in final data analysis due to missing data</td>
<td>of the intervention schools there was an additional gym class of approximately 50-minutes. The intervention was tailored to each student’s stage of change.</td>
<td></td>
<td>In the intervention group, physical activity increased among those in the lowest income bracket except for Native Americans (P=0.04). Those who participated in the gym lab increased their physical activity. Those in the Internet/video group decreased their physical activity but not to the same extent as the control group.</td>
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<td></td>
<td>School setting</td>
<td>Intervention: 67 Control: 63</td>
<td>change focused on raising awareness of current exercise patterns and identifying barriers to activity. Those in the preparation, action and</td>
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<td>maintenance stages were trained as ‘peer models’ and led exercise labs with assistance from teachers and the school nurse.</td>
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<td>Students in the intervention groups received online feedback for each Internet session.</td>
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<td>The control group was delivered the usual school curriculum.</td>
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<td>Frenn et al 2005</td>
<td>Quasi-experimental</td>
<td>132 students from 7th grade in one high-school</td>
<td>This 4-week study, consisted of 8 Internet/video sessions, and was delivered through science class. Each session lasted for 40-minutes.</td>
<td>Physical activity over 3 days measured with the Child and Adolescent Activity Log</td>
<td>Students in the intervention group who completed more than half of the sessions increased their average moderate-to-vigorous exercise by 22-minutes compared to a decrease of 42-minutes in the control group (P= 0.05). Those in the intervention, who completed all the physical activity sessions, increased their moderate-to-vigorous exercise each day by 33-minutes. Tailoring the intervention to stage of change appeared to be effective except for those in the preparation stage for physical activity.</td>
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<td></td>
<td>4-weeks duration</td>
<td>Only 103 were included in the final analysis due to missing data</td>
<td>As part of each session, 4 short videos (2-3 minutes) were used to deliver stage-based messages on physical activity and healthy eating. Strategies were included that focused on each stage of change with particular emphasis on the</td>
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<td></td>
<td>School setting</td>
<td>Intervention: 60 Control: 43</td>
<td>pre-contemplation and contemplation stages.</td>
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<td>Each session also included activities which focused on consciousness and behaviour change. The intervention group responded to a series of questions and received computer generated feedback based on their stage of change. They were provided with structured workbooks to support the Internet sessions.</td>
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<td>The classes allocated to the control group took part in their regular curriculum.</td>
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<td>Hortz and Petosa 2006</td>
<td>Quasi-experimental 8-weeks duration School setting – rural schools</td>
<td>240 students from 9th to 12th grade in 2 rural high-schools Intervention: 1 school (143 students) Control: 1 school (97 students)</td>
<td>In addition, to regular physical education classes, students in the intervention group were exposed to the ‘Planning to be Active’ program. This was delivered in 1 physical education lesson each week. It was delivered by the investigator who developed the curriculum. The program covered: outcomes of being active, self-efficacy as well as planning and monitoring their own activity levels and Incentives were provided for students who achieved goals related to exercise. To participate in the study, students had to be enrolled in physical education and have at least and 80% attendance record.</td>
<td>Meeting moderate-to-vigorous and vigorous leisure time physical exercise recommendations Self-reported activity over 7 days using the Previous Day Physical Activity Recall</td>
<td>At pre-test, none of the intervention group and 3.1% of the control group met weekly leisure time MVPA recommendation (5 or more days). Also, 14% of the intervention and 11.3% of the control group reported leisure time VPA on the recommended 3 or more days in the previous week. At post-test, 18.9% of the intervention group and 12.4% of the control group met weekly leisure time MVPA recommendation (five or more days) (P&lt;0.01). At post-test three or more days of leisure time VPA a week was reported by 22.4% of the intervention group and 29.8% of the control group (P&lt;0.01).</td>
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<td>Jago et al 2006</td>
<td>Quasi-experimental Troops randomly assigned to the intervention or control after baseline data collection 9-weeks duration Community group setting - scouts</td>
<td>Boy scouts aged 10-14 years old from the greater Houston area. Total 473 scouts from 42 troops Intervention: 240 scouts Control: 233 scouts Spring program =16 troops; Fall program =26 troops.</td>
<td>The 9-week Fit for Life physical activity intervention included skill building activities at troop meetings, internet-based role modelling, goal setting, goal review and problem-solving. Sessions were led by trained staff. Boy Scouts “drills booklet” given to boys to encourage more physical activity outside of troop meetings. As part of the Internet-based component boys were asked to log onto website at least two times per week. This component included a behaviour change and goal setting program, role-modelling comic characters and problem solving. Boys received points for attending troop sessions and logging onto the website. All who obtained 70% of available points were awarded badges at the end of the program. The control received a fruit and vegetable intervention that mirrored physical activity intervention.</td>
<td>Accelerometry from 3 consecutive days. Self-reported physical activity self-efficacy and preferences.</td>
<td>The light physical activity of the Spring intervention group significantly increased from 143 minutes at baseline to 156 at 9-weeks post-intervention (P=0.01). The Spring intervention group also showed a significant decrease in sedentary minutes from baseline to post-intervention, from 908 minutes to 896 minutes. However at 6-months, there were no differences in LPA or sedentary minutes compared to baseline. The increases in sedentary time and decreases in LPA in the control were not significant. The intervention had no effect on MVPA minutes in the intervention compared to the control.</td>
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<tr>
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<tr>
<td>Marks et al 2006</td>
<td>Randomised study 2-weeks duration Roasted study with recruitment through schools</td>
<td>319 Girls in grades 6-8 from four middle schools, with home telephone and internet access. Prin group: 161 Web group: 158 At baseline, no sig. differences between 2 groups; 51% African-American, 38% Caucasian, 11% Hispanic/other.</td>
<td>This 2-week study compared a web-based physical activity intervention with an identical printed material in the form of a workbook. The intervention took place within the home. Participants in the website group had access to a password protected website containing resources to promote physical activity which included interactive games, a quiz, daily activity planning chart, interactive demonstrations of different types of activities. Website was password-protected and girls were mailed the password. The print workbook containing identical content and graphics from the website. All materials were mailed to homes. Girls were asked to view the materials at least 4-times over the study period. There was no parental involvement in the implementation phase of this study.</td>
<td>Data collected at pre and post via telephone surveys. Primary outcomes: physical activity self-efficacy, physical activity intentions. Secondary outcomes: Self-reported PA over the past 7 days.</td>
<td>In both groups there were significant increases in intention to be physically active (web: P=0.02; print: P&lt;0.001) and physical activity self-efficacy (web: P=0.01; print: P=0.002) after 2-weeks. The print group had a significantly greater change in intention to be physically active than web group (P&lt;0.001). Self-reported physical activity increased significantly in the print group only (P=0.002). Low activity girls (less than three days a week) at baseline reported significant increases in MPA in both web (P=0.001) and print groups (P&lt;0.001). The average increase in MPA was 2-days a week in the print group compared to 1 day a week in the web group. The increase was significantly greater in the print group (P=0.04). Process evaluation indicated non-significant differences between the groups on self-reported frequency and duration of time spent using the study materials. Girls in the print group were significantly more likely to recall all sections of the materials (print: 54%, web: 41%; P&lt;0.003), and more likely to report spending more time or a lot of time thinking about the information (print: 74%, web: 58%; P=0.02).</td>
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<tr>
<td>Young et al 2006</td>
<td>RCT 8-months duration School setting</td>
<td>211 girls in the 9th grade in one single sex high-school Intervention: 115 Control: 105 83% African American</td>
<td>An 8-month alternative physical education program that aimed to increase physical activity and decrease sedentary behaviours. The program was delivered by a teacher hired specifically for the project. The program was tailored to assist students in making informed decisions about the benefits of being active, develop problem-solving skills and obtain support. It focused strongly on self-monitoring of activity levels. Standard physical education classes in which students took part taught units active in nature. A family support component included a family workshop, newsletters and family based homework. The control participated in physical education classes each week, taught by a trained teachers working in the school. Their parents also received a newsletter each month on various health topics.</td>
<td>Self-reported daily physical activity measured by energy expenditure using 7 day recall Self-reported sedentary activities.</td>
<td>Intervention classes spent significantly more physical education class time (47%) engaged in moderate-to-vigorous activity compared to the control (30.5%) (P&lt;0.001). There was no difference in daily energy expenditure within the intervention group or between the intervention and control group.</td>
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Table 6. Summary of studies of pedometer interventions providing feedback and encouraging goal setting

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<tr>
<td>Schofield et al 2005</td>
<td>Quasi-experimental 12-weeks duration School setting</td>
<td>85 girls in years 11 and 12 (average 15.8 years) from three schools. Pedometer Intervention (PED): 27 Minutes Intervention (MIN): 28 Control: 30 Participants were classified as being low-active.</td>
<td>In this 12-week study, girls were divided into groups of eight and received a log book and information on how they could be more active each day, overcoming barriers to being active and injury prevention. Groups met for thirty minutes a week in the first six weeks of the program. The log book for the minutes intervention referred to minutes of daily activity and the pedometer intervention to daily step counts. Girls were encouraged to increase their step counts or minutes of activity each week until they reached a prescribed target level. In the second six weeks, focus shifted to maintaining activity levels. Participants received three reminder post cards with activity tips and encouragement.</td>
<td>4 day step counts using a pedometer Total 30 min blocks of MVPA and VPA using self-reported 3 day recall</td>
<td>There was a significant increase at 12-weeks in the number of steps taken over four days by both the pedometer (11,000) and minutes (8,500) group (P&lt;0.001). At 12-weeks the pedometer group took significantly more steps over 4-days than the control (P=0.03). At the end of the intervention MVPA of the pedometer group had increased by 33 minutes over 3-days and VPA increased by 39-minutes over 3-days. In the minutes group MVPA increased by 84-minutes and VPA by 36 minutes over a 3-day period. The control decreased their MVPA by 12 minutes and increased their VPA by 6-minutes over a 3-day period. These differences between the control and intervention groups at 12-weeks were not significant.</td>
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<tr>
<td>Zizzi et al 2006</td>
<td>Quasi-experimental Random allocation to cohorts by recent physical activity history 3-weeks duration School setting</td>
<td>165 students (56 boys/109 girls) from 4 high schools Pedometer plus goal setting: 84 Pedometer only: 81</td>
<td>Students wore a pedometer for 3-weeks. The goal setting group established a daily step count goal after wearing the pedometer for 1-week. They also received a health related handout each week to assist with the goal setting process. A log was provided to students each week to remind them to wear the pedometer and to track their weekly steps. No feedback was given on whether their weekly step count goal was met. Students were provided with face-to-face session on the proper wear and use of their pedometer. The pedometers were also calibrated and tested in this session. As an incentive to enrol in this project, participants were offered a free pedometer.</td>
<td>Daily step counts measured by pedometer</td>
<td>There average number of steps taken per day increased by 179 to reach 9014 in the goal setting group and by 463 to reach 9486 in the pedometer only group. Few students met the target of at least 11,000 steps per day. The intervention led to an increase of 5% - 8% of students meeting daily step targets.</td>
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