Building solutions for preventing childhood obesity

Module 7

Interventions to reduce sedentary behaviours
Building Solutions for Preventing Childhood Obesity

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Interventions to reduce sedentary behaviours

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
- **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 6:** Interventions to increase physical activity in adolescents

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# Table of contents

1  Background and methods  
   1.1  Overview  
   1.2  Search strategy  
   1.3  Inclusion and exclusion criteria  

2  Problem analysis and rationale for intervention  

3  Available intervention evidence  
   3.1  Community programs with parental and home-based components  
   3.2  Brief counselling with tailored feedback, advice, follow-up in the primary health care setting  
   3.3  School programs with education, environment and/or policy components  
   3.4  Feedback, reward and reinforcement interventions  
   3.5  School-based education programs integrated into the curriculum  

4  Evidence appraisal  
   4.1  Community programs with parental and home-based components  
   4.2  Counselling with tailored advice, feedback and follow-up  
   4.3  School-based programs with education, environment, policy and/or family and community components  
   4.4  Feedback, reward and reinforcement interventions  
   4.5  School-based education programs integrated into the curriculum  
   4.6  Gaps and Clusters  

5  Promising and appropriate strategies  

6  Implications for policy and practice  
   6.1  Implementation considerations  
   6.2  Portfolio approach  
   6.3  Translating evidence into cross-sector actions  

7  References  

8  Appendix. Tables summarising the available intervention evidence for reducing sedentary behaviours
1 Background and methods

1.1 Overview
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’.

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 reduce sedentary behaviours are outlined below.

1.2 Search strategy
The search strategy included identifying studies and interventions which targeted sedentary behaviour among children aged five years and older, and adolescents published between February 1997 and February 2007 in peer-reviewed journals were identified by searching the Medline, database and by consulting systematic reviews.

The key search terms for this module were:

(Sedentary behaviour OR inactivity OR television viewing) AND (Child OR child, preschool OR adolescent)

1.3 Inclusion and exclusion criteria
The following exclusion and inclusion criteria were applied to research papers identified through the search strategy.

Inclusion criteria
- Studies with population-level focus.
- Studies with individual-based approaches.
- Studies with randomised controlled trial or quasi-experimental designs.
- Studies which focused on the treatment or management of overweight/obesity.

Exclusion criteria
- Sample size of less than sixteen participants.
- 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

The increasing prevalence of overweight and obesity among young people is a major public health concern. Being in an unhealthy weight range is a risk factor for chronic conditions including type II diabetes, cardiovascular disease, fatty liver disease, joint abnormalities as well as psychological health problems\textsuperscript{2-3}. There is also evidence that being overweight or obese during childhood and adolescence increases the risk of being overweight or obese in adulthood\textsuperscript{2-4}. Lifestyle factors are considered to be an important mediating factor in the development of overweight and obesity in children and adolescents\textsuperscript{2} and engaging in sedentary pursuits is thought to contribute to overweight and obesity in children and adolescents.

There are powerful societal inducements to be inactive and there are increasing concerns of an emerging preference among young people to adopt sedentary lifestyles\textsuperscript{5}. In New South Wales (NSW), students in Years Six, Eight and Ten spend approximately 34 hours, 41 hours and 45 hours per week respectively, of their discretionary time engaged in sedentary behaviours\textsuperscript{6}. Sedentariness comprises a spectrum of low energy expenditure behaviours (MET < 1.8) and many sedentary activities in which young people engage, such as sitting around talking, reading, hobbies, and homework provide positive social and psychological benefits and should be encouraged. Of all time spent in sedentariness, small screen recreation (ie television/video/DVD viewing, computers and e-games) is the most popular activity undertaken by young people during their leisure time\textsuperscript{7}. In NSW approximately half of all students’ sedentary behaviour was spent in small screen recreation\textsuperscript{8}.

Interestingly, a meta-analysis of television viewing suggests that the mean viewing time per day has remained relatively stable over the past 50 years\textsuperscript{9}. However, what has changed is that the proportion of households with television sets has increased dramatically including the number of children with televisions in their bedrooms. These changes provide children with greater access and opportunity to watch television, so that while the mean viewing time may not have changed, there has been an increase in the proportion of children who are heavy viewers of television\textsuperscript{10}. The small screen recreation guidelines recommend that children and adolescents spend no more than two hours each day engaging in electronic media\textsuperscript{11, 12}. In NSW, over half of primary school students (61% of boys and 45% of girls) and more than 72% of high school students (77% of boys and 67% of girls) spend more than 2 hours per day on Small Screen Recreation\textsuperscript{13}.

Contrary to popular thought, there is clear and consistent evidence that small screen recreation does not displace physical activity\textsuperscript{14}. However there are very good reasons to target small screen recreation and television viewing in particular. Firstly time spent watching television could be spent in more active pursuits. Young people need to be taught how to be more discerning about their television viewing and how to re-allocate television time to activities which expend energy. Secondly, television appears to be a cue for eating and leads to the over-consumption of energy dense nutrient poor foods\textsuperscript{15, 16}. The causes of this may be associated with the high rate of unhealthy food advertising during children’s television viewing time\textsuperscript{17}. Australia has one of the highest rates of non-core food advertising to children\textsuperscript{18, 19}. If over-consumption of energy-dense nutrient poor foods is not countered by physical activity then energy imbalance occurs, contributing to weight gain. Thirdly, the evidence from a longitudinal study shows that television viewing habits set in early childhood track into adulthood and positively effect body mass index\textsuperscript{20}.

Multiple strategies are required to reduce the high prevalence of overweight and obesity among children. Interventions which target sedentary behaviours, and small screen recreation in particular have potential to change the current energy imbalance among young people. Encouraging children to exchange even thirty minutes of daily small screen recreation will lead to substantial health gains which will ensure better health outcomes later in life.
3 Available intervention evidence

Seventeen studies to decrease sedentary behaviour in children and adolescents have been reviewed as part of this module\(^1\). These studies, which are summarised in the Appendix have been categorised in the following manner.

- Community programs with parental and home-based components
- Brief counselling with tailored advice, feedback and follow-up in the primary health care setting
- School-based programs with education, environment and/or policy components
- School-based education programs integrated into the curriculum
- Feedback, reward and reinforcement interventions

3.1 Community programs with parental and home-based components

3.1.1 Stanford GEMS pilot study\(^{21}\)

*Stanford GEMS* was a twelve-week randomised controlled trial conducted through community centres among 61 African American girls aged between 8 and 11 years and their parents. The aim of this pilot was to reduce television and video use and was designed using a social cognitive framework. Each GEMS session was approximately 2.5 hours and consisted of a homework period (60-minutes), a dance session (60-minutes) and a 30-minute discussion exploring the role of dance in the girls’ lives. The program included an additional home-based component in which 5 lessons were delivered to the girls and their families, with an optional 6th visit. Girls in the control received monthly community health lectures and both they and their parents were sent newsletters on risk factors for cardiovascular disease. At the conclusion of the study, girls and their families in the intervention group reported spending less time watching television/videos and girls in the control group reported an increase in viewing times. Overall, the intervention group reported almost 5 hours less time per week watching television/videos compared with control group. Further, compared with the control group, girls in the intervention reduced the number of dinners eaten in front of the television each week.

*Appraisal*

This innovative dance-based intervention, had a positive effect on small screen recreation, and was well-received by the girls and their families. Unfortunately, there was no longer-term follow-up of the girls who took part and therefore the extent to which the effects of this intervention were maintained or even improved over time is not known. As a model of delivery it appears to be sound; it involved parents and encouraged replacing sedentary activities with more active pursuits. This program was conducted with African American girls and is therefore unlikely to be culturally appropriate or applicable to the NSW setting. Despite this, it would be interesting to replicate this model, adapted to meet the needs of the local population, and implemented over a longer-term with follow-up and evaluation.

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\(^{1}\) A small number of studies specifically involved overweight and obese children and adolescents and/or those identified as being high television watchers. When this it the case it has been clearly stated in the study of the description. All other studies were conducted on general groups of populations of interest.
3.2 Brief counselling with tailored feedback, advice, follow-up in the primary health care setting

3.2.1 Counselling with ongoing follow-up

In the United States, Epstein and colleagues conducted an intensive 6-month family-based treatment program, followed by fortnightly and then bi-monthly meetings over a 2-year period. The participants were recruited through a child obesity clinic and comprised 90 obese children aged 8 to 12 and their families. Children and their families were randomly allocated to 1 of 4 groups, which targeted physical activity or sedentary behaviour and a high or low dose treatment. (Treatment dose was either 10 or 20 hrs per week for low and high, respectively). Specific sedentary activities targeted by the program including watching television/videos, computer games, talking on the telephone and playing board games. Families received workbooks that introduced weight control self-monitoring, the Traffic Light Diet and techniques to achieve and maintain a change in behaviour. Throughout the program families attended individual meetings with a therapist during which weight, diet, target behaviours and contracts were reviewed. Children allocated to the increase physical activity groups were reinforced for increasing their activity, while children allocated to the sedentary behaviour groups received reinforcement for decreasing sedentary activities that compete with activity time or provide an occasion to eat. Although the program successfully decreased targeted sedentary behaviours, participants replaced these activities with other non-targeted sedentary activities. The intervention was successful in reducing both participants and their parent’s body mass index.

Appraisal

This intervention was conducted in a child obesity research clinic and did not have a true control group with which to compare the effects of the intervention. However, when targeting obese children it would not be considered ethical to not provide some level of intervention. The intervention was intense and sustained across a 2-year period and was effective in increasing levels of physical activity and reducing time spent in targeted sedentary behaviours in these children. In addition there was a positive impact on parents which is important given that overweight and obesity are family issues and ideally should be tackled as a family issue. However, this model would not be feasible or sustainable for population-based interventions. It was time and resource intensive and would be expensive to implement on a wide scale. A modified version may be suited to primary health care or child and family health settings, where the intensity could be tailored to meet the needs of individual children and their families.

3.2.2 Healthy Habits

Saelens and colleagues studied the effects of Healthy Habits, a 16-week telephone and mail-based behavioural intervention program initiated through a primary health care setting. The participants were recruited via a pediatric clinic and comprised 44 overweight adolescents aged 12 to 16 years who were interested in weight control. Adolescents were randomly allocated to either a single session of physician counselling (typical care) or a multi-component intervention. At baseline the intervention group undertook an eating, physical activity and sedentary behaviour assessment and developed individual plans. Sedentary behaviours included watching television sitting while talking on the phone or listening to music, or playing games on the computer. The intervention included an individual counselling session with a physician where adolescents discussed and finalised their action plans. Weekly telephone counselling sessions encouraged participants to: monitor their activity levels; achieve at least 60 minutes of moderate-to-vigorous physical activity at least 5 days a week; and decrease sedentariness by substituting sedentary behaviours with more active pursuits. Parents of the intervention group were sent information on how they could support change in their child’s physical activity and sedentary behaviours. The typical care group completed the baseline assessment and met with a physician for a brief counselling session. They were encouraged to change their own behaviour with the help of their family. The program had no effect on self-reported sedentary behaviour or physical activity participation in either the control or the intervention groups. However, at the end of the program and at the 4-month follow-up, 40% of the intervention group reduced their BMI compared with 10% of the control group.
Module 7 - Interventions to reduce sedentary behaviours

Appraisal

While this primary health care intervention of had a positive effect on body mass index of adolescents in the intervention group, at the end of the implementation phase self-reported sedentary time had increased in both groups. This may have been because there was no effect or the tool used to measure sedentary behaviours was not sensitive enough to detect a change or differences between the intervention and the control groups. It would be interesting to study the effects of this intervention with a larger sample size and using a more reliable and valid tool to measure sedentary activities. It should be noted that the intensity of this model is probably unsuitable for population based programs and if delivered through primary health care may miss those adolescents who do not regularly visit their general practitioner.

3.2.3 Counselling combined with television time managers

Ford and others investigated the effects of counselling in a 4-week primary health care intervention study to reduce television viewing among African American children aged 7 to 12 years and their families. Twenty-eight families participated and were randomly allocated to receive counselling only or counselling plus a behavioural intervention. Families in the counselling only arm of the study received a single counselling session of 5-10 minutes duration. Families in the counselling plus behavioural intervention group received an additional session providing a more in-depth discussion on setting television budgets, an information brochure on how to reduce children’s television viewing and an electronic television time manager which monitors television use. While there was no difference between groups in television time, both groups significantly decreased their usage of television/video and video games by approximately 14 hours each week. Both groups also reported a decrease in the number of meals eaten in front of the television, although these findings were not statistically significant. Families who were provided with the electronic television time manager had greater reductions in television viewing compared with those families who did not, indicating that such devices which provide an objective monitoring system hold potential to change behaviour.

Appraisal

One advantage of this study was that it did not specifically target overweight children and so provides an indication of the potential effects of counselling and feedback interventions among the general population. A positive short-term effect on children’s television viewing was detected at the end of 4 weeks. Unfortunately, this study had no true control and it would have been interesting to compare the results of these two models with a third group receiving typical care. Further, because the intervention was small scale both in sample size and duration it is difficult to determine whether the effects of the intervention are sustainable, especially once the electronic television manager is removed from the home. It would appear that the main motivator for reducing television time was the electronic television manager, which could be useful in clinic based interventions, but is probably not feasible to use in population based interventions.

3.2.4 Pace+ for Adolescents

The Patient-centered Assessment and Counseling for Exercise + Nutrition (PACE+) was a randomised controlled trial conducted through the primary care health setting to improve lifestyle factors associated with overweight and obesity. Adolescents allocated to the intervention group completed a tailorised computer-generated progress plan addressing their sedentary behaviors, physical activity and diet, followed by brief provider counseling and monthly tailorised 10-15 minute telephone and mail guidance for 1 year. The control group received a sun protection behaviour program using a similar process to the intervention. The intervention was conducted over 12 months among 878 adolescents aged 11 to 15 years. At the conclusion of this program, the differences in sedentary behaviours between the intervention group and the control group were significant. Boys and girls in the intervention group reduced their self-reported sedentary time each day by about 1 hour while a slight increase in sedentary time was reported by girls in the control group. In addition, boys in the intervention group increased the number of days on which they reported being active.
Appraisal

The 1-year PACE+ intervention was designed for the primary health care setting to promote the adoption and maintenance of improved lifestyle behaviours through a computer-supported intervention. The intervention group significantly reduced sedentary time, however there was no longer-term follow-up beyond the 12-month implementation period and so the sustainability of this model is not known. Despite this, tailored, stage-based brief counselling supplemented with regular follow-up may be a promising approach to reducing the time adolescents spend engaging in sedentary activities. Although no differences in body mass index were measured, maintaining this reduction in sedentary behaviours over time may result in longer-term changes to body mass index. Although this study suggests the effects of provider counselling with an adjunct tailored program for adolescents is limited, the methodology is worth further exploration. Using computers are a common daily activity for most adolescents, but the efficacy of implementing interactive behaviour change programs at a population level is yet to be established.

3.3 School programs with education, environment and/or policy components

3.3.1 Active Programme Promoting Lifestyle Education\textsuperscript{16,27}

The Active Program Promoting Lifestyle Education (APPLES) is a primary school based multidisciplinary, multi-agency program designed to influence children’s diet and physical activity, not simply knowledge. The program includes teacher training, modification of school meals and the development of school action plans targeting curriculum, physical education, canteens and playground activities. The efficacy of APPLES to reduce risk factors for obesity was evaluated using a group randomised controlled trial over a 1-year period. The 10 participating primary schools were paired according to size, ethnicity and social disadvantage and randomly allocated to either the intervention or the control group. This multidisciplinary program, underpinned by the Health Promoting Schools framework, seeks to influence children’s behaviours and knowledge. Strategies incorporated into the APPLES intervention included providing teachers with professional development, modifying school meals as well as developing and implementing school action plans to promote health eating and physical activity. During focus groups, children in the intervention schools reported higher levels of change in behaviour than children in the control schools. However, at the end of 12-months there were no differences detected in self-reported sedentary behaviour or leisure time physical activity between the intervention and control groups.

Appraisal

A key aspect of the APPLES program was that it was underpinned by the Health Promoting Schools Framework. The program was successful in achieving change in school policy, and has good potential population reach, however it did not result in a measurable change in sedentary activities. One disadvantage of the program was the lack of a parental component to support the school-based activities. Given that a lot of sedentary time will occur within the home, it could be argued that parent and family components are crucial to the success of interventions targeting small screen recreation. A significant limitation was measuring the count of sedentary behaviours over a 24-hour period rather than measuring the time spent engaged in sedentary activities. The total time spent in sedentary activity is potentially more important than the number of activities and may have yielded different results. Children participating in this study may have reduced their total time spent in sedentary activities while not necessarily reducing their total number of activities. Focus groups of students in the intervention schools suggest that there may have been a change in sedentary behaviours. The APPLES program suggests that whole-of-school approaches which adopt the health promoting schools model and incorporate teacher training and changes to curriculum and policy may hold promise to change unhealthy lifestyle behaviours. Because of the complex nature of school communities programs need long-term evaluation plans, as system changes tend to occur progressively across time.
3.3.2 Intervention centred on adolescents' physical activity and sedentary behaviours

The Intervention centred on adolescents’ physical activity and sedentary behaviours (ICAPS) is a multilevel 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 randomised controlled trial which commenced in 2002/3 in Eastern France. The intervention includes an educational component focusing on physical activity and sedentary behaviours as well as promoting new opportunities for physical activity during and after school hours. There is an emphasis on ensuring 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 has been evaluated. There were significant changes in sedentary behaviour after 6-months. Girls in the intervention group reported a 3% decrease in daily sedentary behaviours compared with a 14% increase among the control group. Among boys, there was a 35% decrease in daily sedentary behaviour compared with a 14% increase in the control group. At the same time, boys (81%) and girls (83%) in the intervention reported significantly greater levels of participation in leisure time physical activity than the control (66% boys and 50% girls).

Appraisal

Because ICAPS commenced in 2002/3 and is designed run over 4 years the evaluation of the implementation and effect on behaviour change is not available. However information on the programs first 6-months shows promise. Should these effects be maintained or improved over time, its augurs well for similar interventions to reduce sedentary behaviours and increase physical activity among adolescents from a range of socioeconomic and cultural 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 implementing changes which influence sedentary behaviour and physical activity. Importantly the program actively engages with and involves parents rather than providing only written information, which is often the standard approach. The provision of support and training for staff in intervention schools is a key strategy to foster program sustainability. The 6-month process evaluation suggests very good program fidelity and a reasonable reach. The final results from this intervention will be of interest to those working in health promotion.

3.4 Feedback, reward and reinforcement interventions

Understanding the psychology of behaviour is a necessary key to understanding how to change behaviour. Feedback systems are one such mechanism and are derived from control theory. Control theory helps to understand how certain sensors and feedback control a system and can be described as either an open- or closed-loop. A closed-loop system directly senses an output and then delivers a reward with out third party intervention. An example of a closed-loop system is the intervention implemented by Faith and colleagues (see below). Open-looped feedback systems include a third party in the loop that reviews the output and then dispenses reward (see Roemmich and colleagues and Goldfield and colleagues below).

3.4.1 Stationary cycle linked to the family television

This pilot study examined the effects of a contingent television strategy on physical activity and television viewing among 10 obese children aged 8 to 10 years. The novel aspect of this study was that television viewing was contingent upon pedalling a stationary cycle ergometer, where 1-minute of cycling equated to 2-minutes of television viewing. The study was conducted over a 12-week period, including a 2-week baseline period. Children in the control group were also provided with a stationary cycle but were not required pedal to watch television, but could if they chose. Children in the intervention group spent approximately 1.5 hours a week watching television compared with the control group who spent 21 hours per week watching television. Interestingly, the control group used the stationary cycle ergometer, but only in the first 2-weeks.
3.4.2 Pedometers with feedback, reinforced with television time

Roemmich and colleagues investigated the efficacy of an open-loop feedback system to change behaviours associated with overweight and obesity. Eighteen children were enrolled in this study and randomly allocated to an open-loop feedback plus reinforcement group or control group. All children wore an activity monitor and children in the intervention group received feedback from the monitor in the form of tallied activity counts. This was rewarded with television time (400 counts earned one hour of television time) which could be banked if desired. Television allowance units were placed in the homes of all children allocated to the intervention group and children could use their awarded time at any time during the week. Once their allowance ran out, children could not access the television again for the remainder of the week. For the control group the activity monitor display was turned off so they received no feedback on their activity levels and there was no contingency for watching television. Children in this group were given a goal of achieving 60 minutes of moderate-to-vigorous physical activity on most days of the week. Over the 6 weeks of the study, children in the intervention group engaged in 22% less sedentary behaviours and 32% more physical activity compared with children in the control group.

Appraisal

While there were some positive effects on sedentary behaviours as well as physical activity in children considered to be high television users, there were several limitations to the study. Five children (28%) withdrew from this study after randomisation and this loss to follow-up may have biased the measured effects of the intervention. However, the authors did report on an intent-to-treat basis. The intervention period was only 6-weeks and the extent to which any effects could be maintained over time, and without extrinsic motivation, are not known. Behavioural engineering models appear to be efficacious however the feasibility and sustainability of the intervention in this format is not well-suited to a population-based health promotion program. A potential modification to open-loop feedback design is to encourage parents to become the reinforcer of rewards.
3.4.3 Open-loop feedback with rewards and reinforcement\textsuperscript{21}

This study conducted by Goldfield and colleagues in Canada was to replicate the study undertaken by Roemmich and colleagues\textsuperscript{30}, but conducted over an 8 week period. The participants were 30 overweight or obese children aged 8 to 12 years who were recruited through a child obesity clinic. As with Roemmich’s study, the intervention was an open-loop feedback system. Access to sedentary activities, such as television viewing was contingent upon meeting specified physical activity levels. All children were provided with an activity monitor for the study period and randomly allocated to either the intervention or control group. Children in the intervention group were provided with a token which turned the television on. Tokens provided 1-hour of television/video/DVD time for every 400 steps (or approximately 1 hour of walking). The television would automatically turn off once the time the token provided was spent. Children in the control group were provided with feedback on their physical activity, but television/video/DVD time was not contingent on activity counts. Participants met twice a week with researchers to download activity steps and report time spent in physical and sedentary activity. Children in the intervention group had a significantly greater reduction in daily television viewing (decrease of 116 minutes per day) than the control (increase of fourteen minutes each day). Additionally, the intervention group increased their in daily physical activity and maintained their BMI.

\textbf{Appraisal}

This small study was conducted through a primary care setting with no loss to follow-up. The study demonstrated that an open-loop feedback system using pedometers reduced television/video/DVD time and increased physical activity among obese children. A limitation of the study was the short intervention period and lack of follow-up and therefore it is not clear whether any of the effects had been sustained once the extrinsic motivation had been removed. The expense associated with acquiring token operated television sets limits the feasibility and sustainability of this approach to population health programs. There may be scope to modify aspects of this intervention whereby parents are encouraged to set rules around television viewing according to their child’s physical activity level measured by pedometers.

3.5 School-based education programs integrated into the curriculum

3.5.1 Brocodile the Crocodile program – Dennison et al (2004)

The aim of the Brocodile the Crocodile program was to implement an intervention in the child care setting to reduce television viewing among preschool children. The program was a 2-year randomised controlled trial conducted in 16 preschools and child care centres. The intervention involved research staff providing 1-hour sessions each week for a total of 39-weeks. Half of each session was spent in musical activities; 10 minutes, eating a snack; and 20 minutes participating in an interactive educational session. The Brocodile the Crocodile health promotion curriculum consisted of 32 sessions (10 in the spring of the first school year and 22 during the second school year) devoted to healthy eating and 7 sessions designed to reduce children’s television viewing (provided during the second school year). The preschools and centres in the intervention were provided with resources to reinforce key messages and parents received materials to foster family involvement. In addition, parents kept a diary of their child’s television and video viewing habits over one week to increase their awareness. Control preschools and child care centres received materials and information about health and safety. Children in the intervention group had significantly decreased their television and video viewing by 3-hours per week compared with an increase of almost 2 hours per week among children in the control group. The proportion of children watching more than 2-hours of television and videos a day in the intervention group (19%) was also significantly smaller than in the control group (41%).
Appraisal
The sedentary behaviour component of this study was incorporated into a broader program and delivered over an extended period of time, which is advantageous. The effects of the intervention on children’s television and video viewing as reported by their parents were positive. However, in this study there was a considerable drop out rate and loss to follow-up which may have biased these results, and data were not analysed as intention-to-treat. While using parent proxy report has limitations, it is the most practical way of measuring sedentary behaviour in this age group. The study was conducted in relatively small centres and preschools that were located in rural communities, which may impact on participation, compliance and commitment and thus these results might not be generalisable to other centres and preschools. Longer-term follow-up of the effects of the study, in a more representative sample of centres and preschools, would be interesting. It is also not clear whether the reductions in television viewing resulted in increased activity. The intervention appears to provide a feasible, practical and successful method to reduce television/video viewing in preschool aged children.

3.5.2 Movement and Activity Glasgow Intervention in Children (MAGIC)\textsuperscript{32}
The Movement and Activity Glasgow Intervention in Children (MAGIC) intervention was designed to enhance physical activity programs in child care centres, plus provide parents with a home-based health education program which targeted increasing physical activity through play and reducing sedentary behaviours among preschool aged children. The program was piloted across one year among 36 child care centres with centres randomised to the intervention or control group. Intervention centres received 3 physical activity sessions each week for 24 weeks. The sessions were designed to increase children’s participation in activity as well as develop and improve their fundamental movement skills. Parents received resource packs to link the school-based activities to the home and provide information on increasing activity and reducing television watching. Training was provided for preschool staff enabling them to deliver the program. A random sample of preschoolers wore accelerometers to provide an objective measure of physical and sedentary activity. At 6 and 12-months, data from accelerometry indicated no difference in sedentary time between children in the intervention and control preschools. However, children in the intervention did show significant improvements in their fundamental movement skills compared with children in the control group.

Appraisal
In addition to addressing time spent being sedentary, Reilly and colleagues aimed to increase physical activity in preschool aged children and impact on their body mass index, by delivering regular physical activity sessions in preschools. While there was an improvement in the children’s fundamental movement skills, accelerometry measured no change in physical activity or sedentary time. The authors suggested that the dose of physical activity delivered as part of this intervention was not adequate enough to be detected by accelerometry, or perhaps an alternative means of measuring the outcomes was required. It should also be noted that while accelerometry provides a measure of physical activity, it has little validity for measuring sedentary behaviours. In comparison to Dennison and colleagues (2006)\textsuperscript{38} the larger number of children and preschools involved in this study would render the results more generalisable. Strategies may be needed to engage parents more actively in modelling positive physical activity and small screen behaviours at home. Process evaluation suggested that the effects of this program may have been mediated by individual teachers and preschools and this would need to be considered if looking to implement a similar program. A key component of this intervention was the professional development of preschool staff. It would be interesting to investigate the extent to which this impacted on teaching practices including increasing the knowledge, skills and confidence as part of future research.
3.5.3 Eat Well Keep Moving

The Eat Well Keep Moving program is a 2-year school-based program designed to improve diet and physical activity among primary school children. The effects of the program on a number of health behaviours including time spent watching television and participation in physical activity were studied by Gortmaker and colleagues with 479 children in 4th and 5th grades. The intervention involved an interdisciplinary classroom-based education program which was developed through a formative research including focus groups with students and school staff. In order for the program to be well-implemented and sustainable, the program was designed to fit in with the goals and financial constraints of the school. Furthermore, the program was designed to be integrated into the existing school structures and curriculum using a cross-curricula approach including maths, science social studies classes and provide links to school food services and physical education activities. The school-based component of this program was a series of theory lessons, integrated into a range of curriculum areas, and taught by classroom teachers over a period of 2 years. The sedentary activity component focused on reducing television viewing to less than 2-hours per day. To support the program and provide children with opportunities to try new behaviours, the program included home-based activities and was promoted to parents. Teachers were provided with professional development each year. At the end of the program, there was a small non-significant decrease in time spent watching television each day (30 minutes).

Appraisal

The effects of this intervention were minimal and the study design had some limitations. Allocation of schools to either the intervention or control group in this study was not random, but based on an indication from the initial schools enrolled that they wanted to be exposed to the intervention as soon as possible. The underlying characteristics of these schools and self-selection may have biased the direction of the study results. In addition, the manner in which the main outcomes were measured may not have been sensitive enough to detect a change and there was some loss to follow-up which may have also impacted on the results. While integrating the lessons into the formal curriculum is good practice, the dose and intensity of this intervention may not have been sufficient to bring about a change and television viewing was not addressed as a separate theme. It could also be argued that this intervention would have benefited from more active involvement of parents.

3.5.4 Planet Health

Planet Health was a school-based health behaviour intervention, based on Eat Well Keep Moving, designed to reduce obesity prevalence among primary school children. As part of this program key messages were integrated throughout the curriculum and delivered by the classroom teacher. Gortmaker and colleagues conducted a randomised control trial to measure the effects of this program on a range of health behaviours including television viewing and physical activity on 1295 multiethnic children in Years 6 and 7, over 2 school years. Each intervention school received teacher training, lesson plans, physical education materials, wellness sessions for teachers and financial incentives. The curriculum components focused on sedentary behaviours, particularly television viewing and physical activity. Students in the intervention assessed their own levels of activity and inactivity, set and evaluated personal goals and were encouraged to replace sedentary pursuits with moderate-to-vigorous activity of their own choice. After 2-years, the prevalence of obesity in girls in the intervention group had decreased from 23.6% to 20.3% and was significantly lower than in the control group in which it had increased from 21.5% to 23.7%. Obesity in boys decreased in both the intervention and control groups and after 2-years the difference between the groups was not significant. The hours of television and videos watched each day decreased significantly in boys (24-minutes) and girls (35-minutes) in the intervention group.
Module 7 - Interventions to reduce sedentary behaviours

Appraisal

Being a randomised controlled trial, Planet Health had a stronger study design than Eat Well and Keep Moving\textsuperscript{33}. The study results showed a reduction in television viewing in both boys and girls. The study was a randomised controlled trial which eliminates the possibility of biased results. A key aspect of the implementation of this program was the enhanced provision of professional development workshops and support for teachers and school staff. Additionally, reducing television viewing was dealt with as its own topic, rather than focusing specifically physical activity as a means of reducing sedentary behaviours. However, parental involvement was still not a focus of this intervention and it would be interesting to investigate whether including a parental component as part of this program would enhance the efficacy of this promising intervention.

3.5.5 Monitoring personal sedentary time and setting sedentary time goals\textsuperscript{35}

The effectiveness of a program, based on social cognitive theory, which aimed to reduce the time children spent watching television, through encouraging selective small screen use, was measured in a 6-month randomised controlled trial. The trial was conducted with 192 children in 3rd and 4th grades from 2 socio-demographically and scholastically comparable schools. The school-based components of the program included incorporating 18-lessons into the standard curriculum. Program activities included monitoring and self-reporting television, video and video game use as a means of motivation; challenging children to achieve 10 days in which they had no television, video or video game use; encouraging children to limit their weekly use of television, videos and video games to 7 hours; teaching children to become more selective television viewers; and enlisting children as advocates for reducing small screen use. Additionally, intervention households were provided with an electronic television time manager to assist with budgeting television time. The school curriculum components of the intervention were delivered by classroom teachers who received professional development to support the curriculum components of the intervention. Newsletters were distributed to parents to encourage them, to support their children in budgeting their small screen time. At the conclusion of the study, children in the intervention group had reduced their weekly television viewing time by 5-hours. At the conclusion of the program, children in the intervention reported spending significantly less time each week watching television (9 hours) than the control (15 hours). Video game use reported by the intervention group (1 hour) was significantly less than the control (4 hours) at the end of the program. Compared to the control group, children in the intervention group had a significantly greater relative decrease in BMI.

Appraisal

This promising school-based intervention was effective in reducing television and video viewing as well as video game use in children. The school-based intervention components reflect good practice and present a feasible and sustainable approach to reducing sedentary behaviours with a potentially good population reach. Unfortunately using television time managers as a means of providing additional motivation to children would be expensive at a population level. Despite this, the use of time managers to record television use of individual family members would have reinforced the themes being discussed at school and actively involved parents in the program and appear to be efficacious in limiting small screen time. While being a clustered randomised controlled trial, the study was conducted in only 2 schools which limits the generalisability of the results. There may have been contextual factors within these schools which affected the efficacy of the intervention. It would be interesting to investigate the longer-term impacts of this program, in a larger and more representative sample of schools and children. This program could also be enhanced with more active parent activities to model positive small screen use, as the home is where a majority of television use occurs. It would be worthwhile to investigate if, over time, physical activity participation increased as sedentary time decreased.
3.5.6 Switch Off-Get Active

Switch Off-Get Active, a 16-week teacher led schools-based program, aimed to increase physical activity and limit small screen recreation. The program was designed to complement the existing health curriculum. During the 10 lessons delivered as part of Switch Off-Get Active, children in the intervention schools reflected on their personal leisure time use, identified alternatives to small screen activities, set personal leisure time goals, monitored achievement of these goals and identified opportunities to be physically active in their local area. Prior to the program, teachers were provided with resources to deliver each lesson, including student workbooks and small screen use diaries. These were developed in consultation with health promotion staff and non-specialist teachers. Parents were encouraged to support their children in limiting small screen time through written communication and actively monitoring their recorded small screen time. Harrison and colleagues investigated the impact of this program on 312 4th class children attending disadvantaged schools. Rather than being random, allocation of schools to the intervention and control was designed to achieve a balance between boys and girls and urban and rural schools in the intervention and control arms of the study. At the end of the 16 weeks, daily self-reported screen time had decreased significantly in 4 intervention schools (37-minutes) and 2 control schools (21-minutes). However, overall the difference in self-reported screen time between children in the intervention and control schools was not significant. In addition the intervention did have a significant impact on moderate-to-vigorous physical activity, which is reported in another module.

Appraisal

This program reflected good practice by integrating key messages into the existing curriculum, providing teachers with professional development and engaging them in the delivery of the program as part of their core business. Despite this the sedentary behaviours of children decreased in only some of the intervention schools, and overall there was no impact measured on small screen activities. The authors also suggested any decreases in small screen activities that were detected, were not clinically significant. The study results reflect a number of factors including the non-random manner in which schools were allocated to either the intervention or control. The program effects may have also been influenced by a number of mediating and contextual factors, including differences between individual schools, the attributes of children attending each school and differences in program implementation between schools. Achieving longer-term change in small screen time is likely to be dependent on support within the home environment and ideally strategies to address small screen activity would include a parental and family component. It may be worthwhile to investigate the effects of an enhanced program, with random allocation to study group over a longer period of time on small screen behaviours.

3.5.7 Developing adolescents skills to manage sedentary time and increase activity

A randomised controlled trial assessed the effects of a life-skills intervention, designed to increase physical activity in adolescent girls were assessed in 211 students in the 9th grade. This 8-month program, based on the social action theory, was implemented in one single-sex high-school. The program consisted of 2 components in addition to the regular curriculum. As well as attending their normal physical education lessons, girls in the intervention group participated in a life-skills course designed to assist them in making informed decisions about the benefits of being active, develop problem-solving skills and obtain support from others in being active. The school-based components of this program were supported by family activities including a workshop, newsletters and adult-child homework. Rather then being delivered by physical education teachers, this intervention was delivered by a teacher hired specifically for the project. At the end of 8-months there was a significant decrease in the proportion of girls reporting that they watched more than 3-hours of television a day (decreased by 5% on weekdays and 7% on weekends) in the intervention group. In contrast there was no change reported by girls in the control group. There were no significant differences between the groups in physical activity measures.
Module 7 - Interventions to reduce sedentary behaviours

Appraisal

This intervention focused on curriculum-based activities to develop life-skills in addition to regular physical education classes, enhanced by strategies to encourage parental involvement. This model appears effective in reducing television and video game use in adolescent girls. While this program has the potential to reach large numbers of adolescent girls, this study was only conducted in 1 school, thus making it difficult to determine its generalisability. One advantage of this program was that it was integrated within the school’s existing physical curriculum, but in the longer-term it would be neither feasible nor sustainable to hire teachers specifically to deliver this or similar programs in schools. Existing physical education teachers could deliver life skills education and professional development courses would build teacher capacity. In this study, participants were predominantly African American and therefore it may not be culturally appropriate NSW. Replication of this approach in the future is warranted but may require program modification to ensure applicability and relevance to the target population group.
4 Evidence appraisal

4.1 Community programs with parental and home-based components

Only 1 community-based study was reviewed, which makes it difficult to determine the overall efficacy of this approach in reducing time spent in sedentary behaviours. Importantly, the addition of the parental component did appear to enhance the community program.

Thorough and well planned community programs are potentially sustainable, flexible and economically viable. There is also scope for delivering these programs in a wide variety of organisations to meet community needs and interests. While the limited number of studies in this area makes it difficult to recommend this approach as promising, community-based programs warrant further exploration to determine their effectiveness.

4.2 Counselling with tailored advice, feedback and follow-up

Most of the evidence on individual counselling and tailoured advice comes from studies conducted in the primary care setting. The results suggest that these strategies have some positive effects on sedentary activities of children and adolescents and demonstrate the value of targeting the entire family as a large proportion of sedentary behaviour time, especially those related to the use of small screen, occur in the home, as part of leisure-time activity. Some of the strategies used within the primary care setting could be modified in order to be feasible and sustainable at a population level and are worthy of further consideration.

The studies in which overweight and obese children and their families were the target group achieved some positive change in sedentary activity and BMI. However, they were studies of treatment programs and thus resource and time intensive. Studies which targeted children and adolescents without an identified weight problem produced inconsistent results. While one study measured a decrease in television viewing time in both groups, the between group difference was not significant but there was no true control in this study. In contrast, Patrick and colleagues found significant differences in sedentary time between the intervention and control groups at the conclusion of their school-based intervention. These programs were less intensive than the treatment programs and therefore potentially more feasible and sustainable at a population level.

General practitioners are familiar with lifestyle counselling and given that they are the primary providers of health care to families in Australia, the efficacy of individual counselling and tailoured programs holds potential to change unhealthy lifestyle behaviours at the family level. While general practitioners may not have the time and capacity to undertake the more intensive version of these programs, the less intensive versions do appear to have potential for addressing small screen recreation. It may also be prudent to consider the possible roles for practice nurses in delivering programs in the primary health care setting.

The models used in primary care settings are not amenable to population-based interventions in their current format. Further research is required on the efficacy implementing counselling with tailoured information and feedback using technologies such as web based programs and e-communications.

4.3 School-based programs with education, environment, policy and/or family and community components

The examples of comprehensive school-based programs which were reviewed were limited and their findings inconsistent. However, the ICAPS program, which is still under evaluation, appears to be promising. While the overall effectiveness of this approach in reducing time spent engaging in sedentary behaviours remains unclear, comprehensive school-based programs which achieve the right mix of education, environment, policy and family/community components may be effective in achieving sustained positive changes in sedentary activities.
The ICAPS study is investigating a very comprehensive whole of school model, supplemented with family and community components, which reflects best-practice. The initial results suggest that this model may have merit as a potentially effective school-based approach to reducing small screen recreation, while also increasing physical activity. In its initial 6-months of implementation, ICAPS has demonstrated its potential for increasing physical activity and decreasing sedentary behaviours simultaneously through a set of comprehensive and integrated strategies. The program encourages young people to replace small screen recreation with more active pursuits rather than other sedentary activities.

Sahota and colleagues\textsuperscript{26, 27} also adopted a whole of school approach which is good practice. Their program had positive effects on school policy, which is potentially a very effective way of reaching large numbers of children as well as being feasible and sustainable. However, the APPLES program did not bring about a decrease in small screen recreation. Despite targeting primary school aged children, this intervention did not include a parental component. This would suggest that the inclusion of a family or parental component is necessary when targeting small screen recreation in children. This is because the majority of small screen time would occur within the home.

### 4.4 Feedback, reward and reinforcement interventions

Three interventions used feedback, reward and reinforcement to reduce small screen sedentary activities in children and adolescents. The distinct advantage of these programs was that being family-based they included an active parental involvement, which is important given that a substantial amount small screen recreation time would take place within the home. These approaches were found to be effective in populations of children and adolescents with and without an identified weight problem.

While producing very promising results, some of these interventions, especially those relying on specialised pieces of equipment\textsuperscript{29} are not currently feasible or sustainable as population-based approaches due to the costs and resource requirements to fully implement.

However, a number of the feedback, reward and reinforcement interventions offer more feasible approaches to decreasing sedentary behaviours, especially small screen time. Providing feedback through pedometers\textsuperscript{31} and accelerometers\textsuperscript{30} and rewarding activity with television time were both effective in reducing small screen recreation. While using pedometers and accelerometers is more feasible for population-based interventions, these studies also relied on placing devices in the home to manage access to televisions time which is less feasible and sustainable at the population level. However, there may be opportunities to modify these programs for implementation on a wider scale and measure their efficacy.

The studies reviewed in this module provided consistent evidence of the efficacy of feedback, reward and reinforcement interventions in reducing sedentary behaviours, especially small screen recreation, in children and adolescents. Despite this, they would be expensive due to their reliance on specialised equipment and are not currently feasible or sustainable at a population level. It is also unclear the extent to which the effects of these programs are maintained, once the source of extrinsic motivation is removed and the children are required to rely on intrinsic motivation to reduce their sedentary time.

### 4.5 School-based education programs integrated into the curriculum

The school-based education interventions to reduce sedentary behaviours produced inconsistent results. The studies reviewed as part of this module were conducted in pre school and child care as well as primary and high-school settings. Some included an additional parental component.

Increasing emphasis is being given children at a younger age in an effort address sedentary activities in a manner that may have lasting effects. The limited studies targeting pre school aged children\textsuperscript{32, 38} produced inconsistent results. Integrating activities into a larger program, providing professional development, resources and support as well as including an active parental component
appears to be effective in reducing sedentary behaviours\textsuperscript{38}. In contrast, including a parental component that is based purely on the provision of information appears to be less effective\textsuperscript{32}. Providing professional development to child care staff has the potential to build skills and capacity, rendering programs more sustainable in the long-term and it is good practice to include support and resources as well as an active parental component.

A number of approaches to influence the small screen time of primary-school aged children have been used with varying degrees of efficacy. Integrating key messages into general curriculum taught by non-specialist teachers and supplemented with home-based activities\textsuperscript{33, 34} have been shown to be effective in decreasing sedentary activities. In contrast encouraging students to reflect on their own leisure time pursuits before setting personal goals and monitoring achievement of these goals appears to be effective in some schools but not in others\textsuperscript{36}. This suggests that aspects specific to individual schools e.g. structures, policies, teachers and students may mediate the effects of the intervention. Supplementing the school-based delivery of lessons regarding goal setting to reduce small screen activities with specific devices to assist children in limiting and budgeting their television time appears to be effective\textsuperscript{35}. However, it may be neither feasible nor sustainable to provide such devices as part of a population-based strategy to reduce sedentary time.

Developing adolescents’ skills to be more physically active through the school curriculum, and supplementing this with a family component\textsuperscript{37} did reduce some sedentary activities but did not increase physical activity. While this approach had positive effects on sedentary activities, it is not clear whether activities such as television and video viewing are replaced by more active pursuits or other sedentary behaviours. Additionally, life-skills activities such as these directly addressing sedentary behaviours in addition to physical activity is worthy of future research.

Delivering school-based programs in which key messages are integrated into education programs within the existing curriculum represents good practice and appears to have some efficacy. When working within schools it would also be prudent to provide teachers with professional development and support and supplement key messages with parental strategies including provision of information and home-based activities. School-based programs have a good reach and are potentially feasible and sustainable in the longer-term. Involving community groups might also help to provide children (or their parents) and adolescents with viable physical activity options with which to replace sedentary time which might also increase physical activity.

4.6 Gaps and Clusters
The majority of interventions reviewed in this module were delivered in the school setting. Schools present both a convenient and appropriate setting for delivering health interventions which influence health including sedentary activities. Through schools large groups of children and adolescents can be reached in a sustainable, flexible and cost effective manner.

The scope and potential for implementing a range of strategies across various settings to reduce time spent in sedentary behaviours, especially small screen recreation, should not be overlooked. While interventions delivered through the school environment have been shown to be effective in decreasing time spent in sedentary activities, the vast majority of small screen time would occur outside of school hours, as part of leisure-time activity. Therefore primary health care, family and community based approaches are important and legitimate settings for addressing sedentary time of children and adolescents using feasible and sustainable programs. The studies reviewed in this module that were conducted in these settings were limited in number or tended to be less feasible and sustainable due to their intensity or costs. Research on interventions suitable for implementation at a population level in non-school settings remains a priority.
As the focus shifts to targeting pre school aged children as part of health promotion efforts to influence sedentary behaviours of children while they are a younger age, funding to investigate programs developmentally appropriate to this age group is a priority. Interventions targeting pre school aged children could be studied across a range of settings in including, but not limited to, child and family health, child care, as well as the home and broader community environments.

Interventions that address both sedentary behaviours and physical activity by encouraging children and adolescents to replace sedentary pursuits with leisure time 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 health 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.
5 Promising and appropriate strategies

On the balance of evidence, interventions which aim to reduce time spent in sedentary behaviours, particularly small screen activities have been shown to be quite effective and should be encouraged. It is important to note that a number of the interventions which did change sedentary behaviour targeted children already identified as having a weight problem and these may be neither feasible nor sustainable for a population-based approach. These interventions may need to be adapted to ensure they are suitable for delivery to larger populations.

5.1 Promising strategies based on available evidence

- School-based programs on sedentary behaviours that combine curriculum, environment and policy strategies with family and community components.
- School-based education on sedentary behaviours in which key messages are integrated into the curriculum.

5.2 Strategies worthy of consideration (may require modification or more evidence)

- Restricting access to television in the home.
- Providing feedback, reward and reinforcement for reducing sedentary screen time.
- Community-based interventions on sedentary behaviours which include family component.
- Family counselling interventions on sedentary behaviour and screen time.

5.3 Intervention research - gaps and priorities

- Interventions to decrease time spent engaging in non-educational computer based activities.
- Web-based programs and e-communication strategies which provide strategies on reducing sedentary behaviour and screen time.
- Health education initiatives with a focus on sedentary behaviours that target pre-school aged children and their families.
6 Implications for policy and practice

6.1 Implementation considerations

School-based programs, when comprehensive and implemented using best practice strategies, are feasible, sustainable and applicable to NSW. These programs integrate education and/or key messages into the existing curriculum, are delivered by teachers, supported by environment and/or policy change and include a family and/or community component. Such programs also support schools through professional development for teachers and providing support and resources. A range of school-based programs, when suited to the educational and developmental needs of a specific age group, have been shown to be effective in decreasing sedentary behaviours.

Counselling interventions tend to target the entire family, rather than individual children or adolescents. These programs allow family and home-based factors which influence small screen time to be addressed, which is an advantage. Primary health care is an ideal setting for the delivery of these programs, but the extent of their reach will be limited to the families, including children, or adolescents who present to their general practitioner. While general practitioners would be familiar with delivering brief interventions, they may require information to support them in providing messages related to sedentary behaviours. While these programs are effective, they tend to be intensive, particularly if follow-up strategies are included, and this might impact on their feasibility and sustainability. Opportunities for involving general practice nurses or other health professionals in these programs may well be worth investigating.

Restricting access to television in the home and/or making access contingent on achieving prescribed activity levels has proven to be effective in reducing sedentary activities in children and adolescents. Unfortunately, at a population level, some components of these programs are likely to be expensive and therefore, at present, may not feasible or sustainable and would have limited population reach. It may well be prudent to investigate and research how the principles of these programs could be adapted and applied in a more economically feasible and therefore sustainable manner. These approaches are promising; further research into how they can be adapted to increase their relevance to population health programs is needed.

Given that the desired effect of any decrease in sedentary time is also an increase in time spent being physically active, it is prudent for programs which target sedentary time, to also encourage replacing these activities with more active pursuits. This could easily be woven into school-based curriculum focused interventions.

The majority of the studies reviewed in this module were conducted overseas and some were tailored to specific communities and cultural groups. Therefore modifications may be required to ensure that these approaches are applicable to the New South Wales context. 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 reducing the time spent in sedentary behaviours, particularly small screen activities, protects 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 decrease in sedentary behaviours of children and 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 sedentary behaviours in a range of domains in the lives of children and adolescents from different settings to different developmental stages. This is consistent with recommendations for best practice such as Getting Australia Active39.
Generally, the implementation and effectiveness of programs 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 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.

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<th>DO</th>
<th>CONSIDER</th>
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<tbody>
<tr>
<td><strong>DO</strong></td>
<td>School-based programs combining curriculum, environment and policy strategies with family and community-based components.</td>
<td>Counseling interventions which target the family unit</td>
<td>Health and physical education targeting preschool children and their families</td>
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<td></td>
<td>School-based education in which key messages are integrated into the curriculum</td>
<td>Community-based interventions with a family component</td>
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<tr>
<td><strong>CONSIDER</strong></td>
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**Sectors**

- **E** = Education
- **C** = Community
- **PC** = Primary health care
- **R** = Recreation
- **L** = Local government
- **I** = Industry
- **H** = Health

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Module 7 - Interventions to reduce sedentary behaviours

7 References


8. Appendix. Tables summarising the available intervention evidence for reducing sedentary behaviours

Table 1. Summary information of community programs with parental and home-based components

<table>
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<tr>
<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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<tbody>
<tr>
<td>Robinson et al 2003</td>
<td>RCT</td>
<td>61 African American girls 8 – 11 years old</td>
<td>In this 12 week pilot study of GEMS, dance classes were offered 5 days a week through community centres. Girls in the intervention were encouraged to attend as often as possible. Each session was 2.5 hours long. It started with a snack, followed by a 1 hour homework period. The dance session which followed was 45 –60 minutes long and a 30 minute talk explored the role of dance in the girls' lives. The Sisters Taking Action to Reduce Television (START) component was 5 lessons delivered in the home with the girls and their families. Families were offered an optional additional 6th visit as part of this program. The control received monthly community health lectures delivered by volunteers. In addition 5 newsletters were sent to parents and 11 newsletters were sent to the girls. The content of these focused in reducing cardiovascular risk factors.</td>
<td>Physical activity measured with accelerometry. Self-reported media use (especially small screen) BMI Measurements were taken at baseline and 12 weeks</td>
<td>Girls in the intervention group reported 23% less media (small screen time) relative to the controls. Total household television use decreased in the intervention group and at the end of the 12 weeks was significantly lower than in the control group (P=0.007). Girls in the intervention group reported eating 4% fewer breakfasts and 40% fewer dinners in front of the television (P=0.03). In the intervention group, 85% of families received the 5 visits as part of the START component and the optional additional visit. Overall 46% of girls in the intervention group attended dance classes on at least 2 days each week. There were large differences between communities and these differences were influenced by the availability of transport to attend the classes.</td>
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Table 2. Summary information of brief counselling programs with tailored feedback, advice and follow-up

<table>
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<tr>
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<tr>
<td>Epstein et al 2000</td>
<td>Randomised trial 6 months duration and families were followed-up at 12 and 24 months after randomisation</td>
<td>90 obese children 8-12 years of age and their families</td>
<td>This intervention targeted obese children and was delivered as part of a 6 month intensive family-based treatment program. It included weekly meetings (individual and group) for 16 weeks followed by 2 fortnightly and 2 monthly meetings.</td>
<td>Body Mass Index, Physical activity frequency and time measured by self report using the Minnesota Leisure Time Activity Survey, Percentage of time engaging in targeted and non-targeted sedentary activity, Aerobic fitness by heart rate monitor, Participants were measured at 6, 12 and 24 months</td>
<td>There were no differences between the 4 groups. Across all groups at 6 months the proportion of children who were overweight had decreased by 26% (P&lt;0.001). After 2 years the proportion of overweight children had decreased by 13% compared to baseline (P&lt;0.001). Across all groups after 2 years, time spent being physically active had significantly increased (P&lt;0.05). Targeted sedentary behaviours had decreased significantly at 6 months (P&lt;0.001) and at 2 years (P&lt;0.05). While children reduced participation in targeted sedentary behaviours, some of these were replaced with non-targeting sedentary behaviours. Obese parents of the children in the program also achieved significant decreases in weight at 6 months (12kg) and at 2-years (7kg) in those families completing the program.</td>
</tr>
<tr>
<td>Decreasing Sedentary Behaviors in Treating Pediatric Obesity USA</td>
<td>Childhood obesity research clinic setting</td>
<td>Participants were randomly allocated to one of four groups:</td>
<td>Families received parent and child work books introducing weight control and self-monitoring, the Traffic Light Diet, and techniques for achieving and maintaining behaviour change. At each meeting children were weighed and this weight was graphed, they met with an individual therapist and attended a parent or child group meeting. The therapist reviewed their weekly weight change, diet, target physical activity or sedentary behaviours and behavioural contracts. Participants in the increase physical activity group were reinforced for increasing physical activity. School or work related activity was not counted towards meeting goals. Those in the decreasing sedentary behaviours group were reinforced for decreasing sedentary activities that compete with activity time or set an occasion for eating. Academic sedentary behaviours were not targeted for reduction. There was no control group in this study.</td>
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<td>This intervention targeted obese children and was delivered as part of a 6 month intensive family-based treatment program. It included weekly meetings (individual and group) for 16 weeks followed by 2 fortnightly and 2 monthly meetings.</td>
<td>Body Mass Index, Physical activity frequency and time measured by self report using the Minnesota Leisure Time Activity Survey, Percentage of time engaging in targeted and non-targeted sedentary activity, Aerobic fitness by heart rate monitor, Participants were measured at 6, 12 and 24 months</td>
<td>There were no differences between the 4 groups. Across all groups at 6 months the proportion of children who were overweight had decreased by 26% (P&lt;0.001). After 2 years the proportion of overweight children had decreased by 13% compared to baseline (P&lt;0.001). Across all groups after 2 years, time spent being physically active had significantly increased (P&lt;0.05). Targeted sedentary behaviours had decreased significantly at 6 months (P&lt;0.001) and at 2 years (P&lt;0.05). While children reduced participation in targeted sedentary behaviours, some of these were replaced with non-targeting sedentary behaviours. Obese parents of the children in the program also achieved significant decreases in weight at 6 months (12kg) and at 2-years (7kg) in those families completing the program.</td>
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<tr>
<td>Decreasing Sedentary Behaviors in Treating Pediatric Obesity USA</td>
<td>Childhood obesity research clinic setting</td>
<td>Participants were randomly allocated to one of four groups:</td>
<td>Families received parent and child work books introducing weight control and self-monitoring, the Traffic Light Diet, and techniques for achieving and maintaining behaviour change. At each meeting children were weighed and this weight was graphed, they met with an individual therapist and attended a parent or child group meeting. The therapist reviewed their weekly weight change, diet, target physical activity or sedentary behaviours and behavioural contracts. Participants in the increase physical activity group were reinforced for increasing physical activity. School or work related activity was not counted towards meeting goals. Those in the decreasing sedentary behaviours group were reinforced for decreasing sedentary activities that compete with activity time or set an occasion for eating. Academic sedentary behaviours were not targeted for reduction. There was no control group in this study.</td>
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<td>Ref</td>
<td>Design</td>
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<td>Intervention description</td>
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<td>Ford et al 2002</td>
<td>Randomised trial 4 weeks duration Primary health care setting</td>
<td>28 families with 7–12 year old children  Counselling plus behaviour: 15 families  Counselling only: 13 families  African/American children receiving primary care at an urban community clinic serving a low-income population</td>
<td>Eligible families were randomised to receive counselling only or counselling plus a behavioural intervention. Families in the counselling only group received a brief (5 – 10 minute) counselling intervention. Families in the counselling and behavioural intervention received brief counselling plus a fifteen to twenty discussion on setting television budgets and were provided with parent information. They also received an electronic television time manager.</td>
<td>Time spent viewing TV/video, PA, eating whilst watching TV using parental and child self-report</td>
<td>Children in both groups decreased their weekly television/video viewing and video game use by 14 hours. The decrease within each group was significant (P&lt;0.05). There were no significant differences in television/video viewing and video game use between the intervention and control (P=0.71). Overall household television use decreased in both groups but not significantly. While not significant, the intervention also decreased the number of meals eaten in front of the television. Organised physical activity each week increased by 2.5 hours in the behavioural intervention group. This was significantly different to the counselling only group in which organised activity each week decreased by 3.5 hours (P=0.004).</td>
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<tr>
<td>Patrick et al 2006</td>
<td>RCT 1 year duration Primary health care with home-based follow-up</td>
<td>819 adolescents 11-15 years of age Intervention: 438 (202 boys/179 girls) Control: 381(179 boys/216 girls)</td>
<td>This 1-year intervention was delivered through primary care with home-based follow-up. The intervention involved completing a computer-assisted diet and physical activity assessment and stage-based goal setting followed by brief counselling with health care provider, and monthly mail and telephone counselling over twelve months. The control took part in a sun exposure protection program using similar process. Counselling phone calls and mail outs occurred at 3 and 6-months. Monetary incentive was provided for completing each assessment.</td>
<td>Weekly minutes of MVPA measured by self-report and accelerometers. Self-report number of days physical activity per week and sedentary behaviours (hours of television viewing).</td>
<td>At the end of the year there was a significant difference in sedentary behaviours between the intervention and control. Girls in the intervention reduced their sedentary time each day by about 54 minutes while in the control it increased by 12 minutes (P&lt;0.001). Boys in the intervention group decreased their daily sedentary time by an 60 minutes while it increased by 6 minutes in the control (P=0.001). Boys in the intervention also increased the number of days a week on which they were active compared to the control (P=0.01). This intervention had no effect on BMI.</td>
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<td>Ref</td>
<td>Design</td>
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<td>Intervention description</td>
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<tr>
<td>Saelens et al 2002</td>
<td>RCT</td>
<td>44 overweight adolescents 12-16 years old and interested in weight control</td>
<td>In this 7-month program, participants were assigned to a multi-component intervention or a single session of physician counselling. Adolescents in the intervention completed a computer program assessing their eating, physical activity and sedentary behaviours and developed individual plans. They then met with a physician to discuss and finalise these plans in tailored counselling session. Following this they received telephone counselling over 16 weeks. They were encouraged to monitor their own activity levels to achieve the goal of 60 minutes of moderate activity at least 5 days a week. In addition, they were encouraged to decrease time in sedentary activities and replace this with more active pursuits. Intervention group parents received information on how they could support behaviour change in their child. After the computer assessment, those in the typical care group met with a physician for a brief counselling session. They were encouraged to implement behaviour change on their own with the help of their family.</td>
<td>Body Mass Index, Self-reported sedentary behaviour over 7 days, Total physical activity measured by 7-Day Physical Activity Recall, Measures taken at baseline, 4 months and 7 months</td>
<td>There were no significant differences in sedentary behaviours between baseline, 3-month and 7-month follow-up. Reported sedentary behaviour remained relatively unchanged between baseline and the 3-month and 7-month follow-up.</td>
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### Table 3. Summary information of school-based programs with education, environment and/or policy components

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<tr>
<th>Ref</th>
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<th>Participants</th>
<th>Intervention description</th>
<th>Outcome variables</th>
<th>Key findings/ Outcomes</th>
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<tr>
<td>Sahota et al</td>
<td>Clustered RCT</td>
<td>634 children 7-11 years old from 10 schools</td>
<td>Intervention schools received the Active Programme Promoting Lifestyle Education in Schools (APPLES). APPLES is a multi-disciplinary program that seeks to influence behaviours not just knowledge. This program consists of teacher training, modification of school meals, and the development and implementation of school action plans to promote healthy eating and physical activity. The control schools continued with their usual curriculum without any intervention.</td>
<td>Physical activity over the previous week measured by self report Sedentary behaviour over the previous 24 hours measured by self-report Focus groups</td>
<td>There were no differences in sedentary behaviours or physical activity between the intervention and control groups. In focus groups children in intervention schools reported higher levels of behaviour change than children in control schools.</td>
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<td>2001 (2001)</td>
<td>12 month duration</td>
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<td>School setting</td>
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<td>Simon et al</td>
<td>Cluster RCT</td>
<td>954 adolescents (average age 11.4 years) from 8 schools</td>
<td>This presents the 6-month results of a study which will be of 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 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</td>
<td>After 6-months, the proportion of girls in the intervention reported more than 3-hours of sedentary behaviour each day was 17% (decrease of 7%) compared to 28% (increase of 4%) in the control (P&lt;0.0001). In boys at 6 months engaging in sedentary behaviours for more than 3 hours a day was reported by 41% of the intervention (decrease of 3%) and 48% of the control (increase of 14%) (P&lt;0.0001). 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 4. Summary information of feedback, reward and reinforcement interventions

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<th>Ref</th>
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<td>Faith et al 2001</td>
<td>RCT</td>
<td>10 obese children 8-10 years old who watch more than 2 hours of television each day and do not engage in regular activity.</td>
<td>This 12-week pilot study investigated the effects of contingent television on physical activity and television viewing.</td>
<td>Pedalling and television viewing times which were continuously recorded.</td>
<td>The intervention group spent less time watching television and more time pedalling than the control over the 10-week implementation period. Children in the intervention pedalled for an average of 64 minutes each week, which was significantly higher than the control who pedalled for an average of 8 minutes each week (P=0.04). The intervention watched an average of 1.5 hours television each week while the control group watched an average of 21 hours of television each week (P=0.006).</td>
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<td>USA</td>
<td>12 weeks duration</td>
<td>Home-based setting</td>
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<td>Intervention: 6 Control: 4</td>
<td>A contingent television placed in the home of all participants for 12-weeks (2-weeks baseline and 10-weeks intervention).</td>
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<td>In the intervention group, television viewing was contingent on pedalling at a prescribed level or greater. The system was left in the home for the child to use as often as they chose.</td>
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<td>Parents were encouraged to not allow their child to watch their own television during the study period.</td>
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<td>In the control, the contingency remained inactive for the duration of the study.</td>
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<tr>
<td>Goldfield et al 2006</td>
<td>RCT</td>
<td>30 children aged 8 to 12 who were: overweight or obese, watch more than 15hrs TV each week and engage in less than 30 minutes MVPA each day</td>
<td>In this 8-week program, families were randomised to receive open-loop feedback (control) or open-loop feedback plus reinforcement (intervention). Children wore pedometers for 8-weeks and met with a researcher every two weeks to download activity counts.</td>
<td>Total activity counts, average daily activity counts, time spent in MVPA and VPA measured by pedometers Self-reported activity and sedentary behaviours using the Past Day Physical Activity Recall</td>
<td>At 8-weeks, the intervention group had significantly greater increases in total daily activity counts (P&lt;0.05) and daily minutes of activity (P&lt;0.05) than the control. Daily targeted sedentary behaviours decreased by 116 minutes in the intervention group and increased by 14 minutes in the control (P&lt;0.001). Daily minutes of MVPA increased by 9 minutes in the intervention group while remaining stable in the control (P&lt;0.05). The BMI of children in the intervention fell slightly while in the control it increased slightly (P&lt;0.03).</td>
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<td>Canada</td>
<td>8 weeks duration</td>
<td>Home-based setting</td>
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<td>Open loop feedback: 16 families</td>
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<td>Open loop feedback plus reinforcement: 14 families</td>
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<td>Ref</td>
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<tr>
<td>Roemmich et al</td>
<td>RCT</td>
<td>18 children and adolescents 8-11 years of age who watched more than 15 hours of television a week</td>
<td>In this 6-week home-based program all participants wore an accelerometer. Children in reinforcement group were given feedback through the accelerometer that displayed their tallied activity counts and were also reinforced with being active with television time. A television allowance unit was placed on television sets of children in the intervention. Children could bank their television hours if they chose. For the control group, the accelerometer display was turned off (but still recording data) so they received no feedback and there was no contingency for watching television. Children were given a goal of 60 minutes of moderate-to-vigorous most days each week. Each week, participating children and their parents met with a case manager.</td>
<td>Body Mass Index, Daily physical activity measured with accelerometer, Self-reported television time, recreational computer use, hand-held video games, reading and telephone time in a habit book, Measures were taken once a week for the six weeks</td>
<td>From the intent to treat basis, television and targeted sedentary time did not change significantly in either the intervention or the control group at the end of the six weeks. From the intent to treat analysis children receiving feedback had increased their participation in physical activity by 24% at the end of 6 weeks (P=0.02). In comparison to the control group, the intervention participated in 32% more physical activity and 22% less sedentary behaviours over the 6 weeks.</td>
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### Table 5. Summary information on school-based education programs integrated into the curriculum

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<th>Ref</th>
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<th>Intervention description</th>
<th>Outcome variables</th>
<th>Key findings/ Outcomes</th>
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<tr>
<td>Dennison et al 2004</td>
<td>RCT</td>
<td>163 children aged 2.6 – 5.5 years from 18 preschools and childcare centres &lt;br&gt;102 children participated in the 7 week program targeting small screen activities. Follow-up data was available on 77 children &lt;br&gt;Intervention: 8 centres &lt;br&gt;Control: 8 Centres</td>
<td>This 39-week implemented over two years was based on the ‘Brocodile the Crocodile’ health promotion program. Seven weeks were devoted to reducing television viewing. Each week program staff delivered a one hour session in each of intervention centre. About 30 minutes of each session was spent in musical activities, 10 minutes was allocated to eating a snack and the remaining 20 minutes was devoted to interactive education. Intervention centres were given resources and suggested activities to reinforce the key messages. After each session, materials and activities were sent home to foster family discussion and involvement. Parents were asked to keep a diary of their child’s television and video viewing over 1-week to increase their awareness of their children’s habits. The control centres and preschools received health and safety materials and activities.</td>
<td>Hours of television and videos viewed each week measured by parental proxy report. Hours of computer and video games played each week measured by parental proxy report.</td>
<td>Prior to the small screen component of this study, television/video viewing did not differ between the intervention and control groups. At baseline the 35% of children in the intervention and 41% of children in the control watched more than 2 hours of television/videos each day. After 2-years, 19% of children in the intervention watched more than 2 hours of television/videos each day compared to 41% in the control (P=0.007). The average number weekly hours of television/video viewing decreased by 3 hours in the intervention and increased by about 1.5 hours in the control (P=0.02). There was no difference in the changes in time spent playing video/computer games between the intervention and the control.</td>
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<tr>
<td>Gortmaker et al 1999</td>
<td>Non-random trial</td>
<td>479 students from the 4th and 5th grades &lt;br&gt;Intervention: 6 schools &lt;br&gt;Control: 8 schools 91% of African American</td>
<td>The Eat Well and Keep Moving units, taught over 2 school years, were integrated into maths, science, language and social studies classes. Children received 13 lessons of 50 minutes duration in each of grades four and five. The focus was on decreasing consumption of fatty foods, increasing fruit and vegetable consumption, reducing television viewing time and increasing physical activity time. To give opportunities to try new behaviours and links with parents and community, program activities included classroom-based campaigns on fruit and vegetables, limiting television time and increasing walking. These campaigns included home-based activities and were promoted to parents. Teachers attended training workshops and staff wellness meetings each year.</td>
<td>Television viewing, physical activity and dietary intake using the 24-hour recall and the student food and activity survey</td>
<td>There was a small but non-significant difference in television watched each day between the intervention group and the control group (30 minutes a day).</td>
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<td>Ref</td>
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<tr>
<td>Gortmaker et al</td>
<td>RCT</td>
<td>1295 students in the 6th and 7th grades from 10 schools</td>
<td>Schools allocated to receive the 2-year intervention received a program of teacher training workshops, classroom lessons, physical education materials, wellness sessions and fitness funds. Planet Health units were developed to be integrated into the existing curriculum. In each year 16 lessons were delivered as part of maths, language, science and social studies lessons. An additional lesson was used to develop a 2-week campaign to reduce household television viewing. Lessons could be delivered in 1 or 2 sessions of 45 minutes depending on the detail desired by individual teachers. Physical activity resources focused on both activity and inactivity and included student self-assessment and goal setting to replace inactivity with activity.</td>
<td>Body mass index</td>
<td>In girls, in the intervention schools obesity decreased by 3.3% while in girls in the control schools it increased by 2.2%. There was a significant difference in the prevalence if obesity in girls intervention schools after 2-years (P=0.03). In boys, there was a decrease in obesity in both the intervention and control schools. After 2-years there was no difference in obesity prevalence between intervention and control schools. Girls in the intervention decreased television viewing by 35 minutes a day while the control decreased television viewing by 19 minutes a day (P=0.001). In boys, television viewing decreased by 24 minutes in the intervention, compared to 14 minutes in the control (P&lt;0.001).</td>
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<td>1999</td>
<td>Two years duration</td>
<td>Intervention: 5 schools</td>
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<td>School setting</td>
<td>Control: 5 schools</td>
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<td>Harrison et al</td>
<td>Quasi-experimental (based on willingness to implement the program)</td>
<td>312 children in 4th class</td>
<td>A 16-week teacher-led health education program to increase physical activity and decrease sedentary screen time. It was designed to complement the existing curriculum. Ten lessons of 30 minutes duration were delivered as part of the program. Children reflected on their use of leisure time, were encouraged to set activity goals, increase their physical activity and monitor their own progress. Participating teachers were non-specialist health educators but received training, resources to support lesson delivery and student materials including workbooks and activity logs.</td>
<td>Number of 30 mins blocks of MVPA and screen time measured by 1-day Previous Day Physical Activity recall. This measurement was taken three times at pre- and post-intervention Access to screen technology measured by a short questionnaire</td>
<td>In 4 intervention schools, screen time decreased by 37 minutes a day, which is significant. In 2 control schools, screen time decreased by 21 minutes a day, which was also significant. At the conclusion of the intervention there was no difference between screen time of the intervention and control schools.</td>
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<tr>
<td>2006</td>
<td>16 week duration</td>
<td>Intervention: 5 schools (182 children)</td>
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<td></td>
<td>School-based setting</td>
<td>Control: 4 schools (130 children)</td>
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<td>Ref</td>
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<td>Reilly et al 2006</td>
<td>Cluster RCT 24 weeks duration Nursery settings</td>
<td>545 preschool children from 36 nurseries Intervention: 18 nurseries Control: 18 nurseries</td>
<td>This program had nursery and home-based components. The nursery component consisted of 3 sessions of 30 minutes of physical activity each week over twenty-four weeks. Sessions were intended to increase physical activity and improve fundamental movement skills. In the home component parents received resource packs linking activity in the nursery to home and information on increasing activity and reducing television viewing. Nursery staff were provided with training so they could deliver the intervention. Control nurseries continued with their regular program of activities.</td>
<td>Body Mass Index Total physical activity, proportion of day spent in MVPA and sedentary behaviour measured with accelerometers Fundamental movement skills Measurements taken at baseline and 6 months</td>
<td>There were no differences in the sedentary time between children in the intervention and the control. The fundamental movement skills improved significantly more in children in the intervention than in children in the control.</td>
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<td>Robinson 1999</td>
<td>Cluster RCT 6 months duration School setting</td>
<td>192 children in the 3rd and 4th grades from 2 elementary schools Intervention: 1 school Control:1 school</td>
<td>This intervention aimed to decrease media use but not promote replacement with more active behaviours. The program limited access to and budgeted use of television and encouraged selective viewing and playing. The program incorporated 18 lessons of 30 - 55 minute duration into the curriculum. Classroom teachers taught these lessons. Initially children how to monitor and report their personal television, video and video game use as a motivational tool. Then they were challenged to a ten-day television turnoff. Children were then encouraged to follow a budget of seven hours a week television, video and video games usage. Additional lessons aimed to teach children to watch television and play video games more selectively. Final lessons aimed to enlist children as advocates for reducing television, video and video game use. Households received an electronic television time manager to help with budgeting.</td>
<td>Body Mass Index Self-reported time spent watching television, movies or videos on a VCR yesterday Self-reported time spent watching television, movies or videos on a VCR last Saturday Self-reported time spent in other sedentary behaviours Out of school physical activity</td>
<td>Children in the intervention significantly decreased their relative BMI compared with the control ($P=0.002$). Children in the intervention reduced their television viewing time by 5 hours a week. At the end of the program the weekly hours of television viewing in the intervention (8.8 hours) was significantly lower than the control group (14.5 hours) ($P&lt;0.001$). At the end of the program, weekly video game use reported by the intervention (1.3 hours) was significantly less than the control group (4.2 hours) ($P=0.01$). The intervention group also reported less video watching each week (3.5 hours) than the control (5.2 hours), but this difference was non-significant. There were no intervention effects on reported physical activity levels.</td>
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<td>Ref</td>
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| Young et al 2006    | RCT 8 months duration School setting                                        | 211 girls in the 9th grade in one single sex high-school Intervention: 115 Control: 105 83% African American | This was 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. | Self-reported sedentary activities  
Self-reported daily physical activity measured by energy expenditure using the 7-day recall | At 8 months the proportion of girls in the intervention group reporting 3 or more hours a day watching television declined by 5% on a school day and 7% on a weekend day. In the control group, there was no change.  
At 8-months the proportion of girls reporting 3 or more hours of television viewing on a school day was significantly different (P=0.03) at the end of the program.  
There was a small decrease in the proportion of girls in the intervention reporting playing video games more than three hours a day on school days and weekends. In the control, this decreased slightly on school days but increased on weekends. |