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Arsyllfa Iechyd Cyhoeddus Cymru
Public Health Wales Observatory

Physical activity evidence review technical report

Trawsnewid **data** a **thystiolaeth** i **ddeallusrwydd iechyd cyhoeddus**

Transforming **data** and **evidence** into **public health intelligence**

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We would welcome feedback on this report and would be interested to hear how it has been used. To provide feedback, or request further information, please contact us:

Public Health Wales Observatory
2 Capital Quarter
Tyndall Street
Cardiff
CF10 4BZ

Email: observatory.evidence@wales.nhs.uk
Web: www.publichealthwalesobservatory.wales.nhs.uk

Report authors:
Hannah Shaw, Advanced Evidence and Knowledge Analyst and Chukwudi Okolie, Research Officer, Public Health Wales.

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Contents

1 Background

This evidence review is an update of the systematic review on obesity, diet and nutrition undertaken for the Transforming Health Improvement Implementation Programme, 2014. It has been produced by the Public Health Wales Observatory Evidence Service for the Health Improvement Directorate. It forms part of the work being undertaken to support Welsh Government on an Obesity Prevention and Reduction Strategy.

2 Methods

For this update of the Transforming Health Improvement Implementation Programme, 2014 systematic review only secondary level sources (systematic review and meta-analysis) are included. Reviews of reviews are generally recognised as being useful to aid decision makers.[1] Like a systematic review, this review of reviews will use explicit methods aimed at minimising bias. The protocol for this review is available on request.

2.1 Review questions

Searching and source selection was conducted and outlined in a search technical document and inclusion/exclusion table. This evidence review addressed the following questions:

2.1.1 Question 1

- What universal, whole system or settings based interventions are effective in increasing the frequency, intensity and duration of physical activity in children and young people aged three to 18 years?

2.1.2 Question 2

- What universal, whole system or settings based interventions are effective in increasing the frequency, intensity and duration of physical activity in adults of working age?

2.1.3 Question 3

- What universal, whole system or settings based interventions are effective in increasing the frequency,

[1] Baker P et al. Cochrane Update: The benefits and challenges of conducting an overview of systematic reviews in public health: a focus on physical activity. *J Public Health (Oxf)* 2014; 36(3):518.

intensity and duration of physical activity in older adults?

2.2 Source identification, selection and data extraction

The following sources were searched between October and November 2017 for systematic reviews published between September 2014 and November 2017:

- National Institute for Health and Care Excellence (NICE)
- Cochrane Database of Systematic Reviews
- Health Evidence
- The Community Guide (Community Preventative Services Task Force)
- US Preventative Services Task Force
- EPPI Centre Knowledge Library
- MEDLINE
- PsychINFO

Search results were transferred into Reference Manager database and screened by two independent reviewers at title, abstract and full text for systematic reviews that met the inclusion criteria. An outline of the selection process is available in figure 1.

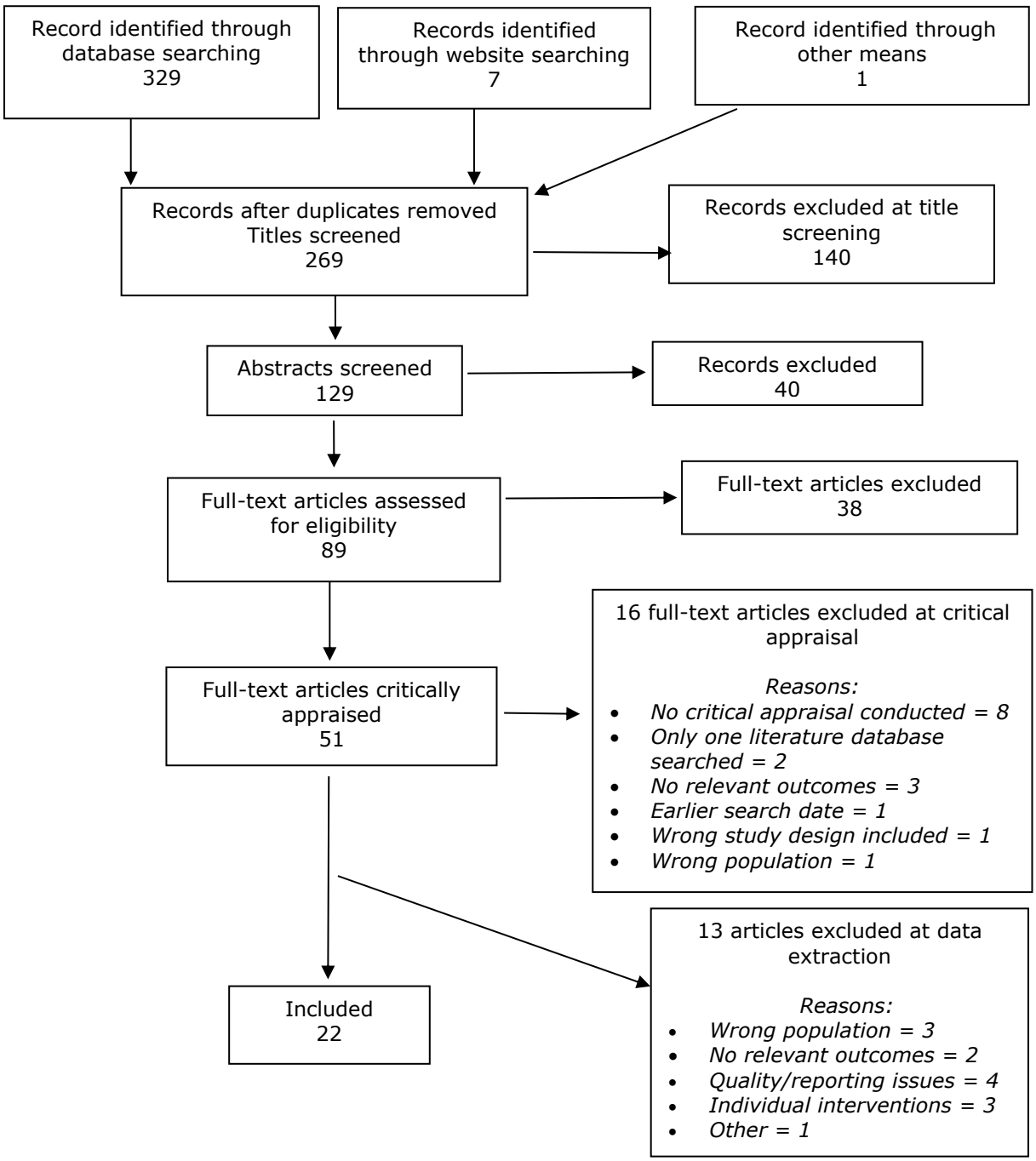
Repeatability checks for screening were undertaken by the lead reviewer and co-reviewer and any disagreements were discussed and resolved using a third reviewer. Systematic reviews included at full text were critically appraised independently by two reviewers using a critical appraisal checklist developed by the Observatory Evidence Service. There was major concern about the quality of 16 systematic reviews, which were excluded after a discussion between all reviewers. Reasons for exclusion were recorded. Systematic reviews produced to support National Institute of Health and Care Excellence (NICE) guidance, Cochrane Reviews, US Community Guide systematic reviews, US Preventative Services task force, and EPPI Centre systematic reviews were not subject to critical appraisal, as they were considered to be transparent and have a robust and reproducible method.

Data from included systematic reviews was extracted into data extraction tables by the lead and co-reviewer. Each intervention that met the inclusion criteria was graded on the basis of the quality, strength and direction of the evidence (appendix III). Repeatability checks on data extraction and grading were also undertaken.

Intervention summaries were provided for specific systematic reviews, as requested by the Health Improvement team. These are available in appendix II.

3 Results

Figure 1: PRISMA flow chart of information through the review process



4 Appendix I Data extraction tables

Study details	Results of the review	Main findings and evidence grading
1. Baker PRA et al. Community wide interventions for increasing physical activity. *Cochrane Database Syst Rev* 2015; (1):CD008366.DOI: 10.1002/14651858.CD008366.pub3. **Type of source:** Cochrane systematic review. **Interventions:** Community wide interventions to increase physical activity in the whole population comprising of at least two broad strategies from the following six options: • Social marketing through local mass media (e.g. television (TV), radio, newspapers) • Other communication strategies (e.g. posters, flyers, information booklets, websites, maps) to raise awareness of the project and provide specific information	**Description of included studies:** Thirty three studies were included in the systematic review. Of these, 20 studies included an individual counselling component from health professionals, and therefore do not meet the inclusion criteria for the Public Health Wales review which is focused on population level interventions. The remaining 13 studies were mostly controlled before and after studies (n=8), but included cluster randomised controlled trials (n=4) and one stepped wedge cluster randomised trial design. Four studies were conducted in the USA, two in Australia, one in Japan, one in Canada, and five in Europe. All were conducted in a variety of community locations including rural or remote settings and urban centres or cities and had a minimum six-month follow-up. **Quality of included studies:** All studies were assessed for risk of bias using the Grading of Recommendations Assessment, Development and Evaluation Tool (GRADE) tool. The overall quality of the studies was poor with six being assessed as having a high risk of bias, four at a low risk of bias, and three with an unclear risk of bias. This was largely due to studies with no randomisation to control and comparator groups, the selection and retention of participants, and the use of non-validated outcome measures. Both studies from the UK were considered to be at low risk of bias.	**Intervention:** Multi-component community wide interventions. **Evidence statement F:** There is moderate quality evidence that this intervention is unlikely to be effective. **Authors conclusions:** Although numerous studies of community wide interventions have been undertaken, there is a noticeable absence of studies reporting any benefits. The body of evidence in this review does not support the hypothesis that multicomponent community wide interventions effectively increase population levels of physical activity. The author's suggest caution in making such a broad conclusion as many of the authors of the included studies identified the reason for failure as the program being unable to achieve penetration, being too short

Study details	Results of the review	Main findings and evidence grading
to individuals in the community • Individual counselling by health professionals (both publicly and privately funded), such as the use of physical activity prescriptions • Working with voluntary, government and non-government organisations, including sporting clubs, to encourage participation in walking, other activities and events • Working within specific settings such as schools, workplaces, aged care centres, community centres, homeless shelters, and shopping malls. This may include settings that provide an opportunity to reach disadvantaged persons • Environmental change strategies such as the creation of walking trails and infrastructure with legislative, fiscal or policy requirements, and planning (having ecological validity) for the broader population. **Relevant Outcomes:** Community levels of physical	**Synthesis:** Narrative synthesis. **Findings:** Almost all interventions included a component of building partnerships with local governments or non-government organisations (NGOs). Other strategies included mass media campaigns or other communication strategies. There was considerable variation between intervention approaches, intensity of actions delivered, the outcomes assessed and the comparison communities. Studies utilised a variety of objective and subjective measures to measure physical activity levels. None of the four high quality studies reported evidence of effect upon community levels of physical activity. Six of the 13 relevant studies reported physical activity as some form of dichotomous measure, and all found no evidence of effect, including the two UK studies graded as low risk of bias. Phillips (2014) found no increase in the percentage of people meeting the target of 5 x 30 minutes per week (adjusted risk ratio (RR) 1.03, 95% CI 0.96 to 1.22). Similarly, Solomon (2014) did not find an increase in the percentage meeting the UK recommendations of at least 150 minutes of moderate-intensity activity per week in bouts of 10 minutes or more, or at least 75 minutes of vigorous-intensity activity per week (RR 1.02, 95% CI 0.88 to 1.17). The remaining seven studies reported physical activity as a continuous measure, either as leisure time physical activity or a measure of walking and the majority reported a decrease in physical activity or no evidence of effect. Of the studies	and poor measures were used to detect an effect, or the study was otherwise under-resourced. It is unclear whether effectiveness may be achieved if further resources or other improvements were made to these interventions. Historically, the tools used to measure physical activity were generally weak, inhibiting the ability to interpret the results and draw conclusions. However, with newer approaches such as accelerometry, the accurate measurement of physical activity appears possible. It is also worth considering the significant challenges of implementing multi-strategic community wide interventions in an attempt to reach the whole community. Some studies found gender differences in the effectiveness of the intervention. These issues should be considered in the design and implementation of any community wide intervention, particularly in recruitment and marketing messages. Policy makers and health professionals need to consider the options they advocate for and the programs they fund because this review has not found evidence of effectiveness at a population level.

Study details	Results of the review	Main findings and evidence grading
activity using objective or subjective outcome measures. **Study Population**: Whole communities (persons of any age residing in a geographically defined community, such as urban, peri-urban, village, town, or city). **Studies were included up to:** January 2014. **Included study types:** Cluster randomised controlled trials (C-RCTs), randomised controlled trials (RCTs), quasi-experimental designs which used a control population for comparison, interrupted time-series (ITS), and prospective controlled cohort studies.	reporting an increase, the Ghent 10,000 steps study reported a statistically significant increase in walking measured with a pedometer (steps per day) ($P<0.01$) and self-reported walking (minutes per week) ($P<0.01$). The adjusted changes were 10.8 per cent and 17.34 per cent, respectively. However, leisure time physical activity decreased from baseline to follow-up in both the intervention and control communities in the Ghent 10,000 steps. Importantly, this reduction was significantly greater in the control group than the intervention group ($P\leq 0.05$) with the adjusted percentage change calculated as 25.6 per cent. Another study, conducted in a school setting, reported adjusted change in supervised leisure time physical activity of 43 per cent in adolescents and an adjusted mean difference (MD) of 1.1 hours per week (95% C.I. 0.56 to 1.63) in leisure time physical activity at four years' post baseline. This was a statistically significant difference between intervention and control groups.	**Comments:** Of the included studies, most were set in high income countries, but some low income countries were included. There was a mix of rural and urban communities. Accounting for these factors, it may be difficult to generalise these findings to the Welsh population. None of the studies provided results by socio-economic disadvantage or other markers of equity. However, of those included studies undertaken in high income countries, 14 studies were described as being provided to deprived, disadvantaged or low socio-economic communities. No studies from reference 11 (Meyer et al., 2016) were found in this systematic review. Reference 8 (Hunter et al., 2015) included one study (Cohen et al., 2013) that was excluded in this Cochrane systematic review as it was not considered a community wide intervention.

Study details	Results of the review	Main findings and evidence grading
2. Bellicha A et al. Stair-use interventions in worksites and public settings-A systematic review of effectiveness and external validity. *Prev Med* 2015; 70:3-13. **Type of source:** Systematic review. **Interventions:** Point-of-decision prompts including motivation and/or directional signs near stairs/lifts or stairwell enhancements (e.g. artwork or music). **Relevant Outcomes:** Stair use (ascent and descent) or stair climbing (ascent). **Study Population:** Individuals in either worksites or public settings. **Studies were included up to:** June 2013.	**Description of included studies:** Fifty articles were included incorporating 60 studies. Study design was not well defined by authors, but 41 were reported as ITS and the remaining 19 were reported as 'other' (so not RCT, controlled clinical trial (CT), cohort analytic, case control or cohort study). Twenty two studies were conducted in worksites and 28 in public settings such as a train station or shopping malls. The majority of studies were from the UK (n=23) and USA (n=13), and three from Belgium, two each from Australia, China, and the Netherlands, and one each from Denmark, Germany, Japan, South Africa and Spain). Intervention duration ranged from one day to 16 weeks. The main outcome was stair climbing in 48 studies and stair use (ascent and descent combined) in 12 studies, 11 of these in worksites. The alternative to stairs was always an elevator in worksites and an escalator in public settings. Stair use was measured by observers in 50 studies, by automatic counters in six studies, by a combination of camera and observer in three studies and by an interviewer in one study. **Quality of included studies:** The quality of included studies was assessed using an adapted version of the EPHPP quality assessment tool. Study quality was rated as moderate or weak in 22 and 38 studies, respectively. Less than half of reviewed studies (23 of 60) included measurements during a follow-up period after the intervention. Only one study evaluated long-term effectiveness during follow-up (at least six months after the end of the intervention). **Synthesis:**	**Intervention:** Combined use of motivational and directional signs to promote stair use in workplaces. **Evidence statement C:** There is some evidence supporting the use of this intervention but it is not conclusive (this evidence grading is based on the quality of the included studies rather than observed effects of the intervention). **Intervention:** Motivational prompt interventions to promote stair climbing in public settings. **Evidence statement C:** There is some evidence supporting the use of this intervention but it is not conclusive. Conducting a two phase intervention in public settings increased stair climbing in 86 per cent of studies. **Author's conclusion:** Results of this review emphasise the importance of separating studies by intervention setting

Study details	Results of the review	Main findings and evidence grading
Included study types: Any.	A narrative synthesis was conducted. Stair use or stair climbing was expressed as a percentage relative to the use of an escalator or an elevator and measured at baseline, intervention and follow-up where available. A harvest plot was used to visualize findings. The median absolute change and the median relative change in stair climbing were presented as the quantitative synthesis. The Reach Effectiveness Adoption Implementation Maintenance (RE-AIM) framework was also used to translate research findings into practice and policy. **Findings:** The most widely used intervention across included studies was motivational prompts. All but one study conducted in public settings used motivational prompts as the intervention; one study in a shopping mall used a stairwell enhancement. All worksite interventions used motivational prompts, often in combination with directional signs and in a few studies in combination with stairwell enhancements or promotion of stair use. Stairwell enhancements were used in four studies and involved artwork and music, interactive paintings or painting and replacement of doors. In 36 studies interventions were designed as a single phase whilst 24 studies involved two phases. During the intervention period of all studies, an increase in stair climbing was found in 64 per cent of studies in worksites and 76 per cent of studies in public settings. An increase in stair use was found in 73 per cent of studies in worksites, and in the only study measuring stair use in public settings.	(i.e., worksites and public settings) in assessing the effectiveness of stair interventions. The data provides evidence that stair climbing is increased during the interventions in public settings. However, evidence of such effect is limited in worksites. They also suggest that some interventions may be recommended in each setting for greater effectiveness: in worksites, stair climbing is increased to a larger extent when directional signs supplement motivational signs; in public settings, increase in stair use appears maintained over time when interventions include two phases. Designing more effective interventions in worksites appears especially important from a public health perspective because worksites offer more opportunities to climb the stairs throughout the day than public settings and could allow a large number of people reaching the recommended level of physical activity by accumulating short bouts of physical activity. Stairwell enhancements seem promising in addition to point-of-decision prompts in this setting,

Study details	Results of the review	Main findings and evidence grading
	Studies using a combination of motivational and directional signs in worksites reported more often an increase in stair climbing compared to studies using motivational signs only. In worksites, all the studies reporting an increase in stair climbing scored weak on quality and were heterogeneous in terms of sample size. The only study of moderate quality found no effect of intervention. In public settings, around half of studies reporting an increase in stair climbing were of moderate quality and the remaining were of weak quality. During follow-up (after the removal of interventions), stair climbing remained elevated compared to baseline in 75 per cent of studies in worksites and 67 per cent of studies in public settings. Few studies assessed effectiveness post intervention or in the long-term. Conducting a second intervention phase was found to maintain a higher level of stair climbing over time, compared to baseline, especially in public settings. The majority of studies conducting two intervention phases received a weak and a moderate quality rating in worksites and public settings respectively. Three of four studies using stairwell enhancements in addition to point-of-decision prompts in worksites found a significant increase in stair use or stair climbing.	and should be examined in future studies to better assess the evidence of their effectiveness. Information on external validity also needs to be better reported in future studies to help translate research results to practice. **Comments:** The studies were conducted in different countries, with a majority of studies from the UK and USA and there is no reason to believe that studies from other countries would be generalisable to Wales. Authors were unclear about the design of included study types. No studies were given a strong quality rating. There is a lack of long-term effectiveness data.

Study details	Results of the review	Main findings and evidence grading
3. Brown HE et al. Family-based interventions to increase physical activity in children: a systematic review, meta-analysis and realist synthesis. *Obes Rev* 2016; 17:345-360. **Type of source:** Community Preventive Services Taskforce systematic review. **Interventions:** Family-based interventions including one or more of the following: • Goal-setting tools and skills to monitor progress, such as a website to enter information • Reinforcement of positive health behaviours, such as reward charts or role modelling of physical activity by parents or instructors • Organised physical activity sessions, such as instructor led opportunities for active games.	**Description of included studies:** The systematic review included 47 studies. Of these, 27 studies were RCTs or C-RCTs and eight were pilot or feasibility studies, with the remaining 12 being comparison trials. The majority of interventions were conducted in the USA (n=28), seven conducted in the UK, five conducted in Australia, two in Canada, and one each in Mexico, Italy, New Zealand, Singapore and Germany. Study samples were small with half the studies including 60 participants or less. Most studies included families with children aged between eight and 11 years. Study populations included children who were all considered to be healthy weight (four studies), children who were mostly overweight or obese (three studies), or children whose weight was not reported (12 studies). Interventions lasted from eight days to 12 months. Only 14 studies reported long–term outcomes ≥ 12 months. **Quality of included studies:** Quality assessment of studies was based on the EPHPP quality assessment tool. Three studies received a strong quality rating, 21 moderate and 23 weak. Common weaknesses were blinding and selection bias. **Synthesis:** Twenty-eight studies contributed to the realist synthesis and the authors also conducted a meta-analysis of 19 studies. **Findings:** Included studies addressed physical activity only (eight studies) or physical activity plus additional behaviours such as dietary habits (11 studies). Overall, evaluations based on self-reported measures (questionnaires, recall diaries, interviews) were no more likely to report a positive intervention effect (68 per cent,	**Intervention:** Family-based interventions to promote physical activity in children. **Evidence statement C:** There is some evidence supporting the use of this intervention but it is not conclusive. **Author's conclusions:** This combined review provides an up-to-date overview of the literature on physical activity promotion within family settings. Existing studies demonstrate a small effect on physical activity and, through a realist synthesis, highlight the following four key recommendations for practitioners and policy-makers: • Family-based interventions should be tailored to consider the ethnicity of the family, parental motivation to increase children's physical activity, and time constraints due to work and school responsibilities • Combining goal-setting and reinforcement techniques improve physical activity by increasing motivation

Study details	Results of the review	Main findings and evidence grading
Relevant Outcomes: Increasing physical activity. **Study Population**: Healthy participants aged 5 to 12 years. **Studies were included up to:** September 2015. **Included study types:** Peer-reviewed experimental studies of any design.	compared to 64 per cent of those using objective measures, such as pedometers, accelerometers, or direct observation). Interventions were delivered by community leaders (often selected for their cultural connection to participants), healthcare providers, researchers, or teachers. Interventions delivered by medical or healthcare staff appeared least effective. Seven studies evaluated the effect of remote delivery, of which five (71%) were effective. Education was provided in almost all interventions; other frequently applied intervention strategies included goal-setting, reinforcement of positive health behaviours and role modelling. Interventions primarily took place in schools, afterschool programs, homes, community centres, churches, universities, or research institutes. They ranged from eight days to 12 months in duration. Nineteen studies contributed to the meta-analysis, one of strong, ten of moderate, and eight of weak methodological quality. The meta-analysis demonstrated a significant small effect in favour of the intervention group increasing physical activity (standardized mean difference (SMD): 0.41; 95% CI 0.15 to 0.67). Sensitivity analysis, removing one outlier, reduced this to 0.29 (95% CI 0.14 to 0.45). The Realist Synthesis concluded that in the context of family constraints (such as time or scheduling difficulties), a combination of goal-setting and reinforcement intervention strategies were effective in changing physical activity behaviour, through the mechanism of increased motivation. Goal-setting may provide busy parents with the additional impetus needed to prioritise their child's physical activity above other competing demands. The findings suggest that providing education is an effective intervention for changing physical activity knowledge, particularly	• The family psychosocial environment should be considered when designing interventions to increase physical activity among both children and their families. These efforts should include a focus on the child as the agent of change. **Limitations:** Authors identified the following limitations in their work: Based on the quality assessment, only three studies were of strong methodological quality, and nearly half were rated weak. In particular, issues of selection bias were inadequately addressed. For example, 21 per cent of studies did not report recruitment rates and therefore were unable to assess external validity. Subjective methods of measuring physical activity were employed in a relatively high number of studies, and long-term follow-up was uncommon. In addition, most studies were conducted in the USA; the generalisability of results from these studies to other countries is unclear. Further high quality research into family-based physical activity promotion, with clear

Study details	Results of the review	Main findings and evidence grading
	in the context of a lack of understanding of how to change children's physical activity behaviour, and where resources for children's physical activity are inadequate. However, education alone is unlikely to change behaviour. Future efforts should focus on providing feedback or facilitating self-monitoring (particularly to increase physical activity awareness) to enhance the effect of education. Focusing an intervention on something other than the health benefits of physical activity or weight loss appeared to be an effective mechanism for changes in physical activity. This strategy may be particularly useful in the context of those with low self-esteem or poor body image. Children's confidence (identified as both a mechanism and an intermediate outcome) is further suggested to have a bi-directional relationship with physical activity. Consistent support was found for changes to the family psycho-social environment as a target for intervention for positive changes in physical activity behaviour, either directly, or via the child as the agent of change. It is also important to note that, conversely, a lack of family support may restrict healthy behaviour change. The way in which the intervention was delivered was suggested to be important for engagement and efficacy. Evidence suggested that interventions tailored to the ethnic context within which they are delivered were well-received. Targeting the whole family may be an effective strategy in increasing intervention adherence.	articulation of intended behaviour change mechanisms, is needed to strengthen the evidence. **Comments:** This review only used peer-reviewed published data which may make it vulnerable to publication bias. In addition, subjective measures of physical activity were used in a relatively high number of studies and long-term follow-up was uncommon. In addition, the I^2 was 83.5 per cent for the meta-analysis, indicating high heterogeneity. There is a Community Preventive Services Task Force summary available based on this systematic review and meta-analysis. There was an erratum published April 2017 which corrects several errors found in the paper including incorrect labelling on the studies in figure 2, and inconsistent referencing between table 1 and the manuscript reference list.

Study details	Results of the review	Main findings and evidence grading
4. Buchanan L et al. Reducing recreational sedentary screen time: A community guide systematic review. *Am J Prev Med* 2016; 50(3): 402-415. **Type of source:** Community guide systematic review. **Interventions:** Behavioural interventions focused on: (i) reducing recreational sedentary screen time only; and (ii) reducing recreational sedentary screen time and increasing physical activity or improving diet. **Relevant Outcomes:** Physical activity behaviour assessed by accelerometer, pedometer, or self-reported duration. **Study Population:** Not specifically stated but included children and adults.	**Description of included studies:** A total of 35 studies investigated physical activity outcomes. Of these, only 23 met our inclusion criteria but it was not possible to separate these from the overall effect sizes provided. In addition, nine studies targeted low-income populations. More specifically, three studies targeted low-income African American children; two studies targeted Special Supplemental Nutrition Program for Women, Infants, and Children participants; one study targeted Head Start participants; and three studies targeted disadvantaged children. Seven studies targeted overweight or obese participants. Most studies (n=22) took place in the USA, but some were also conducted in Australia (n=6), the UK (n=4) and one each in Canada, the Netherlands, New Zealand, Sweden and Switzerland. Fifteen studies took place in schools. Additionally, 25 took place in an urban/suburban setting. Family-based social support was the most common intervention component. The majority of studies were RCTs (n=31). The remainder were controlled before and after studies (n=4), single group before and after studies (n=4), and a non-randomised trial (n=1). Most included studies (n=32) targeted children aged 13 years and under, two studies targeted adults, and one study targeted the whole family. **Quality of included studies:** Assessment of potential threats to validity were conducted using standardised abstraction forms for Community Guide reviews. Quality of execution was rated as good (zero to one limitation), fair (two to four), or limited (five or more). Limitations were counted in the following nine categories:	**Intervention:** Behavioural interventions that focus on reducing screen time and increasing physical activity in children aged 13 years and under. **Evidence statement B:** There is moderate quality evidence that this intervention is effective. **Intervention:** Behavioural interventions that focus on reducing screen time and increasing physical activity in adults. **Evidence statement C:** There is some evidence supporting the use of this intervention, but it is not conclusive. **Intervention:** Behavioural interventions that focus on reducing screen time and increasing physical activity in whole families. **Evidence statement H:** Evidence about the effectiveness of the intervention is lacking.

Study details	Results of the review	Main findings and evidence grading
Studies were included up to: June 2013. **Included study types:** Primary research published in a peer-reviewed journal, technical report, or government report; primary investigations of interventions rather than guidelines or review.	• Description of the study population and intervention • Sampling • Measurement of exposure • Measurement of outcome and independent variables • Confounding bias • Data analysis • Participation • Comparability and bias • Other biases Review authors only included studies they considered to be of good or fair quality execution, but with any level of design suitability. Five studies with limited quality of execution were excluded from the review. Of the relevant studies, the most common limitations were in sampling and description. **Synthesis:** Narrative synthesis. **Findings:** Forty-seven study arms from 35 studies reported physical activity. Intervention components included electronic monitoring device, tracking/monitoring, family social support, coaching/counselling, environmental, classroom based health education and mass or small media. Sixteen study arms from 14 studies reported a median increase in moderate to vigorous physical activity (MVPA) of 2.3 minutes per day (interquartile interval (IQI)=–4.5 to 16.7). Accelerometer counts were used to measure physical activity in seven study arms and in seven high-intensity study arms. Four study arms from two studies found a	**Author's conclusions:** Among children, behavioural interventions demonstrated reduced screen time and increased physical activity. More research is needed among adolescents and adults. The authors report that interventions targeting children aged under six years may be more effective because of parental control, and that the more effective interventions included family social support, behavioural interventions, and electronic TV monitors **Comments:** All of the studies were conducted in high or medium income nations. Included studies were balanced across genders and the racial distribution was similar to that of the USA population. The findings from this review may be generalisable to the local Welsh population.

Study details	Results of the review	Main findings and evidence grading
	median increase of 66.0 counts/day (range=40.8 to 115), three study arms from three studies where TV viewing was contingent on physical activity found a median increase of 130.0 counts/day (range=127.8 to 150.0). Review authors reported the body of evidence for both interventions was generally positive, though the magnitude of effect was often small. Among adults, four study arms from three studies reported a median increase of 14.3 minutes/day in duration of MVPA (range=10.8 to 29.6). No outcome was given for the single whole family study. Outcomes relating to diet, weight and screen time are reported in the sister Observatory Evidence Service (OES) technical report and are not included here.	

Study details	Results of the review	Main findings and evidence grading
5. Carlin A, Murphy MH, Gallagher AM. Do interventions to increase walking work? A systematic review of interventions in children and adolescents. *Sports Med* 2016; 46(4):515-530. **Type of source:** Systematic review. **Interventions:** An intervention in which the main component, or one of the main components, was aimed at increasing walking behaviour. **Relevant Outcomes:** Walking levels (self-reported or objectively measured). **Study Population:** Children and adolescents (5 to 18 years old).	**Description of included studies:** Twelve studies were included which involved around 3,702 children and adolescents. Nine studies included children (aged five to 12 years old) and three studies targeted adolescents (aged 13 to 18 years old). The majority of included studies (75%) were conducted in the USA (n=5) or the UK (n=4). The remaining were conducted in Australia (n=2) or Taiwan (n=1). Study types included RCTs (n=5), quasi-experimental controlled trials (n=5), and C-RCTs (n=2). **Quality of included studies:** Risk of bias was assessed using Cochrane methodology. No overall summary of risk of bias was provided for each of the studies, however a low, high or unclear rating was assigned to each of the seven criteria. Attrition and reporting bias was low in eight studies; selection bias was low in five studies. However, selection bias was high in five studies, and most included studies scored highly for other risks of bias. Performance, detection and selection bias was unclear for eight of the included studies. **Synthesis:** Narrative synthesis. **Findings:** The majority (n=9) of included studies used objective measures to assess changes in walking (pedometers, accelerometers or mapping technology) while others (n=3) used direct observation or survey methods. Settings varied from active travel to school (n=6), school only (n=4), home (n=1) or school and family (n=1). Follow-up times for the outcomes ranged from seven days to 18 months within interventions. **Walking interventions in the school setting – children:**	**Intervention:** Walking interventions in the school setting aimed at children. **Evidence statement C:** There is some evidence supporting the use of this intervention to increase levels of walking in children but it is not conclusive. **Intervention:** Family-based walking interventions. **Evidence statement H:** Evidence about the effectiveness of this intervention to increase walking is lacking. **Intervention:** Walking interventions in adolescents. **Evidence statement C:** There is some evidence supporting the use of this intervention to increase walking but it is not conclusive. **Author's conclusions:** This systematic review highlights that walking interventions may provide an effective means for

Study details	Results of the review	Main findings and evidence grading
Studies were included up to: January 2015. **Included study types:** Intervention studies with a control or minimal intervention group included.	Eight studies evaluated this intervention. Six reported increases in physical activity using a mix of subjective and objective outcome measures. The remaining two reported either no change or a decrease in physical activity compared to control. Two educational interventions encouraging active travel to school through classroom lessons and interactive resources for families reported contrasting outcomes at follow-up. Both were quasi-experimental controlled trials conducted within the UK. Both scored high risk in random sequence generation, unclear in blinding of participants and personnel, unclear in blinding of outcome assessment, low risk in selective reporting and high risk of other bias in the quality rating. Three American walking school bus interventions found increased walking following intervention. These were composed of a RCT, a C-RCT and a quasi-experimental controlled trial. Random sequence generation was low in two and high in one (the quasi-experimental trial), allocation concealment was unclear in two and high in one (the quasi-experimental trial), blinding was rated as high in two trials and unclear risk in the quasi-experimental trial. Selective reporting was categorised as low risk in two and unclear in another. Each scored a low risk of bias in the incomplete outcome data category of the quality assessment and high risk in other bias. Significant differences were noted in the RCT with intervention participants achieving an increase of 25 and 30 per cent more time spent in MVPA than control, respectively. A 12 month follow-up of a walking school bus quasi-experimental controlled trial resulted in significant increases in the proportion of children travelling to school by walking (increase of 25 per cent). The C-RCT, objectively evaluated physical activity-related outcomes using accelerometers, with intervention participants significantly increasing their minutes/day of	increasing walking behaviours in younger populations, at least in the short-term. The majority of school-based walking interventions were shown to be effective at increasing walking in both children and adolescents. Specifically, active travel to school interventions have been shown to increase levels of walking in children; however, a lack of studies in adolescents has been highlighted, which may represent a possible focus for future policy in relation to the promotion of active travel to school, particularly within secondary schools. Such findings have implications for those involved in the promotion of physical activity in this age group. Schools/ teachers can play a key role in providing further opportunities for walking within the school environment, in addition to active travel. Furthermore, this review has highlighted the importance of targeting interventions, either by age or sex. This review has identified, for the first time, a number of behaviour change therapies that may be effective in

Study details	Results of the review	Main findings and evidence grading
	MVPA by 2.2 minutes at time point 2, compared with a decrease of 4.8 minutes observed in control participants. A two year multicomponent active travel to school C-RCT from Australia found parent based data showed the percentage of students walking to school significantly increased by 28.8 per cent within the intervention schools. This scored low risk in random sequence generation, blinding of outcome assessment, and selective reporting categories within the quality assessment, and high risk for allocation concealment and blinding of participants and other bias, and unclear in incomplete outcome data. In contrast, an active travel to school day quasi-experimental controlled trial from USA, involving 172 five to 11 year olds, observed no effect. This scored an unclear risk of bias in five of the seven categories and high risk in random sequencing and other bias categories within the quality assessment. A UK school-based RCT which provided regular, structured 15 minute walks throughout the school day, involving 152 five to 11 year olds, reported intervention participants increased their mean daily physical activity levels during school time by 136.6 counts per minute (cpm) compared with 37.8 cpm in control participants. This scored unclear in five of the seven quality assessment categories, low risk for random sequence allocation and high risk for other bias. **Walking interventions within the family setting – children:** A further UK RCT involving just 30 children scoring a low risk of bias in six of the quality assessment categories, and unclear in blinding of participants, evaluated a family-based dog walking intervention in children, with no significant differences reported. **Walking interventions in adolescents (aged 13 to 18):** All three studies in adolescents reported desirable intervention outcomes using pedometers as part of the overall intervention content. A RCT from the USA targeted 113 junior high school students	promoting walking in this population and that should be utilised by practitioners working to promote physical activity and included in future interventions to fully assess their effectiveness. The limited number of studies to date makes it difficult to draw conclusions on the effectiveness of walking interventions in relation to different ages, sex, ethnic or socio-economic backgrounds. Furthermore, this review has highlighted areas for future research needed to provide evidence in relation to walking and physical activity in children and adolescents. **Limitations:** The review authors identified the following limitations: In order that the effect of the intervention on walking could be determined in isolation, this review focused only on studies that had reported changes in walking behaviours. Other interventions that employed walking in combination with other activities, such as cycling and running, were not included as data for walking alone was either

Study details	Results of the review	Main findings and evidence grading
	and was delivered as part of existing physical education (PE) classes, involving promoting self-regulation amongst participants. Those in the self-regulation group significantly increased their daily steps by 2,071 to 4,141 steps per day more than the control group. This study scored unclear risk of bias in four quality assessment categories, low in two and high in other bias. A quasi-experimental trial from Australia, The *Girls Stepping Out Program*, involved 68 adolescent girls attending 12 weekly sessions working towards daily step goals or time-based goals. Those in the pedometer group significantly increased their four day step count at follow-up (40,992 steps) compared with controls (34,221 steps). The quality assessment determined an unclear risk of bias in three categories, low risk in incomplete outcome data and selective reporting and high risk in random sequence generation and other bias. Another RCT from Taiwan targeted adolescent girls and used daily step targets to increase physical activity resulted in a mean difference in aerobic steps per day being significantly higher for intervention (+371 steps per day) compared with control group (-108 steps per day). This study score an unclear risk of bias in three of the seven categories, low in two categories and a high risk of bias in blinding of participants and other bias categories. Commonly employed behaviour change techniques within successful interventions included goals and planning, feedback and monitoring, social support and repetition and substitution.	unreported or unpublished. It is also acknowledged that the majority of studies reported desirable intervention outcomes, which may be due to publication bias. **Comments:** As many of the studies were conducted in the USA, this may affect the generalisability of the findings to the Welsh context as many were conducted within educational settings, which are very different in the USA.

Study details	Results of the review	Main findings and evidence grading
6. Chen J, Wilkosz ME. Efficacy of technology-based interventions for obesity prevention in adolescents: A systematic review. *Adolesc Health Med Ther* 2014; 5:159-170. **Type of source:** Systematic review. **Interventions:** Technology based interventions (web-based, e-learning and active video games). **Relevant Outcomes:** Secondary outcome of physical activity. **Study Population:** Adolescents aged 12 to 18 years. **Studies were included up to:** 2014. **Included study types:** Randomised or quasi-experimental studies.	**Description of included studies:** Physical activity was a secondary outcome for this systematic review. Fourteen studies were included in the review, but only three of these met our inclusion criteria. Two were RCTs and one was a pre-post study design. Studies were generally small in population size (ranging from n=21 to 473). Authors reported where the study was conducted in only two studies, these were in the USA and Canada. **Quality of included studies:** Study quality was assessed using an adapted assessment tool from the Cochrane Effective Practice and Organisation of Care Review Group and recent systematic reviews. Studies were rated as having good methodological quality if they met at least 80 per cent of the criteria (seven of nine items or five of six items). Of the relevant included studies one RCT scored a total of eight out of nine, one RCT scored six out of nine, and one pre-post study scored three out of a total of six. Study quality was not discussed within the results. **Synthesis:** Narrative synthesis. **Findings:** Of the three studies meeting our inclusion criteria, one was an internet-based intervention, and two were active video game interventions.	**Intervention:** Technology-based interventions (including active video games and internet-based interventions). **Evidence statement H:** Evidence about the effectiveness of technology based interventions to increase physical activity in adolescents aged 10 to 18 years is lacking. **Author's conclusions:** The goal of this review was to determine ways in which health care providers and researchers can make more informed decisions about which types of technology-based interventions for adolescent obesity are most suitable and achieve sustainable weight reduction, impact the amount of physical activity, reduce sedentary activity, improve dietary behaviours, and/or positive psychosocial outcomes. Although we found no clear evidence of an effect of technology-based intervention for prevention of obesity in adolescents, the use of developmentally appropriate technology has the potential to assist health care providers in dealing with the obesity epidemic, especially when interventions focus on both physical activity and healthy dietary behaviours. Future research should include rigorous evaluation of cost-effectiveness as well as the mediating and moderating factors associated with effective technology-based interventions, and should also include more long-term follow-up. In addition, assessment of weight-related health outcomes, such as physical activity, sedentary activity, dietary

Study details	Results of the review	Main findings and evidence grading
	The internet-based intervention was an RCT conducted in USA involving 473 boys aged 10 to 14 years. This study scored six out of nine in the quality assessment. The intervention was boy scouts fit for life and involved 20 minutes weekly contact plus internet. Light physical activity was shown to have increased by 12 minutes in the spring intervention. Of the two active video games, one RCT which scored 8/9 in the quality assessment, involved 322 adolescents aged 10 to 14 years. No details of the intervention were provided and no details of physical activity results, despite recording physical activity as an outcome. The remaining study, a pre and post design which scored 3/6 in the quality assessment, was conducted in eight families, totalling 21 subjects with a mean age of 10 (±1.6 years). This study used Wii Fit exercise modules without instruction, but reported no significant changes in daily physical activity after the three month intervention.	behaviours, self-efficacy, and quality of life, should be included in future research. **Comments:** Quality of studies was not discussed within the results. The primary outcome of this review was a reduction in body mass index (BMI), physical activity was a secondary outcome. Each intervention varied greatly in terms of duration, intensity and follow-up. One reference was missing from the characteristics table (table 3), so this information has not been reported here. In addition there were a number of errors found within the tables and referencing in text, which included missing data. This systematic review contained no overlapping studies with Norris[13], but two studies were also included in the systematic review by Gao & Chen.[7] These were Maddison *et al*. (2011) and Owens (2011).

Study details	Results of the review	Main findings and evidence grading
7. Gao Z, Chen S. Are field-based exergames useful in preventing childhood obesity? A systematic review. *Obes Rev* 2014; 15(8):676-691. **Type of source:** Systematic review. **Interventions:** Exergames (Dance Dance revolution, Eyetoy, Wii etc.) in field-based settings. **Relevant Outcomes:** Physical activity levels (no details of how measured). **Study Population:** School children aged 7 to 17. **Studies were included up to:** 2013.	**Description of included studies:** Review authors identified 34 studies meeting their inclusion criteria but only 18 of these, all of which were RCTs or CTs, were included in the effectiveness analysis. The remaining studies which included cross-sectional and pre-post design were included in their descriptive analysis. Of the 18 studies included in the effectiveness analysis, 11 met the inclusion criteria for this piece of work. Of these, five were in the home setting (all RCTs), five were school-based (four controlled trials and one RCT), and one RCT described the setting as 'other'. The majority of studies were conducted in the USA (n=6, three RCTs, three CTs), but also two from the UK (one CT, one RCT), and one each from the Netherlands (RCT), New Zealand (RCT) and Singapore (CT). Studies either involved a mix of children and adolescents, children only or adolescents only. Intervention duration ranged from six to 28 weeks, with eight interventions lasting 12 weeks or less. All eleven studies used commercially available exergames for their interventions; five exclusively using the Dance Dance revolution (DDR) game, four using a mixture of games, one Eye Toy, and one was described as an interactive simulation video game. Of the nine pre-post study designs two were set in the home, six in the school setting and one was classed as 'other' settings, which included a mix of school and home or home, sport and fitness centre. Five used a mix of gaming interventions, three used DDR and one used Wii Fit games. **Quality of included studies:** The design quality of studies was assessed using a 10-item scale which looked at randomisation procedure, if it included a comparison/control group, isolate exergame, if outcome variables were measured pre and post design, dropout numbers, baseline measures, missing data, power analysis for sample size, measure validity and minimum follow-up of six months. Items were rated	**Intervention:** Home-based exergame interventions. **Evidence statement E:** There is some evidence suggesting that this intervention is ineffective for increasing physical activity in children but it is not conclusive. **Intervention:** School-based exergame interventions. **Evidence statement C:** There is some evidence supporting the use of this intervention to increase physical activity in children, but it is not conclusive. **Author's conclusions:** Physical activity as a result of exergame use can contribute towards daily recommendations of physical activity. Nevertheless, solely depending on exergames as a physical activity promotion

Study details	Results of the review	Main findings and evidence grading
Included study types: Observational and interventional – RCT, pre-post study, cross sectional. Only intervention studies contributed to effectiveness analysis.	positive, negative or not applicable (unknown or not reported). A design quality score ranging from 0 to 10 was calculated by summing up the positive rates. High quality was defined when a RCT or controlled trial scored above the median score of 5.5. All five home based studies scored above the median score of 5.5, ranging from seven to 10 out of 10. Four of the five school-based studies scored above the median, ranging from six to eight. The remaining study scored five. The single 'other setting' study scored just below the median score with five out of 10. The nine pre-post study designs generally scored a lower quality rating. Of the two home based interventions one study scored 5/10 and one scored 3/10, both were from the USA. The school-based settings, all from USA, ranged between 2/10 and 7/10, with four scoring 5/10 or above. Finally, the 'other' settings pre-post study scored 3/10. **Synthesis:** Narrative synthesis. **Findings:** **Home based settings:** Of the five included studies, two found no increase in physical activity post intervention. One RCT from the USA (quality score 8/10) found children receiving exergames were not more physically active than those receiving inactive video games. A UK based RCT which scored 7/10 found no differences in physical activity between groups. Two studies also reported an increase in physical activity. An RCT from USA scoring 9/10 for quality found intervention children showed increased MVPA and a reduction in light physical activity. The control group in contrast showed no increased in MVPA, but did show a reduction in light physical activity. A RCT	strategy among children is not realistic because the light-to-moderate physical activity generated from exergame play is insufficient to help children meet the recommended physical activity levels. Having said that, exergames hold promise as an ideal intervention only if they replace sedentary activities like video games, surfing the Internet, watching TV as opposed to traditional physical activity and sports. Also, exergames can be one supplemental component of school-comprehensive physical activity programmes, but not replace PE classes. Additionally, when implementing exergames, we should provide systematic instructions on exergame use for children, and provide physical activity opportunities for all children. The ultimate goal is to take advantage of the enthusiastic nature of exergames, and achieve the

Study details	Results of the review	Main findings and evidence grading
	from New Zealand which scored 8/10 for quality reported that the intervention group spent significantly higher time in all physical activities compared to the control group. Finally, an RCT from the USA (scoring 7/10) found self-reported moderate to vigorous exercise increased in the intervention group, but reported no significant difference between control and intervention in the accelerometer or pedometer data. The two pre-post studies found mixed results. The USA study scoring 5/10 found weekly exercise time had increased using a mixture of exergames, but the study scoring 3/10 which utilised Wii Fit games found no effects on daily physical activity. **School-based settings:** Five studies utilised the school setting for their interventions. Of these all reported increases in physical activity levels in the intervention groups, three were significant increases. These included a CT from the USA with a quality rating of 6/10 which reported significantly greater daily PA levels than the comparison over time. A USA RCT scoring 8/10 for quality found children who set specific goals had significantly greater increased physical activity levels than those in the control group. The more difficult the goals, the greater the increase. Lastly, a CT from the USA scoring 7/10 reported significantly greater increased PA levels than comparison groups. The other two studies reporting increases included a CT from the UK scoring 5/10 for quality, which found intervention children accumulated significantly greater daily steps than control children in the first week. However this was reversed at the mid and end points of the intervention. Finally, a CT from Singapore, rated as 4/10 for quality, reported exergaming children were more likely to report positive physical activity behaviours. Three of the six pre-post study designs, all from the USA, found exergaming more effective than the control. These had the lowest quality scores. One study	long-term success in making playing exergames part of children's daily workout routine. It also needs to be recognised that the potential of exergames in field-based settings might have been underestimated because of a variety of limitations inherent in many published studies. Future research and practice should take into account these limitations to unravel and exploit the maximal efficacy of exergames. **Comments:** Generalisability should be similar as exergames capitalise on children's interest in computerised video games, but there may be differences in acceptability for computer games between the USA and Wales. Authors report that game types, experience, age and gender are all documented as confounding factors associated with exergame

Study details	Results of the review	Main findings and evidence grading
	scoring 2/10 compared a mix of exergames with traditional sports and found the majority of children had increased pedometer steps. One scoring 3/10, using a mixture of exergames found children were significantly more active after the intervention, but there was no difference in physical activity at home. The highest scoring study, with 5/10 compared exergaming against a conventional aerobic fitness unit. Children were more active in the exergaming unit over time, although at all measurements (pre-, post- and follow-up) the moderate intensity level was not reached. The three highest quality rated studies found exergaming did not improve physical activity levels. The lowest quality scoring pre-post study (5/10) compared exergaming against traditional PE classes, and found in-class physical activity in the exergaming unit was significantly lower than the fitness unit. One study scoring 6/10 compared DDR, fitness and football units. They found students spent significantly higher percentages of time in MVPA in the fitness and football units than they did in the DDR unit. The highest scoring study (7/10) compared DDR and aerobic dance units and found that although children rated DDR more enjoyable, they spent significantly more time engaging in MVPA in aerobic dance. **Other settings:** The one included study, a RCT from the Netherlands (rated 5/10 for quality) compared a weekly multiplayer class over 12 weeks to motivate children to play an exergame (interactive dance simulation video game) at home, with just the video game. This study found the multiplayer group had significantly higher physical activity time than the home group. The last pre-post study was conducted in USA and scored 3/10 for quality. It looked at a DDR intervention among African American and Hispanic-American children. Children's physical fitness was found to increase and be sustained over the 30 weeks.	studies that limit its generalisability. The referencing is a little muddled in tables two and three, as is the numbering in table 2. In addition authors reported finding studies between 2010 and 2014 in their descriptive analysis, but the search dates are up to 2013. This systematic review contains two studies that are also included in Chen and Wilkosz.[6] It also contains four studies that are also included in Norris *et al.*[13]

Study details	Results of the review	Main findings and evidence grading
8. Hunter RF et al. The impact of interventions to promote physical activity in urban green space: a systematic review and recommendations for future research. *Soc Sci Med* 2015; 124:246-256. **Type of source:** Systematic review. **Interventions:** Interventions to encourage the use of urban green space which involved either a physical change to the urban green space or a physical activity intervention to promote use of urban green space or a combination of both. **Relevant Outcomes:** Physical activity (objective and subjective measures). **Study Population:** Whole population.	**Description of included studies:** The systematic review included 12 studies of which eight were controlled pre-post design, one difference in difference design, one RCT, one post-test only comparison and one pre and post population based survey. Studies were conducted mainly in the USA (n=9), the other three were conducted in Australia. Seven studies were set in areas where most of the population were of low socio-economic position and of ethnic minority groups. Target populations were heterogeneous, as were interventions and outcome measures. Follow-up times ranged from immediately post intervention to 14 months post intervention. **Quality of included studies:** Risk of Bias was assessed using the Cochrane Risk of Bias tool. Only one study had a low risk of bias (the only RCT), five were high risk and six deemed to have an unclear risk of bias. Allocation concealment and blinding were noted as concerns, and no study accounted for missing data and risk of contamination was difficult to assess. **Synthesis:** Narrative synthesis. **Findings:** **Development or improvement of urban green space:** Nine studies were included in this analysis and four studies (three from USA and one from Australia), three with an unclear risk of bias and one with a high risk of bias, showed a positive outcome with increases in physical activity and park	**Intervention:** Development or improvement of urban green space. **Evidence statement D:** The evidence for development or improvement of urban green space for increasing physical activity is inconsistent and it is not possible to draw a conclusion. **Intervention:** Promotion of urban green space. **Evidence statement H:** Evidence regarding the effectiveness of physical activity only interventions is lacking, as there are too few studies to draw a firm conclusion. **Intervention:** Development or improvement in combination with promotion of urban green space. **Evidence statement H:** Evidence relating to a combination of built environment change and physical activity promotion is lacking, as there are too few studies to draw a firm conclusion.

Study details	Results of the review	Main findings and evidence grading
Studies were included up to: July 2014. **Included study types:** Experimental or quasi-experimental. Included studies required a control group.	use. Interventions included skate park and senior centre renovations, major park improvements, urban greenway trail, and greening of vacant urban lots. Five studies showed no significant impact on physical activity. These included interventions such as major improvement or renovations to parks, and creation of pocket parks and riverside greenway development. Of these five studies, three were assigned by authors as being at high risk of bias. **Promotion of urban green space:** One RCT given a low risk of bias, conducted in USA showed a significant increase in physical activity and park users for both intervention arms over the 24 month follow-up period. An average of 600 more visits/per week/per park and an estimated 1,830 more metabolic equivalent (MET)-hours of physical activity per week per park were generated. The primary mediator of change was investment in signage which explained 37 per cent of change in park users and a 39 per cent increase in MET-hours. **Development or improvement in combination with promotion of urban green space:** Two studies were included in this analysis, a newly constructed Rail Trail (high risk of bias) and significant renovations to playfields (unclear risk of bias). Both studies found a significant increase in physical activity (0.19 hours (SD1.5 hours) per week cycling and 4 to 9 fold increase respectively). The Rail Trail study noted that usage was higher among bike-owners than walkers and was moderated by proximity to the trail.	**Author's conclusions:** In summary, there was some evidence to support the use of built environment only interventions for encouraging use and increasing physical activity in urban green spaces. However, more promising evidence existed for the use of physical activity programs combined with a physical change to the built environment. These findings highlight that multifaceted urban green space intervention strategies are likely to have a more significant impact on levels of physical activity than changes to the built environment in isolation. However, these results should be interpreted with caution given the relative dearth of intervention-based research in this area and further work is urgently required. Results from this review show promising evidence to support the use of physical activity programs and physical changes to the built environment for increasing urban green space use and physical activity. **Comments:** There may be socio-cultural or local differences when considering this evidence in the Wales context. No studies included in this systematic review were found in Stewart *et al*.[18]

Study details	Results of the review	Main findings and evidence grading
9. Langford R et al. The WHO Health Promoting School framework for improving the health and well-being of students and their academic achievement. *Cochrane Database Syst Rev* 2014; (4): CD008958. DOI: 10.1002/14651858.CD008958.pub2. **Type of source:** Cochrane systematic review. **Interventions:** Interventions (of any duration) based upon the Health Promoting Schools (HPS) framework that demonstrate active engagement of the school in health promotion activities in each of the following areas. • School curriculum • Ethos or environment of the school or both	**Description of included studies:** Sixty-seven studies were included in the review, 18 of which reported outcomes related to physical activity or sedentary behaviours or both. Four of the 18 studies focussed only on promoting physical activity, 13 studies focussed on both physical activity and nutrition, while the remaining study focussed on nutrition only, despite presenting outcome data for physical activity. All 18 studies were C-RCTs. Nine studies contributed data to the meta-analysis for physical activity. Of the 18 studies reporting physical activity outcomes, eight were conducted in the USA, seven in Europe (Belgium, France, Switzerland, the Netherlands, United Kingdom, Norway, and Spain), two in Australia, and one in Mexico. Fourteen studies focused on younger-aged children (12 years of age and under). One study focused on eight to 14 year olds, while three studies targeted older students (over 12 years of age). Seven studies reported on interventions that were implemented for up to one year (ranging from eight weeks to 12 months). One study ran for just under two years, seven studies ran for two to two and a half years, one study ran for three years, and one study ran for four years. For assessments of physical activity, four studies used student self-reports, one used observations, and four studies objectively measured physical activity using accelerometry. Two studies provided self-reported data for all children with a subset of participants also providing accelerometry data. **Quality of included studies:** The quality of included studies was assessed using the Cochrane Risk of Bias tool. Overall, the quality of evidence was low to	**Intervention:** Physical activity plus nutrition interventions based on the HPS framework. **Evidence statement C:** This intervention is supported by low to moderate quality of effectiveness. (SMD 0.14, 95% CI 0.03 to 0.26; 6 trials, 6,190 participants). Analysis only of studies using accelerometry (Three studies, 2816 participants) SMD 0.18, 95% CI 0.10 to 0.26 I^2 = 0%). **Intervention:** Physical activity interventions based on the HPS framework. **Evidence statement D:** The evidence is inconsistent and it is not possible to draw a conclusion. **Intervention:** Nutrition interventions based on the HPS framework. **Evidence statement H:** Evidence about the effectiveness of the intervention is lacking.

Study details	Results of the review	Main findings and evidence grading
• Engagement with families or communities or both. **Relevant Outcomes:** Physical activity or sedentary behaviours: accelerometry, multi-stage fitness tests (for example, shuttle runs, step tests), self-reported levels of physical activity or sedentary behaviours. **Study Population**: Children and young people aged four to 18 years attending schools or colleges. **Studies were included up to:** 22 April 2013. **Included study types:** C-RCTs where clusters were at the level of school, district or other geographical area.	moderate. Most studies were assessed to be at low risk of bias for allocation concealment. Due to the nature of these interventions, the majority of studies were assessed to be at high risk of bias because it was unlikely that participants could be adequately blinded to the fact they were taking part in an intervention. The majority of outcomes presented in studies were subjective, self-reported measures; thus the outcome assessors (usually the participants themselves) were not blind. For the majority of studies the risk of reporting bias was unclear; no protocol was available and therefore it was not possible to assess whether authors reported all relevant outcomes as intended. **Synthesis:** A meta-analysis was conducted for physical activity. **Findings:** Eighteen studies reported outcomes related to physical activity, nine of these contributed to the meta-analysis. Of these nine, six studies looking at physical activity plus nutrition interventions produced a small increase in physical activity in intervention students relative to control schools (SMD 0.14, 95% CI 0.03 to 0.26; 6 trials, 6,190 participants) but there was a large amount of heterogeneity (I^2=66%). When analysis was restricted to just those studies using accelerometry data (3 studies), heterogeneity was reduced (I^2=0%) and the size of the effect increased slightly (SMD 0.18, 95% CI 0.10 to 0.26). The two physical activity interventions showed inconsistent results with one (using self-reports) favouring the intervention and the other (using accelerometry) showing no effect (I^2=93%). There was no evidence of an effect for the single nutrition only intervention that also reported physical activity outcomes.	**Author's conclusions:** This review provides evidence that a holistic school-based intervention, like the HPS framework, can be effective at improving a number of health outcomes in students, especially those concerning physical activity and physical fitness. While this review has produced some evidence in favour of the HPS framework, the number of studies contributing evidence is low, hampering the ability to draw definitive conclusions. More well-designed research in this area is required to establish the effectiveness of this approach for other health topics and academic achievement. **Comments:** The majority of included studies were set in high-income countries. All interventions took place in co-educational schools. The findings from this review may be generalisable to the local Welsh population.

Study details	Results of the review	Main findings and evidence grading
10. Maher CA, et al. Are health behavior change interventions that use online social networks effective? A systematic review. *J Med Internet Res* 2014; 16(2):238-250. **Type of source:** Systematic review. **Interventions:** Online social network interventions to promote health behaviour change. **Relevant Outcomes:** Changes in behaviour relating to amongst others physical activity. **Study Population:** Child or adult populations. **Studies were included up to:** 2012. **Included study types:** RCTs and randomised cross-over trials.	**Description of included studies:** Ten studies were included in this systematic review, but only three of these studies met our inclusion criteria. These were a RCT conducted in the USA with 134 healthy participants aged below 25 years, a randomised cross-over study from the UK with 10 participants, and a single pre-post study with 545 participants from Australia. **Quality of included studies:** Risk of methodological bias scores were based on the CONSORT tool and scored out of a maximum of 25. The RCT from the USA scored 13.5/25, the small UK study scored 8.5/25 and the larger Australian study scored just 3/25. Quality issues included provision of effect size estimates and their precision, reporting participant blinding, attrition rates and participation rates. **Synthesis:** Narrative synthesis. **Findings:** There was some confusion over the results of the RCT from the USA with a quality rating of 13.5/25, as in the characteristics table this study reported a primary outcome of physical activity, but in the narrative results it is described as having reported an increase in dietary awareness. This study used a Facebook group to supplement a physical activity website and participants were all female.	**Intervention:** Online social network interventions targeting health behaviour change. **Evidence statement H:** Evidence about the effectiveness of the intervention is lacking. **Author's conclusions:** In conclusion, research using online social networks to bring about health behaviour change is still in its early stages of development and, while several studies show promise, much is still to be learned about optimizing these interventions to increase their efficacy. In particular, research is needed to determine how to maximize retention and engagement, whether behaviour change can be sustained in the longer term, and to determine how to exploit online social networks to achieve mass dissemination. A key limitation of the review was the heterogeneity of the identified studies. Studies varied in terms of target population, intervention, and study design. Furthermore, only a relatively small number of eligible studies were identified. It is currently unclear whether social networking-based interventions are equally useful for all health behaviours or whether they

Study details	Results of the review	Main findings and evidence grading
	The randomised cross-over trial from the UK with a quality rating of 8.5/25 reported no significant difference between intervention and control, although both groups did improve significantly over time. This intervention used a Facebook app 'StepMatron' to encourage self-monitoring of daily steps and included a discussion board/forum. 90 per cent of participants were female. The large Australian single pre-post study which scored 3/25 reported a significant improvement in physical activity. This study used a health online social networking website which used education and a discussion board/forum.	may be more effective for some than others. The identified studies only followed participants for a relatively short period (the longest was six months). Given that many of the health benefits of health behaviour are achieved over a long-term period, further work is needed to examine whether the short-term behaviour change achieved in the included studies can be sustained over a longer period, such as 12 months and beyond. **Comments:** Most participants were female. The review was interested in a wide range of behaviour change outcomes relating to tobacco smoking, alcohol use, physical inactivity, or diet. Secondary outcomes of interest were potential mediators of behaviour change (such as dietary awareness or physical activity self-efficacy) or impacts related to behaviour change (such as quality of life or body weight).

Study details	Results of the review	Main findings and evidence grading
11. Martin R, Murtagh EM. Effect of active lessons on physical activity, academic and health outcomes: a systematic review. *Research quarterly for exercise and sport* 2017; 88(2):149-168. **Type of source:** Systematic Review. **Interventions:** Interventions deliberately teaching academic content using physically active methods. **Relevant Outcomes:** Health outcomes including intensity, duration and frequency of physical activity. **Study Population:** School-aged children (5-18 years). **Studies were included up to:** March 2015.	**Description of included studies:** Fifteen articles met the inclusion criteria and were examined in the systematic review. Of these ten studies included a physical activity outcome and are described here. Four were cluster randomised control trials (C-RCTs), two were pre and post trials, and one each of a pre, mid and post trial, controlled trial, non-randomised controlled trial and a randomised controlled trial. Seven studies were conducted in USA, involving between 75 and 1,527 pupils. One study from USA described included 150 classes, but did not count individual pupils. The remaining three studies were conducted in China (non-RCT, 753 pupils), New Zealand (pre and post, 61 pupils) and Australia (RCT, 54 pupils). All studies took place in primary school settings. **Quality of included studies:** Studies were scored for risk of bias using the Cochrane collaboration risk of bias assessment tool. High, unclear and low risks of bias were awarded in each category. All were given a score of either high or unclear risk of bias. Elements commonly given a high risk of bias were random generation concealment, allocation concealment and other bias. Unclear risk of bias were given for aspects of blinding participants and outcome assessment, and for incomplete outcome data and selective reporting. **Synthesis:** Reported results were assessed in terms of Cohen's ES standard (≥ 0.8 = large; < 0.8 to > 0.2 = medium; ≤ 0.2 = small). **Findings:**	**Intervention:** Classroom based interventions in primary schools of at least one week in duration that integrated physical activity and academic content. **Outcome:** Increasing frequency, duration and intensity of physical activity. **Evidence statement C:** There is some evidence supporting the use of this intervention but it is not conclusive. **Author's conclusions:** This review illustrates the important role that physically active academic lessons can play in increasing physical activity levels of school children. Additionally, potential benefits for education and health outcomes and facilitators of learning were observed. Several recommendations with regard to study design and reporting have been identified. Specifically, this review demonstrates the need for future research to involve more robust designs (i.e. randomised, controlled trials) and to adhere to reporting standards (e.g., Consolidated Standards of Reporting Trials [CONSORT]. The results reported are of relevance for policymakers, educational administrators, and teachers. Our findings provide evidence for the valuable contribution that physically active

Study details	Results of the review	Main findings and evidence grading
Included study types: Controlled intervention studies.	Of the 10 studies reporting physical activity outcomes for physically active academic lesson interventions on daily physical activity levels, eight reported statistically significant increase in physical activity outcomes, and two reported no significant change. Three were found to exceed Cohen's convention for a large effect (one controlled trial and one pre post study design from USA, and one RCT from Australia). Two studies demonstrated a medium effect size (both cluster RCTs from USA) and one study from USA (Cluster RCT) reported a small effect size. The remaining two studies did not contain enough information for systematic review authors to calculate an effect size (one non-randomised controlled trial from China and a cluster randomised controlled trial from USA, both with a high risk of bias). The two remaining studies reported no significant change in outcome (from USA and New Zealand). Findings relating to weight outcomes are reported in the sister Observatory Evidence Service (OES) technical report and are not included here.	teaching methods can make to school-based health promotion. **Limitations:** The authors note that are only generalisable to primary school aged children as no studies including children aged 12 years and over were included. Authors also noted that components of the interventions were not well described, making examination of these difficult. Intervention also varied greatly from between one week and three academic years. The search strategy was limited to English only publications and so there may be a risk of publication bias as the findings are only based on the available published evidence. **Comments:** Findings may not be generalisable to Welsh/UK context as studies were undertaken in schools in mainland China and the USA.

Study details	Results of the review	Main findings and evidence grading
12. Meyer M et al. Physical activity-related policy and environmental strategies to prevent obesity in rural communities: A systematic review of the literature, 2002-2013. *Prev Chronic Dis* 2016; 13: E03. **Type of source:** Systematic review. **Interventions**: Physical activity–related policy or environmental interventions. **Relevant Outcomes:** Physical activity. **Study Population:** Rural communities. **Studies were included up to:** May 2013. **Included study types:** Empirical, formative, process or outcome research.	**Description of included studies:** Thirty articles representing 26 distinct studies were included in this systematic review. Fourteen studies met our inclusion criteria. Included studies were RCTs (n=3), pair-RCTs (n=1) and pre-post studies (n=10). Studies were conducted in Canada (n=1) or the United States (n=13). Three studies investigating students used American Indian tribes. Most policy or environmental strategies implemented in the studies focused on schools (n=11), whether the target population was students, school employees, or community members using the school facilities outside of school time. The remaining three studies were set in worksites, childcare settings or within the community. Samples sizes ranged from 89 to 5,400, but were often reported as units of worksites, schools or districts. Twelve of the included studies investigated interventions aimed at children in a school setting, and of the remaining two, one was conducted in the community and one based in a worksite. **Quality of included studies:** The study quality of RCTs was assessed using Cochrane Collaboration's assessment tool and non-RCTs were assessed using the GRADE guidelines for observational studies. Of the RCTs two were rated as a high risk of bias, and two as a medium risk of bias (including the pair RCT). Sequence generation was absent in all RCTs, and all reported selective outcome data and had other sources of bias.	**Intervention:** Physical activity–related policy or environmental interventions in rural communities. **Evidence statement D:** Evidence about the effectiveness of this intervention in rural communities is inconsistent and it was not possible to draw a conclusion. **Author's conclusions:** The main findings of this review is the importance of making schools the focal point of physical activity related interventions and building on existing community resources. Additionally, several physical activity related Common Community Measures for Obesity Prevention (COCOMO) strategies, such as improvement of public transportation or geographic availability of supermarkets, may not be applicable to rural communities. Authors recommend inclusion of non-COCOMO physical activity related strategies and refinement of current COCOMO recommended measurements. COCOMO strategies and recommended measurements provide an evidence-based approach to address obesity and measure the success of intervention strategies. Most physical activity related strategies appeared to be applicable in rural communities, along with

Study details	Results of the review	Main findings and evidence grading
	The remaining pre-post studies scored as high risk of bias (n=6), medium risk of bias (n=1) and low risk of bias (n=3). None of the non-RCTs adequately controlled for confounding. **Synthesis:** Narrative synthesis. **Findings:** Included studies employed a variety of strategies, including PE in schools, increasing the amount of physical activity in PE classes, increasing amount and access to physical activity equipment, increasing opportunities for extracurricular physical activity, improving access to outdoor recreational facilities, enhancing infrastructure to support walking, and adopting worksite policies. Many studies used a combination of strategies, with only two studies employing single strategies and the remaining 12 utilising two or more. Nine studies used subjective measures (usually surveys) to record outcomes. One study used objective measures to report physical activity (pedometer), two used both objective and subjective measures, and two failed to report how outcomes were measured. Two of the four RCTs used subjective measures, one used both subjective and objective measures and the pair randomised trial (medium risk of bias), failed to report which outcome measure was used to assess physical activity levels. Of the 11 studies reporting positive changes in physical activity after implementation of policy or environmental changes, three studies reported significant positive changes in physical activity. These were all pre-post in	several non-COCOMO strategies were effectively implemented in rural communities. These were: • Increase physical activity opportunities at school outside of PE • Increase amount of and access to physical activity equipment or improve existing equipment resources • Promote physical activity resources • Provide access to public buildings after hours for physical activity purposes • Adopt worksite policies or practices • Reduce home screen time • Reduce school and preschool sedentary time • School district-side adoption of a physical activity supportive curriculum. **Limitations:** Authors reported measurement of physical activity outcomes in the studies reviewed was rare and lacked consistency and methodological strength, limiting interpretation. When physical activity change was reported, most studies used a form of self-report. Few studies used objective measurement, and those that did measure physical activity objectively only did so in a subset of their sample, with half using pedometers. Authors also highlighted the lack of detail on study methods and variation in study design, measurement of outcomes, and context limited

Study details	Results of the review	Main findings and evidence grading
	design and used subjective (low risk of bias), objective (high risk of bias) and both (high risk of bias) to measure outcomes. Of the four randomised trials, three reported an increase, although not significant, and one reported no change (medium risk of bias, using subjective outcome measures). As many studies implemented more than one strategy, it was not possible to attribute the improvements to one strategy alone.	ability to compare results of strategies across studies and examine effectiveness. Most studies were biased across assessment categories, indicating overall weakness in research design. Only 14 studies measured change in physical activity in response to policy or environmental strategies, and measurement approaches greatly varied. **Comments:** Studies were only included if they were from USA or Canada so may not be generalisable to the population in Wales. In addition, three studies investigated students from American-Indian tribes or First Nations of Canada.

Study details	Results of the review	Main findings and evidence grading
13. Moore M et al. Effective community-based physical activity interventions for older adults living in rural and regional areas: A systematic review. *J Aging Phys Act* 2016; 24(1):158-167. **Type of source:** Systematic review. **Interventions:** Community-based interventions. **Relevant Outcomes:** Increased physical activity participation. **Study Population:** Older people (aged 65 years or over) living in the community (i.e., not residential care) within rural or regional areas (i.e., not metropolitan or remote areas). **Studies were included up to:** August 2014.	**Description of included studies:** Seven studies were included in this systematic review, with three relevant to our inclusion criteria. Of these one was a RCT from the USA, one a population based study from Taiwan, and one a quasi-experimental trial from the USA. **Quality of included studies:** Risk of bias was assessed using the Cochrane Collaboration risk of bias tool. Of the three relevant included studies, the USA RCT scored a low risk of bias for selection bias, performance bias, detection bias, and other bias. It scored unclear for attrition and reporting bias. The population study from Taiwan scored a low risk of bias for selection bias and detection bias, an unclear risk of bias for attrition bias, and a high risk of bias for performance bias, reporting bias and other bias. The quasi-experimental study scored unclear risk of bias for selection and other bias, and a high risk of bias for the remaining four categories. **Synthesis:** Narrative. **Findings:** The RCT from the USA had 1,635 participants ranging from 70 to 89 years. Authors found the physical activity group increased walking and weight training time (MD 104 minutes, 95% C.I. 92 to 116 minutes) The intervention group also increased moderate intensity physical activity (MD 40 minutes per week, 95% C.I. 29 to 52 minutes per week). This study allowed participants to self-select the type of physical activity they undertook.	**Intervention:** Community-based interventions in older adults living in rural and regional settings. **Evidence statement C:** There is some evidence supporting this intervention to promote physical activity, but it is not conclusive. **Author's conclusions:** There is limited rigorous research investigating effective community interventions for promoting physical activity in older adults living in rural and regional community settings. Individual studies reported health benefits of community-based interventions, however, findings across studies were inconsistent. It is likely that these findings reflect variations in intervention types, duration, outcome measures, and follow-up. Consequently, based on current evidence, it is difficult to evaluate the relative value of different community-based physical activity interventions for improving specific health parameters in older rural and regional populations. Available evidence indicates that interventions which are tailored, promote low to moderate intensity activity, and incorporate personal contact for intervention

Study details	Results of the review	Main findings and evidence grading
Included study types: No study design specified.	The population study from Taiwan which scored a high risk of bias for performance, reporting bias and other bias, but a low risk of bias for selection bias and detection bias, found significant increase in exercise duration for those participating in a prescribed Tai Chi programme (MD 56% $p<0.001$) compared to control villagers. The quasi-experimental study undertaken in 139 older USA residents found that after 12 months of low-intensity physical activity twice weekly normal walking pace improved (adjusted MD 0.63 seconds, 95% C.I -0.45 to 0.81 seconds). As the confidence interval crosses the line of no effect, this is not a statistically significant result. This was also a prescribed intervention. Common to all studies was the inclusion of low to moderate intensity exercises or low-impact physical activity. All three interventions lasted a minimum of 12 months. Studies with long-term interventions reported a reduction in adherence over time. For example, the population study from Taiwan reported adherence rates of 87 per cent at two months and 49 per cent at 12 months.	delivery (e.g., face-to-face counselling, group sessions) are potentially effective in this setting. Researchers aiming to investigate the effectiveness of community interventions in older adults should consider using multiple follow-up time points of at least six months, and incorporate reliable and valid measures of adherence and physical activity participation (e.g., pedometer/ accelerometer). **Comments:** Studies were conducted in Australia, Canada, the USA and Taiwan which may limit the generalisability of this to the Welsh population. A key finding from this review was the limited number of studies that have employed rigorous methods using valid and reliable self-report and objective measures to investigate the benefit of community-based interventions for promoting physical activity participation and adherence.

Study details	Results of the review	Main findings and evidence grading
14. Norris E, Hamer M, Stamatakis E. Active video games in schools and effects on physical activity and health: a systematic review. *J Pediatr* 2016; 172:40-46. **Type of source:** Systematic review. **Interventions:** Active video games (AVG) in school. **Relevant Outcomes:** Physical activity, measured either directly or indirectly. **Study Population:** 18 years and under. **Studies were included up to:** April 2015. **Included study types:** Pre-post design, RCTs and CTs.	**Description of included studies:** Twenty-two studies were included, and 15 reported on physical activity outcomes. Eleven studies were from the USA, three from the UK, and one from Singapore. Three were RCTs, four were pre-post intervention studies, two controlled trials, three alternating treatment design and three repeated measures. Participants ranged from 5 to 15 years old. **Quality of included studies:** Study quality was assessed using the EPHPP tool. Included studies were generally of poor quality. Of the fifteen relevant studies three were assessed as moderate quality, and the remaining 12 were deemed to be low quality. Authors commented that blinding was unclear in all studies included. **Synthesis:** Narrative synthesis. **Findings:** Intervention duration ranged from one-off sessions to 14 months, with two studies not reporting length. Interventions were mostly held during PE lessons with other studies running sessions during breaks and lunchtime, before school or after school. Most AVG utilised widely available consoles such as Nintendo Wii, Microsoft Xbox and Sony PlayStation. Games included DDR, Wii Fit and Wii Sports. One study failed to provide information on the dance mat provided. Nine studies used activity monitors via accelerometry, pedometry or heart rate monitoring to assess physical activity. Four studies assessed physical activity using self-report questionnaires and two via observations.	**Intervention:** School active video games. **Evidence statement C:** There is some evidence supporting the use of active video games in schools to improve physical activity, but it is not conclusive. **Author's conclusions:** There is currently insufficient evidence to recommend AVGs as efficacious health interventions within schools. Higher quality AVG research utilizing randomized controlled trial designs, larger sample sizes, and validated activity measurements beyond the school day is needed. **Comments:** Studies were conducted in a variety of countries and AVG interventions ranged enormously in terms of length and number of sessions. In addition, measures of physical activity were subjectively and objectively measured. Four studies included in this systematic review are also included in Gao and Chen.[7]

Study details	Results of the review	Main findings and evidence grading
	Nine of the 14 studies, eight from the USA and one from Singapore found AVGs to increase light physical activity via accelerometry, observations or questionnaires (eight graded as weak and one as moderate). Of these, four studies reported significant increases in physical activity. Four studies, two repeated study designs from the USA (both graded as weak quality), a RCT from the UK (graded as moderate quality) and a controlled trial from the USA (graded as weak quality) found overall lower moderate to vigorous physical activity in the AVG groups. Only one of the repeated study designs from the USA reported significantly less physical activity in the AVG groups. Two studies, a pre-post study from the USA, graded as weak and a RCT from the UK graded as moderate found no overall difference between the AVG and control groups.	

Study details	Results of the review	Main findings and evidence grading
15. Plotnikoff RC et al. Effectiveness of interventions targeting physical activity, nutrition and healthy weight for university and college students: A systematic review and meta-analysis. *Int J Behav Nutr Phys Act* 2015; 12:45. **Type of source:** Systematic review and meta-analysis. **Interventions:** Lifestyle interventions aimed at improving physical activity and/or dietary intake and/or weight. **Relevant Outcomes:** Physical activity related outcomes: steps per day, time spent undertaking vigorous and/or moderate physical activity, VO^2 max, muscular strength/	**Description of included studies:** Of the 41 studies identified in the review, 29 examined physical activity (11 exclusively, 18 in combination with other health behaviours). Of these 29 studies, 22 were conducted in the USA, two in Turkey and one each in Jordan, Lebanon, Scotland, Ireland, and Taiwan. Study designs included RCTs (n=16), non-randomised controlled trials (n=7) and pre-post designs with no control group (n=6). **Quality of included studies:** Risk of bias was assessed using the Academy of Nutrition and Dietetics Criteria Checklist: Primary Research tool assessing 10 criteria. These criteria included whether: • The study clearly stated the research question • If the selection of participants was free from bias • If the study groups were comparable • Description of method of handling withdrawals • Use of blinding • Detailed description of interventions and comparisons • Clear definition of outcomes and valid and reliable measurements • Appropriate statistical analysis • Consideration of limitations • Likelihood of bias due to funding. Study quality was classed as positive if criteria 2, 3, 6 and 7, as well as one other validity criteria question were scored with a 'yes', neutral if criteria points 2, 3 6 and 7 did not score a 'yes', or negative if more than six of the validity criteria questions were answered with a 'no'.	**Intervention:** Lifestyle interventions aimed at improving moderate physical activity in university and college students. **Evidence statement B:** This intervention is supported by moderate quality evidence of its effectiveness (five studies, SMD 0.18, 95% CI 0.06 to 0.30, Z=2.84, P=0.005). Heterogeneity I^2=0%. **Intervention:** Lifestyle interventions aimed at improving total physical activity in university and college students. **Evidence statement E:** There is some evidence suggesting this intervention is ineffective, but it is not conclusive (five studies, SMD -0.11, 95% CI -0.30 to 0.08, Z=1.13, P=0.26). Heterogeneity I^2=65% (significant). **Intervention:** Lifestyle interventions aimed at improving vigorous physical activity in university and college students. **Evidence statement E:** There is some evidence suggesting this intervention is ineffective, but it is not conclusive. (Five studies, SMD 0.28,

Study details	Results of the review	Main findings and evidence grading
endurance, energy expenditure, flexibility. **Study Population:** Students attending institutions within the tertiary education sector. **Studies were included up to:** April 2014. **Included study types:** All quantitative study designs (including RCTs, non-randomised experimental trials and pre-post with no control group).	Of the 29 studies examining physical activity, the average risk of bias classification was neutral. Those included in the meta-analysis were classified as either neutral or positive. **Synthesis:** Meta-analysis. **Findings:** Eleven studies focused on physical activity alone, while 18 included other health behaviours. Eight studies contributed to the meta-analyses, two of which were included in all three meta-analyses (one of which was rated as positive quality), while three contributed to two (all neutral quality) and the remaining three (two graded as neutral quality and one as positive quality) all contributed to just total physical activity. Meta-analysis of five studies assessing moderate physical activity demonstrated significant increases in moderate physical activity in intervention groups compared to control (SMD 0.18, 95% CI 0.06 to 0.30, Z=2.84, P=0.005). The studies were homogenous I^2=0%. For total physical activity there was no significant effect. This meta-analysis included five studies, three of which included multiple intervention arms compared to a single control group, meaning 10 intervention arms were included in the analysis. Meta-analysis showed SMD -0.11, (95% CI -0.30 to 0.08), Z=1.13, P=0.26. There was significant heterogeneity I^2=65%. For vigorous physical activity there was no significant effect (meta-analysis of five studies SMD 0.28, 95% CI -0.8 to 0.63, Z=1.54, P=0.12). There was significant heterogeneity I^2=84%.	95% CI -0.8 to 0.63, Z=1.54, P=0.12). Heterogeneity I^2=84% (significant). **Author's conclusions:** Tertiary education students within the university/college setting are ideal targets for lifestyle interventions aimed at improving health behaviours. There is significant scope for implementation of lifestyle interventions to improve the health of this group that represents a significant proportion of our population. **Comments:** The majority of studies examined were conducted in tertiary educational settings in the USA. There may be slight differences in the educational systems between the USA and Wales, but this is unlikely to affect the generalisability of findings from this review. Study participants were overwhelmingly female, which may be due in part to the higher percentage of females enrolled in some universities and colleges.

Study details	Results of the review	Main findings and evidence grading
16. Reynolds R et al. Systematic review of incidental physical activity community interventions. *Prev Med* 2014; 67:46-64. **Type of source:** Systematic review. **Interventions:** Any aimed at increasing physical activity over four weeks or more. **Relevant Outcomes:** Incidental physical activity. **Study Population:** Participants of 20 or more children or adults in community settings. **Studies were included up to:** December 2012. **Included study types:** RCTs, controlled trials, controlled before and after study and ITS.	**Description of included studies:** Forty-two articles, incorporating 43 studies (one article incorporated two studies) were included in this systematic review. All studies were conducted in high income countries (UK n=20, North America n=11, Europe n=6, Australia n=3, New Zealand n=1, Japan n=1 and Hong Kong n=1). Twenty three were controlled before and after studies, seven were interrupted time series trials, seven were controlled trials and six were RCTs. **Quality of included studies:** Authors used the guidelines suggested by the Cochrane Public Health Group for risk of bias. These include two sets of criteria; one for RCTs, controlled trials and controlled before and after studies, and another for ITS. Of the 43 included studies, the level of bias was moderate to high in 77 per cent of studies and low or low to moderate in only 23 per cent of studies. Specifically, nine were judged by the authors to be of low risk of bias, one of low to moderate risk of bias, 20 of moderate risk of bias, one of moderate to high risk of bias and 12 of high risk of bias. **Synthesis:** Narrative synthesis. **Findings:** Most studies (58%) were community-based, conducted in school settings (28%, n=12), workplaces (21%, n=9) and higher education campuses (9%, n=4). The remainder of studies were community-wide, conducted in shopping centres (19%, n=8), over ground or underground train stations (14%, n=6) and whole-of-community (10%, n=4). The majority of the studies were between a duration of four weeks and 12 weeks (58%, n=25), followed by >12 weeks to <6 months (19%, n=8), 6 months to <12 months (19%, n=8) and lastly 12 months or more (5%, n=2).	**Intervention:** School-based interventions. **Evidence statement B:** There is moderate quality evidence supporting the effectiveness this intervention in increasing incidental physical activity. **Intervention:** Work-based interventions. **Evidence statement C:** There is some evidence supporting the use of this interventions but it is not conclusive. **Intervention:** Playground interventions. **Evidence statement C:** There is some evidence supporting the use of this intervention to increase physical activity, but it is not conclusive. **Intervention:** Stair use interventions. **Evidence statement C:** There is some evidence supporting the use of this intervention to

Study details	Results of the review	Main findings and evidence grading
	Interventions were aimed at increasing active transport (23% n=10), increasing playground energy expenditure (16% n=7), and increasing stair use compared to lift/escalator (60% n=26). **Active travel interventions** Ten studies looked at active travel interventions. This intervention saw the largest mean percentage increase in incidental physical activity: first in children at school (124.5% increase, or 41.9% when the 372% increase study was excluded) followed by community-wide in whole-of-population (63.0% increase in n=1) and then in adults in the workplace (38.8% increase, n=1). **School-based active travel interventions** Seven of these were school-based and included: • Walking bus programmes (a single CT set in the USA with a moderate risk of bias). This found a significant increase in incidental physical activity outcomes • School-based education (two CTs, both based in the UK with a high risk of bias, and a single controlled before and after study based in the USA with a low-moderate risk of bias). Only one UK controlled trial found a significant increase in incidental physical activity • Advice on school travel patterns (RCT based in the UK with a low risk of bias). This reported a significant increase in incidental physical activity • Safe walking routes to school (a USA based controlled before and after study rated as a moderate risk of bias). This was found to have a significant increase in incidental physical activity • Impediments to active transport to school (an Australian RCT with a moderate risk of bias). This too found a significant increase in incidental physical activity. **Work based active travel interventions** The remaining three studies looked at work-based education (two of which were from the same paper: A Finish study incorporating an RCT	increase physical activity, but it is not conclusive. **Author's conclusions:** This systematic review suggests that primarily active transport interventions, and secondarily children's play interventions, and to a lesser extent stair use, may be important incidental physical activities to incorporate into public health interventions that aim to promote physical activity for health. However, healthcare providers, users and policy makers should use caution when interpreting results due to risk of study bias and heterogeneity in study design. The limitations make it difficult to extrapolate the collated study findings into meaningful figures, e.g. extra minutes per day of active transport by walking and therefore potential changes in energy expenditure and health-related measures in the longer term. However, the time spent per day in active transport or playground activities would be larger than that spent walking up or down stairs. This finding plus the finding that active transport

Study details	Results of the review	Main findings and evidence grading
	and a controlled before and after study which was rated with a high risk of bias for both study arms) and work route and safety information (a UK based RCT given a high risk of bias rating) as active travel interventions. The Finish RCT found a significant increase, but the controlled before and after study did not report an increase in incidental physical activity. The UK study did find a significant increase in incidental physical activity. **Playground physical activity interventions** Seven studies were in this category, and four studies reported a significant increase in incidental physical activity. Interventions included: • A learning landscapes program (construction of culturally-tailored schoolyard play spaces), a USA controlled trial with a high risk of bias found a significant increase in incidental physical activity • The provision of play equipment/physical structures and/or markings (five studies, all but one (an RCT from Belgium), with a high risk of bias. These were a mix of RCTs, controlled trials and before and after studies). The three studies that found a significant increase in incidental physical activity were two from the UK and one from Belgium, all with a high risk of bias • A controlled before and after natural experiment which involved the upgrade of a community playground conducted in New Zealand. This also had a high risk of bias, but reported a significant increase in incidental physical activity. Collectively, playground physical activity studies suggest programmes that promote physically active play at school can be effective in increasing physical activity and reducing sedentary time during breaks such as morning recess. **Stair use interventions** Twenty six studies looked to increase ascending, or ascending and descending stair use. The stair use associated health benefits described in 22 studies focused on increased percentage stair use by the study populations.	interventions resulted in the largest increases in activity suggests that primarily active transport and secondarily playground interventions have the greatest public health potential and significance of incidental physical activity interventions. **Comments:** As the included studies were conducted in high income countries, many from the UK, this should be generalisable to Wales. **Limitations** The review authors identified the following limitations: The risk of study bias; the heterogeneous results between studies, such as number of observations and/or number of participants, or how change in active transport is measured; the risk of incomplete retrieval of identified research; the challenge of defining IPA; the difficulty in assessing the intensity or dose of an intervention and taking this into account when considering a study's results; and different activities that have different energy requirements being grouped together in one type of

Study details	Results of the review	Main findings and evidence grading
	Twenty studies found a significant increase in incidental physical activity. Of these, 16 were controlled before and after studies, four were ITS. Nine of these were conducted in the UK, four in the USA, three in Australia and one each in Hong King, Japan, Spain and Switzerland. Fourteen were rated as a moderate risk of bias, five with a low risk of bias and one with a high risk of bias. Six studies did not report a significant increase in incidental physical activity. These were mostly from the UK (n=4), and one each from the USA and Australia. Three of these were ITS, one was a controlled before and after study (from the UK), and one a controlled trial (from the UK). The remaining study design was not provided. All three ITS were given a low risk of bias, and the controlled before and after and controlled trial were given a moderate risk of bias. The study without a study design was given a moderate risk of bias by systematic review authors. Interventions included strategies such as placement of motivational point-of-decision prompts such as signs and posters beside/in between stairs and escalators or lifts or stair riser banners, improving the attractiveness of a stairwell involving artwork, music, new carpet or painting the walls. Sustainability of stair use post intervention was mixed with one study finding stair use remained higher than at baseline, but another found the small brief initial effects were not maintained.	intervention. These make it difficult to extrapolate the collated study findings into meaningful figures.

Study details	Results of the review	Main findings and evidence grading
17. Sims J, Scarborough P, Foster C. The effectiveness of interventions on sustained childhood physical activity: A systematic review and meta-analysis of controlled studies. *PLoS ONE* 2015; 10(7). **Type of source:** Systematic review and meta-analysis. **Interventions:** Intervention(s) to maintain physical activity levels in children. **Relevant Outcomes:** Measures of Moderate to Vigorous Physical Activity (MVPA) or Total Physical Activity (TPA). **Study Population:** Non-clinical children or adolescents aged between 5 to 18 years.	**Description of included studies:** Fourteen studies were included in the review. Seven of the 14 studies were conducted in the USA, two in Australia, one in China, Hong Kong, Denmark, Israel and Portugal. All but one of the studies were conducted in high-income nations according to the World Bank economic classifications, with one conducted in the upper middle-income bracket. Overall, six C-RCTs, three RCTs, two randomised prospective studies, one cluster randomised prospective study, one nested RCT and one controlled longitudinal trial, were included. The number of participants ranged from 41 to 3,714. Overall, 51.27 per cent of the participants were female. Mean baseline age was 10.67 years (± 1.91), with eight studies targeting participants of UK primary education age and six studies targeting UK secondary education age participants. Three studies were treatment orientated, recruiting specifically overweight or obese participants, with the remainder being promotional or preventative. **Quality of included studies:** Study quality was assessed using the Methodology Checklist for Randomised Controlled Trials. Overall there was a high number of uncertain verdicts against the papers, potentially indicating that reporting of relevant information within the published articles was more pertinent than the actual methodological quality of the studies. A visual inspection of funnel plots for both outcomes suggested the possibility of small-study effect. **Synthesis:** Meta-analysis. **Findings:**	**Intervention:** Interventions to maintain physical activity levels in children. **Evidence statement E:** There is some evidence suggesting this intervention is ineffective, but it is not conclusive. **Author's conclusions:** Improved physical activity levels subsequent to intervention were not maintained six month post intervention. Potentially useful avenues of future research include; specifically exploring community treatment of high risk individuals, and the inclusion of a rigorously implemented and reported follow-up measurement stage in the methods. **Comments:** The review was conducted in high-income nations, the majority of which were in the USA. The findings may be generalisable to Wales.

Study details	Results of the review	Main findings and evidence grading
Studies were included up to: November 2014. **Included study types:** Peer-reviewed studies utilising a trial design incorporating a control group, irrespective of whether randomisation was used and reporting six-month post intervention measurement.	Interventions included extra PE classes in curriculum time, physical activity delivery outside curriculum time, counselling, goal-setting, incentive based interventions and peer modelling either singularly or in combination. Twelve studies reported MVPA and 10 TPA. The collated results from the 12 studies reporting MVPA showed a small increase in favour of the intervention group with a mean difference of 1.47 minutes per day (95% CI -1.88 to 4.82; p=0.39). For the 10 studies reporting TPA the analysis showed no difference between the pooled effects of the intervention and those for the control group, with a standardised mean difference of -0.13 (95% CI -0.74 to 0.48; p=0.67). Sub-group analyses revealed males (2.65 minutes per day: 95% CI 2.03 to 3.27) reported higher levels of MVPA than females (-0.42 minutes per day: 95% CI -7.77 to 6.94), community settings (2.67 minutes per day: 95% CI 2.05 to 3.28) were more effective than school settings (1.70 minutes per day: 95% CI -4.84 to 8.25), and that treatment (4.47 minutes per day: 95% CI -0.81 to 9.76) demonstrated greater effects than population approaches (1.03 minutes per day: 95% CI -2.54 to 4.60). Meta-regression revealed no significant differences by factor on pooled effects.	

Study details	Results of the review	Main findings and evidence grading
18. Singh A et al. Impact of school policies on non-communicable disease risk factors - a systematic review. *BMC Public Health* 2017; 17(1):292 **Type of source:** Systematic review. **Interventions:** School level policy interventions that modified risk factors (unhealthy diet, physical inactivity, alcohol and tobacco use) and associated health related behaviours either alone or as part of any intervention programme. **Relevant Outcomes:** Physical activity levels or behaviour. **Study Population:** Children or adolescents between six and 18 years old. **Studies were included up to:**	**Description of included studies:** Twenty-seven studies were included in the review of which six met our inclusion criteria relating to physical activity. Of these, three were RCTs and three were three quasi-experimental studies. The majority of studies were conducted in the USA (n=4), while one each were from Spain and Greece. **Quality of included studies:** Studies were assessed for quality using the EPHPP quality assessment tool. Based on the quality assessment of the selected studies, four were categorised as having weak methodological quality, one as moderate and strong. **Synthesis:** Narrative synthesis. **Findings:** School policies that included changes in physical activity involved a mix of multiple and single policies. These included; integration of health promotion in existing curriculum, 90 minutes of moderate intensity physical activity delivered as part of academic instruction, teacher training to develop activities related to food habits and/or physical activity, lessons on brisk walking, multicomponent workbooks, health education which included a physical activity component, the physical environment and a district mandated physical activity policy (20 minutes per day). All but one of the six relevant studies reported a significant and positive change. The remaining study, a quasi-experimental study from the USA rated as weak quality, found no evidence of effectiveness. This study implanted a policy that increased opportunities for physical activities such as installing physical fitness	**Intervention:** School level policy interventions to reduce physical inactivity in children and adolescents. **Evidence statement C:** There is some evidence supporting the use of this intervention, but it is not conclusive. **Author's conclusions:** Mixed findings were observed concerning effectiveness of school policies in reducing non-communicable disease (NCD) risk factors. More good quality evidence is required to conclude on the effectiveness of school level policies in reduction of NCD risk factors. Additionally, further research is required to assess whether healthy changes are sustained over long-term to reduce NCD risk in later life. **Comments:** The majority of included studies were from the USA. There may be slight differences in the school systems between countries but this is unlikely to affect the generalisability of findings from this review to Wales. The majority of studies were of weak methodological quality.

Study details	Results of the review	Main findings and evidence grading
January 2014. **Included study types:** Any experimental or observational study design (RCTs, controlled before-after study, quasi-experimental, ITS, cohort study or cross-sectional study).	stations, an incentive system, training of PE teachers and lesson plans for PE teachers. Policies that were observed to be effective from studies considered to be moderate and strong methodologically by review authors included teacher training, developing activities related to food habits and/or physical activity, and multi-component workbooks.	

Study details	Results of the review	Main findings and evidence grading
19. Stewart G, Anokye NK, Pokhrel S. What interventions increase commuter cycling? A systematic review. *BMJ Open* 2015; 5(8): e007945. **Type of source:** Systematic review. **Interventions:** Individual/group interventions. Environmental interventions including: • Whole-city approaches • Changes in walking and cycle infrastructure • Ride to work day. **Relevant Outcomes:** Changes in commuter cycling including: • Frequency of cycling • Change in workforce commuting mode	**Description of included studies:** Twelve studies were included for this systematic review, five looked at group interventions and five looked at environmental interventions. The remaining two looked at individual interventions and will not be reported here. All relevant interventions were before-and-after studies, and six were conducted in the UK, two in Australia and one each in New Zealand and the USA. **Quality of included studies:** A quality checklist extracted from NICE's Public Health Guidance methods manual was used to assess study quality. Of the ten relevant included studies, two were given a + rating (potential sources of bias not addressed in the study or not clear from the way the study was reported); and eight studies were given a − rating (study with significant sources of bias). **Synthesis:** Narrative synthesis. **Findings:** Follow-up ranged from between two months and nine years, and sample size ranged between 113 and 1.2 million. **Group interventions:** Five studies contributed to this finding, all were given a high risk of bias for quality. Two studies were from the UK, two from Australia and one study from New Zealand. Group interventions included workplace travel which was examined by three studies from England, Australia and New Zealand. Results were mixed; the English study, a university travel survey indicated a non-significant rise in cycle commuting from seven per cent in 1998 to 11.8 per cent following the implementation of a workplace travel plan. In Australia, 5,577 people registered for the Ride to Work Day event. Of these, 17 per cent indicated that they had not cycled to work before the event. At five months post-event, 27 per cent of first-timers were still cycling to work (defined as at least once a week) compared with 67 per cent of those who had been	**Intervention:** Group workplace interventions to increase commuter cycling. **Evidence statement D:** The evidence regarding the effectiveness of group workplace interventions to increase commuter cycling is inconsistent and it is not possible to draw a conclusion. **Intervention:** Environmental interventions to increase commuter cycling. **Evidence statement D:** The evidence regarding the effectiveness of environmental interventions to increase commuter cycling is inconsistent and it is not possible to draw a conclusion. **Author's conclusions:** There is little robust evidence of effective interventions to increase commuter cycling even at a subpopulation level. Many studies lack appropriate controls, their external validity to the wider population remains unclear, and they have high

Study details	Results of the review	Main findings and evidence grading
• Change in commuting population transport mode • Use of infrastructure by defined populations and population modal shift. **Study Population:** Adults aged 18 and over. **Studies were included up to:** November 2014. **Included study types:** Studies including comparison groups and/or pre and post intervention studies.	cycling to work before the event. In New Zealand, 40 organisations were originally recruited to the 'Bike Now' programme of which 27 (675 workers) remained in the programme at one year. Of these, 112 (16.6%) of 675 respondents indicated that they were cycling less, 347 (51.4%) about the same and 216 (32.0%) more. None of the above included a control group. Two studies examined the effect of cycling training on cycling to work. Results were not consistent; an Australian study, using recall interviews, found no difference in either duration or frequency of cycling at two months (including number of days cycled to work) following a cycling proficiency training programme (n=110), although statistically significant increases in those who did not cycle before the course were found. In London, another using self-reported survey data three-month post intervention found the mean number of days cycled to work had increased from 0.66 to 1.33 in the past week. Neither study included a control group. Loss to follow-up from the London study was high (104 responses from 471 participants). **Environmental interventions:** The five studies looking at environmental changes were either small single interventions or a larger initiative targeting whole cities or towns (several of them within the UK), or several policies taken together on cycle commuter prevalence. One Scottish before and after study involved building a bridge in Glasgow. This was associated with a 47.5 per cent increase in the number of cyclists entering the city from the South with almost no changes in cyclists crossing other bridges. Results for this study may have been confounded by concurrent roadworks which were not controlled for. The systematic review refers to the Cycling Cities and Towns (CCT) initiative in England as a capital revenue (promotional activities, cycle training) and investment (e.g. cycle lanes, cycle parking) scheme but does not give detail on actual changes implemented as a result of increased funding. The controlled before-after study assessing this initiative involved three types of	rates of loss to follow-up all indicating a high risk of bias. Wider environmental interventions that make cycling conducive appear to reach out to hard to define but larger populations. This could mean that environmental interventions, despite their small positive effects, have greater public health significance than individual based or group-based measures because those interventions encourage a larger number of people to integrate physical activity into their everyday lives. More research is needed to establish how prevalence of commuter cycling can be increased. **Comments:** Given that the review restricted its focus to commuter cycling it may have excluded a number of interventions that increased general and commuter cycling. There was no mention of how outcome measures from the included studies were collected, only that there was great variability among them.

Study details	Results of the review	Main findings and evidence grading
	control groups, matched towns, towns that were unsuccessful in receiving CCT funding and a non-London national comparison group. The study showed a 0.69 per cent increase in cycling to work in intervention towns, compared to matched towns between 2001 and 2011. Larger effects were seen against the two other control groups. A whole city intervention was implemented in Dublin involving financial incentives (tax free loans to purchase cycles), infrastructure change and promotional events and shared bike schemes. Census data indicated that cycle modal share increased from four per cent to five per cent in 2011 but it is unclear to what extent the 2008 financial crisis in Ireland affected the results. Traffic free infrastructure involving a main project and feeder routes in three UK cities/towns were evaluated for effects on residents living within five km of the respective projects. Three thousand, five hundred and sixteen out of 22,500 individuals responded to survey packs and 53 per cent and 43 per cent provided data at one and two year follow-up respectively (excluding those that had moved house). Respondents were asked if they had cycled on the infrastructure for six journey purposes including commuter cycling. At two year follow-up 18 per cent of people who knew about the project reported transport cycling compared to seven per cent of the full study. Another before–after study conducted in Minneapolis and the University of Minnesota assessed the effects on cycle commuting once cycle facilities had been implemented or improved. At the University cycle commuter modal share increased from 2.8 per cent to 3.3 per cent (n=4,855) and in Minneapolis it increased from 0.788 to 0.841 (n=21,111). Authors reported that in the suburbs cycle commute share fell from 0.335 per cent to 0.279 per cent (n=9,016). External influences including "The Lance Armstrong effect" may have been present at the time.	

Study details	Results of the review	Main findings and evidence grading
20. Torbeyns T et al. Active workstations to fight sedentary behaviour. *Sports Med* 2014; 44(9):1261-1273. **Type of source:** Systematic review. **Interventions:** Standing and active workstations as a single intervention (no combination with other interventions). **Relevant Outcomes:** Energy expenditure (assessed using a BodyBugg armband), step counts, or accelerometer. **Study Population:** School-aged children (6 to 18 years) and adults (aged 19 to 64 years).	**Description of included studies:** Of the 32 included studies, seven studies met the inclusion criteria of this work and reported relevant outcomes. Of these, four looked at school-aged children and the remaining three investigated active workstations in adults. It was not possible to comment on where the studies were conducted or the gender mix between groups as these are not reported. **Quality of included studies:** Methodological quality was assessed using an adapted tool developed from the Scottish Intercollegiate Guidelines Network (SIGN) methodological checklist and the EPHPP tool. Of the relevant studies, three were classified as weak, three as moderate and one as strong quality. **Synthesis:** Narrative synthesis. **Findings:** Authors separated findings into active workstation interventions in school-aged children and adults. Intervention and control group sizes vary across studies, but were generally small in number. Population sizes varied (between eight and 58 participants). Interventions included standing workstations and treadmill workstations. Outcomes were reported as step count, energy expenditure (kcal per day, kcal per hour or kcal per minute and others) and physical activity. In all longitudinal interventions, the subjects had freedom of choice to use the workstation, and so no minimum amount of time for using the workstation was set. **Children**: The four studies reporting on interventions in children were described as non-randomised controlled trials (two longitudinal and one longitudinal crossover). All interventions looked at standing workstations, and intervention length ranged from eight weeks to one year.	**Intervention:** Active workstation interventions in children. **Evidence statement H:** Good quality evidence on the effectiveness of active workstations in children is lacking. **Intervention:** Treadmill workstation interventions in adults. **Evidence statement C:** There is some evidence in support of treadmill workstation interventions to increase energy expenditure, but it is not conclusive. **Author's conclusions:** The implementation of active workstations might contribute to improving people's health and physical activity levels. The effect of the use of these active workstations on cognition and applied work tasks, such as computer task performance, needs further investigation before conclusions can be drawn.

Study details	Results of the review	Main findings and evidence grading
Studies were included up to: February 2014. **Included study types:** RCTs, non-randomised controlled trial and non-randomised non-controlled studies.	One of the largest studies, involving 58 participants with an intervention length of one year, was assessed as weak quality. Outcome measures were reported as energy expenditure; of which an increase was found, although no details are provided. Another longitudinal non-randomised controlled trial, a pilot study, also looked at 58 subjects for one year duration. This weak quality study reported an increase in energy expenditure in the six to seven year old subjects, assessed using BodyBugg armband. The smallest study, given a moderate quality rating, involved just eight participants with a mean age of 11.3 years (no standard deviation provided). Five of the participants were male. The intervention lasted for eight months and although using an objective outcome measure (pedometer) to measure change in step counts, no change was detected. Finally, the only longitudinal crossover trial involved 40 fourth and fifth grade participants, 20 of whom were male. This trial was given a weak quality rating. The intervention length was eight weeks, at which time no difference in physical activity was measured between the control and intervention groups. **Adults:** All three studies looking at increased physical activity or steps per day in adults used treadmill workstations for their intervention. The RCT was assessed as being of moderate quality and involved 43 participants, 20 interventions subjects for 52 weeks and 23 control subjects for 29 weeks. Outcomes reported included increased daily physical activity and increased energy expenditure +> 74 kcal per day (both assessed using accelerometry).	**Comments:** No information is given on the countries in which included studies were conducted so we cannot comment on generalisability. The quality of each study was not taken into account when discussing the results. Repeatability checks for inclusion were not conducted. Quantitative results were not presented for studies finding no effect and there was some lack of detail about the relevant outcomes. It is not clear from the data presented in this review whether primary study authors assessed potential compensatory changes in physical activity outside of the workplace. There is limited data on maintenance of the effect.

Study details	Results of the review	Main findings and evidence grading
	The non-randomised crossover controlled trial was assessed as being of moderate quality. It involved 25 subjects (nurses, clinical assistants, secretaries) over two weeks. Outcomes reported an increase of 2,000 steps per day (assessed using StepWatch activity monitor system) and increased energy expenditure: +100 kcal per day (estimation based on number of steps per day). The crossover RCT was assessed as being of strong quality and involved 20 subjects aged 25 to 70 years who were overweight or obese over a period of 12 weeks. Relevant outcomes reported included increased physical activity and increased energy expenditure: +197 kcal per day (assessed using accelerometer).	

Study details	Results of the review	Main findings and evidence grading
21. Ward D et al. Strength of obesity prevention interventions in early care and education settings: A systematic review. *Prev Med* 2016; 95:S37-S52. **Type of source:** Systematic review. **Interventions:** Early care and education setting-based interventions targeting physical activity. **Relevant Outcomes:** Physical activity-related outcomes. **Study Population:** Children aged 0 to 6 years. **Studies were included up to:** 2015. **Included study types:** All study designs, except case studies, were included if a pre- and post-evaluation was conducted.	**Description of included studies:** Forty-seven articles describing 43 unique interventions were included in the review. Twenty-eight studies met our inclusion criteria. Of these, 15 took place in the USA, five in Australia, three in Germany, two in Switzerland and one each in Belgium and England. The included studies were RCTs (n=24) and non-experimental pre-post (n=4). Generally, the studies took place in childcare settings where many participants were low to middle socio-economic status. **Quality of included studies:** Using the Quality Assessment Tool for Quantitative Studies, eight studies received a strong global rating, nine received a moderate rating, and 11 received a weak rating. **Synthesis:** Narrative synthesis. **Findings:** Twenty eight studies reported relevant physical activity outcomes. Of these, 24 were RCTs or C-RCTs; eight of these were rated strong. The majority (77 per cent) of studies measuring changes in physical activity demonstrated at least one significant intervention effect. When correlating strength scores to percent successful outcomes/total outcomes, no significant positive correlation was observed for physical activity behaviour outcome, with or without the inclusion of parent engagement. When strength scores were correlated with the dichotomized outcome measure (some success vs. no success), physical activity intervention scores were correlated with physical activity outcomes > 0.30, but negatively.	**Intervention:** Early care and education setting-based interventions targeting physical activity. **Evidence statement C:** There is some evidence supporting the use of this intervention, but it is not conclusive. **Author's conclusions:** The review provided tentative evidence that multicomponent, multi-level early care and education interventions with parental engagement are most likely to be effective with anthropometric outcomes. **Comments:** The majority of studies examined were conducted in the USA. Studies took place mainly in low to middle socio-economic status settings and homogenous groups such as African Americans and Hispanics. The findings may therefore not be generalisable to Wales.

Study details	Results of the review	Main findings and evidence grading
22. Ward S, Belanger M, Donovan D, Carrier N. Systematic review of the relationship between childcare educators' practices and preschoolers' physical activity and eating behaviours. *Obes Rev* 2015; 16(12):1055-1070. **Type of source:** Systematic review. **Interventions:** Childcare educators-led interventions. **Relevant Outcomes:** Pre-schoolers physical activity behaviours. **Study Population:** Pre-schoolers who received formal childcare by a non-relative. **Studies were included up to:** June 2015. **Included study types:**	**Description of included studies:** Of the 15 studies included in this review, six met our inclusion criteria. All six were conducted in the USA. Three were C-RCTs, two were quasi-experimental trials and one was a pre-post design study. Participants were of low to middle socio-economic status in three studies and were primarily African American, Latino or Hispanic in five studies. **Quality of included studies:** The methodological quality of all the included studies was assessed using the Quality Assessment Tool for Quantitative Studies, developed by the EPHPP. Of the six relevant studies, one received a low rating while the other five were assessed as moderate quality. **Synthesis:** Narrative synthesis. **Findings:** Of the 10 physical activity-related papers, six assessed the effectiveness of interventions that required educators to instruct lessons on gross motor skills, actively participate in children's physical activities, and/or use various methods of encouraging children to be active. Most studies on physical activity assessed level of activity with objective measures, including accelerometers and with direct observation by data collectors using the Observational System for Recording Physical Activity in Children – Pre-schoolers (OSRAC-P). Only one study used subjective measures to collect information on physical activity.	**Intervention:** Childcare educators-led interventions to promote physical activity. **Evidence statement C:** There is some evidence supporting the use of this intervention, but it is not conclusive. **Author's conclusions:** Educators may play a positive role in promoting healthy behaviours in children, but this is mainly based on a small number of intervention type studies of low or moderate quality. The influence of specific components of educators' practices on children's healthy eating and physical activity behaviours remains inconclusive. This lack of evidence is a barrier to providing evidence-based best practices for educators to use in childcare centres. Future research should look at filling the gaps identified in this review by assessing previously studied practices of educators on larger, more diverse populations and conducting analyses on subgroups of children. The methodological quality of studies should also be improved by ensuring representativeness, reporting on the

Study details	Results of the review	Main findings and evidence grading
All types of quantitative study designs.	Five of the six studies that assessed the effectiveness of educator-led interventions reported a positive effect on children's MVPA. A small study that did not find a positive effect on MVPA nevertheless reported a significant reduction in children's sedentary time. Three of four studies reported an increase in VPA, and one of two reported a significant reduction in LPA. Strength of evidence was based on only three C-RCTs, and two quasi-experimental studies of moderate quality, one low-quality pre-post study. The review authors stated that, based on the strength of evidence evaluation, there is weak evidence that educators influence pre-schoolers' physical activity and sedentary behaviours.	blinding of outcome assessors, conducting or increasing the length of follow-ups, using valid, reliable and objective measurement tools, as well as ensuring that the validity and reliability of these tools are reported. **Comments:** Interventions promoting physical activity in childcare centres included in this review focused largely on a homogenous population – African Americans of low socio-economic status - thus limiting the potential generalisability of these interventions to children in Wales.

5 Appendix II Intervention summaries

Intervention: The use of active lessons within the curriculum

Directional thinking

There is some evidence that integrating physical activity and academic content in primary school classroom curriculum delivery has positive effects on weight change outcomes but it is not conclusive.

[1 systematic review including 3 poor to moderate quality studies]

There is some evidence that integrating physical activity and academic content in primary school classroom curriculum delivery has positive effects on daily physical activity outcomes but it is not conclusive.

[1 systematic review including 10 poor to moderate quality studies]

Other things to consider

- The effect of the intervention on weight change outcomes was small and only reported as statistically significant in two of the three studies.
- The three studies assessing weight change outcomes used interventions based on the principles of TAKE 10! in which 10 minutes of physical activity integrated into core academic lessons at least once a day. In one of the three studies, teachers were supplied with lesson plans and web links to respective programs, however in the other two studies no resources were provided. Two studies provided teacher training.
- One study assessing weight outcomes had a duration of three years, one assessed post-intervention BMI after one year whilst another assessed BMI at one year during intervention at the following year during follow-up.
- Some studies included in the systematic review assessed process measures. Of the interventions based on TAKE 10! self–report questionnaires and observations suggest that integration of this level of activity is feasible.
- Of ten studies included in the systematic review that report effects on physical activity, six are reported by authors as having medium to large effects. However, study design are often not optimal and quality was often not clear because of a lack of detail in the primary research report.

- Systematic review authors reported that they were unable to measure effect sizes for two of the ten studies reporting physical activity outcomes.

Limits to what we know

- The findings may not be generalisable to Wales as many of the studies were conducted in China and the US.
- The primary research studies included in this review were poorly reported; quality assessment frequently assessed the risk of bias in a number of domains as being unclear. Two of the three studies assessing weight outcomes did at least seem to have made efforts to blind outcome assessment and collect complete outcome data for participants. However, this was generally unclear in the studies assessing physical activity outcomes.

References

1. Martin R, Murtagh, EM (2017) Effect of active lessons on physical activity, academic and health outcomes; a systematic review. Research Quarterly for exercise and sport 88(2): 149-168.

Intervention: Active video games and exergames

Directional thinking

There is some evidence that exergames and active video games used in school settings may increase physical activity in children (from age five) and adolescents but it is not conclusive.[1, 2]

[2 systematic reviews including 17 studies of poor to moderate quality]

There is some evidence that exergame interventions used in home settings may be ineffective in increasing physical activity in children and adolescents but it is not conclusive.[1,3]

[*2 systematic review reviews including 5 studies of poor to moderate quality*]

Other things to consider

- Interventions were mostly used in physical activity lessons, some used sessions delivered in breaks or before or after school.[2] Most used widely available consoles such as Nintendo Wii, Microsoft Xbox and Sony PlayStation.[1,2] Games included the Dance Dance Revolution, Wii Fit and Wii Sports.[1, 2]
- Review authors noted that the light to moderate physical activity generated through exergames is insufficient to help children meet recommended physical activity levels so might supplement comprehensive school physical activity programmes.[1]
- Interventions across the studies varied considerably in terms of length and number of sessions.[2]

Limits to what we know

- Review authors note that game types, experience, age and gender have all been documented as confounding factors associated with exergame studies, limiting their generalisability.[1]
- Some of the studies included in the reviews did not use objective measures of physical activity (six studies). These relied on observation or self-report.[2]
- There has been little process evaluation of active video and exergames so uptake/fidelity have not been considered.[1, 2]

References

1. Gao Z, Chen S. Are field-based exergames useful in preventing childhood obesity? A systematic review. *Obes Rev* 2014; 15(8):676-691.
2. Norris E, Hamer M, Stamatakis E. Active video games in schools and effects on physical activity and health: a systematic review. *J Pediatr* 2016; 172:40-46.
3. Chen J, Wilkosz ME. Efficacy of technology-based interventions for obesity prevention in adolescents: A systematic review. *Adolesc Health Med Ther* 2014; 5:159-170.

Intervention: Family based intervention involving goal setting, reinforcement of positive behaviour or organised physical activity sessions to increase physical activity in children

Directional thinking

There is some evidence supporting the use of family-based interventions involving components of goal-setting, reinforcement of positive behaviour and organised physical activity sessions, individually or in combination alongside education to improve measures of physical activity in children but it is not conclusive. A meta-analysis of eighteen studies showed an effect size of 0.29 (95% CI 0.14 to 0.45).

[*1 systematic review including 18 poor to moderate quality studies*]

Other things to consider

- The evidence sought by this review was specific to the age range 5-12. Interventions targeted children across the weight spectrum from healthy to obese. Studies including mostly healthy weight participants were more effective than those reporting a high proportion of overweight or obese participants (80% compared to 59% respectively).
- The meta-analysis estimated effect size on physical activity outcomes with authors judging it as small.

Additional findings from the realist synthesis investigating mechanisms leading to outcomes:

- Family-based interventions should be tailored to consider the ethnicity of the family, parental motivation to increase children's physical activity, and time constraints due to work and school responsibilities.
- In the context of family constraints and competing demands, combining goal-setting and reinforcement techniques to improve physical activity by increasing motivation seems particularly effective.
- The family psychosocial environment should be considered when designing interventions to increase physical activity among both children and their families[1]. These efforts should include a focus on the child as the agent of change.
- Focusing an intervention on something other than the health or weight loss benefits of physical activity e.g. enjoying time together, learning new skills or improving confidence may be a valuable approach.

- Targeting the whole family may be an effective strategy in increasing intervention adherence.
- Interventions were delivered by community leaders (often selected for their cultural connection to participants), healthcare providers, researchers, or teachers. Interventions delivered by medical or healthcare staff appeared least effective.
- Information based interventions that are unaccompanied by additional strategies may change knowledge but be insufficient to change behaviour.

Limits to what we know

- Samples in the included studies were small.
- Follow-up was most commonly up to six months; 14 of the 47 studies included a long term follow-up of 12 months or longer. This limits information on maintenance of effects.
- Only 7 of the 47 of the included studies were conducted in the UK and most studies were conducted in the US.
- Common weaknesses across studies were a lack of participant blinding and potential selection bias due to limited information on recruitment to enable assessment of sample representativeness.

References

1. Brown HE et al. Family-based interventions to increase physical activity in children: a systematic review, meta-analysis and realist synthesis. *Obes Rev* 2016; 17:345-360. [Data extraction table]

Intervention: Community-based physical activity, with or without education, in older adults living in rural and regional settings.

Directional thinking

There is some evidence supporting community-based physical activity interventions, with or without education, to promote physical activity in older adults in rural and regional settings, but it is not conclusive.

[1 systematic review including three poor to moderate quality studies]

Other things to consider

- Interventions involved low to moderate intensity exercise and/or low-impact physical activity (e.g. Tai Chi), but the dose of physical activity varied between study interventions, one included a prescribed exercise programme and one study allowed participants to self-select the type of physical activity they undertook.
- Outcome measures varied between studies, making comparisons difficult, but several characteristics were common to interventions that increased physical activity. These included interventions delivered through personal contact, the inclusion of low to moderate exercise, and offering variety in the mode of activity.
- The evidence in this review is specific to those over the age of 65 years who live in rural or regional areas (i.e. not metropolitan or remote areas).
- Studies including age groups below 65 years of age were excluded from the systematic review. Systematic review authors note that there may be effective interventions assessed in wider age groups that have not been considered by this review.
- Intervention duration ranged from one year to a mean of 2.6 years. Long-term interventions reported a reduction in adherence over time.

Limits to what we know

- A key finding from this review was the limited number of studies that employed rigorous methods using valid and reliable self-report and objective measures to report outcomes.
- Studies were conducted in the USA and Taiwan, which may limit the generalisability of findings to the Welsh population.

References

1. Moore M et al. Effective community-based physical activity interventions for older adults living in rural and regional areas: A systematic review. *J Aging Phys Act* 2016; 24(1):158-167. [Data extraction table]

Intervention: Playground interventions to increase incidental physical activity

Directional thinking

There is some evidence supporting the use of playground interventions to increase physical activity but it is not conclusive.

[1 systematic review including 7 studies of poor to moderate quality]

Other things to consider

- The studies included here suggest that playground interventions (for example provision of play equipment/physical structures or markings in playgrounds) can increase physical activity and reduce sedentary time during breaks. Review authors noted that for these to be effective activating supervision and more structured physical activity might be necessary.
- Findings suggested that boys and younger children are more physically active than girls and older children.

Limits to what we know

- Four of the seven included studies used objective means of measuring physical activity (for example accelerometry).
- Several of the included studies only reported short-term changes that often substantially contributed to meeting physical activity guidelines. Consideration needs to be given to whether these would be sustained in the longer term.

References

1. Reynolds R et al. Systematic review of incidental physical activity community interventions. *Prev Med* 2014; 67:46-64 [Data extraction table]

6 Appendix III Evidence Grading

A (dark green): This intervention is supported by good quality evidence of its effectiveness	Systematic review, of mostly good quality studies, with meta-analysis or majority of studies favouring intervention effect
B (light green): This intervention is supported by moderate quality evidence of its effectiveness	Systematic review of moderate to good quality studies with majority, or meta-analysis favouring intervention effect
C (yellow): There is some evidence supporting the use of this intervention but it is not conclusive	Systematic review of moderate to poor quality studies with majority, or meta - analysis favouring intervention effect or systematic review where the number of studies favouring intervention effect is too small to allow firm conclusions to be drawn
D (orange): The evidence is inconsistent and it is not possible to draw a conclusion	Systematic review of studies with inconsistent findings
E (pink): There is some evidence suggesting that this intervention is ineffective but it is not conclusive	Systematic review of moderate to poor quality studies with majority or meta - analysis favouring no effect intervention or where the number of studies favouring no effect is too small to allow firm conclusions to be drawn
F (red): There is moderate to good quality evidence that this intervention is unlikely to be effective	Systematic review of moderate to good quality studies with majority in favour of control/no effect of intervention
G (purple): There is high quality evidence of ineffectiveness or a specific recommendation that these interventions should not be introduced in the UK	There is high quality review level evidence from meta-analysis of good quality studies suggesting s no effect of the intervention
H (grey): Evidence about the effectiveness of the intervention is lacking	Systematic review, or Public Health Wales reviewers conclude that no reliable evidence of effectiveness or ineffectiveness, is available either because there are no/or too few relevant studies or because the studies available are of a design inappropriate for assessing effectiveness

7 Appendix IV List of abbreviated terms

AVG:	Active video games
CBA:	Controlled before and after
COCOMO:	Common Community Measures for Obesity Prevention
CONSORT:	Consolidated standards of reporting trials
CPM:	Counts per minute
C-RCT:	Cluster randomised controlled trial
CT:	Controlled trial
DDR:	Dance Dance Revolution
EPHPP:	Effective Public Health Practice Project
GRADE:	Grading of Recommendations Assessment, Development and Evaluation Tool
HPS:	Health promoting schools
ITS:	Interrupted time-series
LPA:	Light physical activity
MET-hours:	Metabolic equivalence hours
MD:	Mean difference
MVPA:	Moderate to vigorous physical activity
NCD:	Non-communicable disease
NGOs:	Non-governmental organisations
NICE:	National Institute for Health and Care Excellence
OSRAC-P:	Observational system for recording physical activity in children - preschool
PE:	Physical education
POMA:	Performance orientated mobility assessment

RCT:	Randomised controlled trial
RE-AIM:	Reach, Effectiveness, Adoptions, Implementation, Maintenance framework
SD:	Standard deviation
SMD:	Standardised mean difference
SIGN:	Scottish Intercollegiate Guidelines Network
TPA:	Total physical activity
VPA:	Vigorous physical activity