Physical activity and children

Review 7:

INTERVENTION REVIEW:
FAMILY AND COMMUNITY

NICE Public Health Collaborating Centre – Physical Activity

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Executive Summary

Introduction

This is the seventh review providing background evidence for the development of public health guidance for promoting physical activity in children and adolescents. The descriptive epidemiology review (Review One) made a clear link between physical activity and health outcomes in young people. There is evidence suggesting that levels of physical activity among children are insufficient and there is a clear need to promote physical activity within young people.

Objectives

This review addressed the questions:

(a) **Which community interventions or programmes targeted at children and/or their families increase children's physical activity or core physical skills taken either alone or with their family?**

(b) **What are the characteristics of a physical activity intervention or programme targeted at children and/or their families which increases children's physical activity or core physical skills taken either alone or with their family?**

Methods

Literature searches were conducted using the terms and databases listed below. References were downloaded into a Reference Manager database (see Figure 1 for data). Search terms followed the same order (1) physical activity terms, (2) child terms and (3) location terms. All searches were performed from January 1990 to the most recently published version of the database (usually August 2007). Databases searched were: Cochrane Database of Systematic Reviews (CDSR), Database of Abstracts of Reviews of Effectiveness (DARE), Cochrane Central Register of Controlled Trials, MEDLINE, EMBASE, PsycINFO, CINAHL, HMIC, SPORTDiscus, ASSIA, SIGLE, Current Contents, ERIC, TRANSPORT, Environline, EPPI Centre Databases, NRR.

After the initial screening (see Figure 1), 341 titles and abstracts were assessed for relevance against the following inclusion criteria:

- Is the paper an **intervention study**?
- Is the age group studied **aged under 18 years**?

- Is the intervention based in a **family or community setting**?
- Is an outcome reported on **physical activity behaviour** or **core physical skills?**

In total 195 titles were assessed to be potentially relevant and the full papers retrieved. In addition, studies were excluded if:

- They had a main focus on treating obesity
- They were from less economically developed countries or they were studies about ethnic groups that do not have large populations in England (labelled inappropriate population in Figure 2)
- The intervention was delivered primarily as part of the school curriculum
- The study involved a change to the built or natural environment (and thus had been covered in NICE guidance on the environment and physical activity) or were included in another review in this series (e.g., active travel).

195 papers were accepted for full data extraction and 40 were accepted for inclusion – representing 32 intervention studies. See Figure 2 for flow diagram of the study selection procedure. Only intervention study designs were included but all intervention designs were eligible.

Results

Designs included randomised controlled trials (n=11), cluster randomised controlled trials (n=5), controlled non-randomised trials (n=10); randomised non-controlled trials (n=3), and uncontrolled before and after designs (n=3). Studies varied in scale from 26 to 5106 participants.

The studies were conducted in a single setting or in a combination of settings, within the family (n=11); within community agencies (e.g., boy scouts) (n=2); within primary health care (n=4); within clubs outside of school hours (n=7); within both the family and the school (n=7); and social marketing interventions (n=1).

Studies were conducted in the USA (n=22), other European (non-UK) countries (n=7), the UK (n=1), Canada (n=1) and New Zealand (n=1).

25 interventions studied children under 13 years, with seven studying adolescents 13y or older (one study did not provide age information, and one study provided data separately for both the under 13 and 13+ age groups). The measurement of physical activity involved objective assessment only (n=5), validated self-reported assessment

only (n=7), self-reported assessment of unknown validity (n=11), parental proxy (n=1) and a combination of objective and validated self-report measures (n=8). Time from baseline to follow-up measurement varied from being immediately at the conclusion of the intervention to 5 years. Of the 32 studies, one investigated boys only, seven investigated girls only, and 24 investigated both boys and girls.

Interventions based within the family: Evidence statements

Interventions targeted at overweight/obese children, and/or those at risk for overweight/obesity

There is evidence from two randomised controlled trials in the USA (one [++] and one [+]) that family-based physical activity interventions targeting overweight/obese children and/or those at risk for overweight/obesity, can lead to increases in physical activity in young people. However, two randomised controlled trials in the USA (both [+]) failed to show an effect in the same target group. Characteristics of successful interventions included being located in the home and therefore not involving attendance at external sites and focused on small, specific lifestyle changes (2000 more steps/day and a single dietary target). In contrast, unsuccessful interventions required regular attendance at sites external to the home for education and/or physical activity sessions, broader physical activity and dietary behaviour change, and were with 8-9 year old African-American girls.

Interventions targeted at all young people regardless of weight status

There is evidence from one randomised controlled trial in the USA [+], one randomised non-controlled trial in the USA [+], one controlled non-randomised trial [+] and one uncontrolled before and after study [-] that family-based interventions, targeting physical activity, can lead to increases in physical activity in young people. One randomised controlled trial in the USA [++] and one uncontrolled before and after study in the USA [-] failed to show an effect. One randomised control trial in the USA [-] showed a negative effect. Successful interventions were located mostly in the home and predominantly involved information packs. Two of the successful interventions involved either mothers and daughters or grandmothers, mothers, and daughters exercising together. Unsuccessful interventions all involved regular

attendance at physical activity and education sessions outside of the home. Other differences between successful and unsuccessful interventions were not consistent.

Interventions based within the community: Evidence statement

There is evidence from one randomised controlled trial in the USA [+] and one controlled non-randomised trial in the UK [-] that community-based interventions do not lead to increases in physical activity in adolescents. Characteristics of these interventions included targeting early adolescent boys (10-14 y) through a voluntary sector group with strategies that included skill-building activities at group meetings and internet role-modelling, problem solving, goal-setting and review, and physical activity knowledge games. Other strategies included broad-based education and policy initiatives aimed at both adolescent boys and girls.

Interventions based within Primary Care: Evidence statement

There is evidence from two randomised controlled trials: one in the USA [++] and one in Spain [-], and one randomised non-controlled trial in Ireland [-] that interventions in primary care do not lead to an increase in physical activity among adolescents. One randomised non-controlled trial in the USA [-] did show an increase in physical activity among children and adolescents. Studies involved assessment of health behaviours (usually physical activity and nutrition), development of a behaviour change plan/goal, and brief counselling from a GP or nurse practitioner. Three of the studies provided some level of follow-up support (either by mail, phone call) after the clinic visit. Studies involved male and female adolescents over 11 years old, although one study also included a younger group (8-11 yrs).

Interventions based in clubs out of school hours: Evidence statements

Interventions targeted at weight gain prevention

There is evidence from one controlled non-randomised trial in New Zealand [++] and two randomised controlled trials in the USA (both [+])that interventions targeted at weight gain prevention through out of school hours clubs/activities do not lead to increases in physical activity in boys and girls under 12 years. Children in two of these studies were African-American.

Interventions targeted at all young people regardless of weight status

There is evidence from two controlled non-randomised trials in the USA (one [++] and one [-]) that interventions delivered during the after-school period lead to increases in physical activity in boys and girls below the age of 11 years. However, there is evidence from one cluster randomised controlled trial in the USA [-], and one cluster non-randomised controlled trial in the USA [+]) that interventions delivered during the after-school period do not lead to increases in physical activity in boys and girls below the age of 11 years. Activities undertaken during the after school period included physical activity and education sessions; behavioural skills training; and homework sessions. The after school period varied in length from 45 mins to 2 hours, with frequency varying from daily to 3 times per week. Characteristics of successful and unsuccessful interventions were not obviously or consistently different, and all four studies focused on African-American children

Interventions based within families and schools: Evidence statement

There is evidence from two cluster randomised controlled trials in Belgium and France (both [+]) and three controlled non- randomised trials in the Netherlands, Greece and the USA (one [+] and two [-]) that interventions involving both the school and family and/or community agencies lead to positive changes in physical activity in boys and girls aged 13 or under. These positive outcomes may include an actual increase in physical activity or less of a decline in physical activity relative to controls. Successful interventions had multiple components. At the school level this included computer tailored advice, changes to the school environment, classroom sessions, physical activity sessions, and physical education. Family components included

facilitating social support for physical activity, education on creating a supportive home environment, homework activities involving parents, and community sport information. One cluster randomised controlled trial in the USA [+] and one uncontrolled before and after study in the USA [-] failed to show an effect. The characteristics of these unsuccessful interventions were not consistently different from those of successful interventions.

Social marketing interventions: Evidence statement

There is evidence from one controlled non-randomised trial in the USA [+] that social marketing interventions can increase levels of free-time physical activity in children and adolescents (9-15yr olds). The social marketing campaign employed engaging messages (primarily via TV advertisements) and promoted opportunities to incorporate physical activity into daily lives. The sustained nature of the campaign (2 years) was considered important to its success. Behavioural changes were seen in the activities targeted by the campaign (e.g, free-time activities) and there were no effects on participation in organised sport.

Included papers

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1. Introduction

This is the seventh review in a series commissioned to provide background evidence for the development of public health guidance for promoting physical activity, play and sport in children and adolescents. The descriptive epidemiology review (Review One) made a clear link between physical activity and health outcomes in young people. There is evidence suggesting that levels of physical activity among children and adolescents are insufficient and thus there is a need to promote physical activity within young people.

This report examines the evidence for the effectiveness of family and community based interventions to promote physical activity or core physical skills in young people under 18 years of age.

1.1. Background to this review

This review is best seen in the context of the 'behavioural epidemiology' framework (Sallis & Owen, 1999). This framework proposes five phases in the research process concerning physical activity and health (see Figure 1).

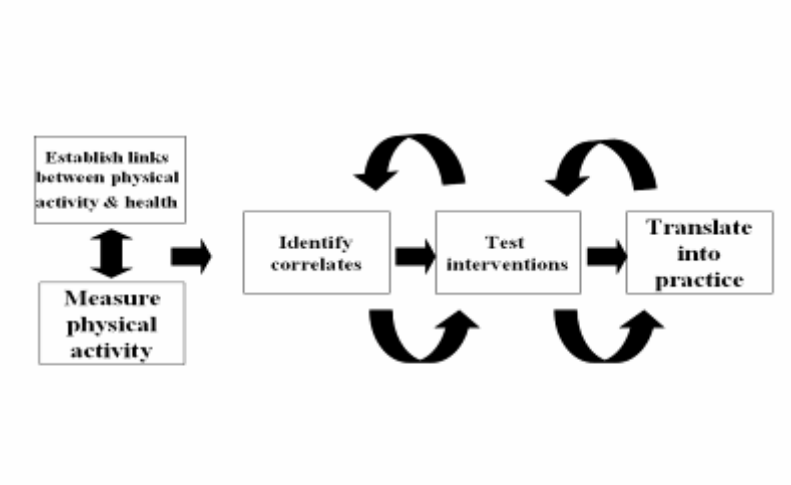


Figure 1: Behavioural epidemiological framework showing the five phases of the research process concerning physical activity and health.

According to this framework, it is first necessary to assess whether there are links between physical activity and health in young people, and this was the purpose of Review One. It is also important to be able to accurately and reliably measure the

behaviour in question – physical activity. However, measurement of physical activity is challenging, especially in children. Measurement error plagues this field because without accurate measures of physical activity it will always be difficult to demonstrate strong associations with other variables, if they exist. In addition, researchers will struggle to show intervention effects due to lack of measurement sensitivity. Typically, studies have employed self-report instruments of varying validity and reliability. The use of such instruments may be particularly problematic in children because physical activity for this age group is likely to be sporadic and they may find it difficult to accurately recall or quantify some types of activity (Welk, Corbin, & Dale, 2000). Similarly the use of parental or adult proxy is problematic because such instruments have poor reliability and validity, and lack responsivity meaning they may not be sensitive to any changes that occur.

Recent studies have used 'objective' measures of physical activity, such as accelerometers (Riddoch et al., 2007). These are likely to give more accurate estimates of volume of activity, but lack the ability to specify the type of activity, which may be important to answer some research questions. There is also debate about the best way to analyse such data, and this variability can lead to differing conclusions regarding the amount of physical activity thought to be undertaken by young people.

In the behavioural epidemiological framework, it is proposed that before interventions are planned and conducted there is a need to know what might be the key determinants, or correlates, of a behaviour, in this case physical activity. These correlates are then used to define target groups (e.g., girls, ethnic minorities) or become targets for change (e.g., increasing parental support for physical activity). Review Two examined the quantitative correlates of physical activity in young people and Review Three reviewed the qualitative evidence on barriers and facilitators to participation in physical activity by young people.

Having established the likely correlates of physical activity (see Figure 1), these might then be used as moderators or mediators in physical activity behaviour change interventions. Typically, these are controlled interventions prior to being rolled out into 'real-world' practices. These latter phases of the model can also inform earlier stages, hence the feedback loops shown. The current review specifically considers the evidence for the effectiveness of family or community interventions to increase physical activity and/or improve core skills in young people under 18 years of age.

1.2. The importance of interventions in family and community settings

The descriptive epidemiology review (Review One) made a clear link between physical activity and health outcomes in children and adolescents. Specifically, it was reported that physical activity has small but significant physical health benefits in young people, notably prevention of overweight and obesity and type II diabetes, and improvements in skeletal health. In addition, physical activity has moderate psychological health benefits, particularly for self-esteem and depression.

According to current recommendations (Department of Health, 2004), children and adolescents should achieve a total of at least 60 minutes of at least moderate intensity physical activity each day. At least twice a week this should include activities to improve bone health, muscle strength and flexibility. From recent estimates it appears that 30-40% of children and 40-60% of adolescents are not meeting this guideline (Department of Health, 2003, 2004). This suggests that physical activity among children and adolescents is insufficient and there is an imperative to promote physical activity within this age group.

Physical activity promotion efforts for young people have often been school-based because of the large number of young people that can be reached through schools and the associated health and physical education (PE) curricula (Sallis et al., 1992; Almond and Harris, 1998). While PE and school-based activity is an important contributor to overall physical activity levels it does not provide sufficient activity for young people to achieve the current recommendations. Stone et al (1998) reviewed studies that had physical activity behaviour as an outcome variable and found that while school based programmes might increase physical activity during PE and other classes they had limited success in improving out-of-school physical activity levels. This finding suggests that other sites for promotion should be utilised in attempts to increase physical activity outside of school hours. The time away from school is critical to overall physical activity levels as there is evidence that a significant proportion of young peoples' activity occurs outside of school hours (Hager, 2006; Mota et al., 2003; Tudor-Locke et al., 2006). As a result there is increasing recognition of the importance of family and community level interventions to promote physical activity participation within young people.

Family level interventions are viewed as important because of the many potential avenues for parental and sibling influence (e.g., modelling, social support, transportation) (Sallis, 1998). Reviews of physical activity correlates have consistently highlighted the family as a key influence on childhood activity levels (Sallis et al, 2000, Review 2). Parental support, in particular, has been shown to be a significant independent predictor of childhood physical activity (Gustafson & Rhodes 2006; Sallis, Patrick et al., 2000; Review 3). Support for a direct association between parent and child physical activity (modelling) remains equivocal, though evidence indicates that active parents are more supportive of their children's physical activity than non-active parents (Gustafson & Rhodes, 2006). Sibling activity is a consistent determinant of physical activity in adolescents but not younger children (Sallis et al., 2000, Review 3). Numerous environmental variables, such as access to facilities, time spent outdoors, and opportunities to exercise, have also been identified as reliable correlates of young peoples physical activity (Review 2), the impact of which are likely to mediated by parents, especially in younger children.

There is increasing recognition that involvement of the community at all levels is important for interventions to be effective (Pate et al., 2000; Sallis, 1998). Agencies such as general practitioners and community youth organisations have the potential to influence the attitudes and behaviour of young people and it seems logical that young people are more likely to adopt healthy physical activity habits if they receive consistent messages across a variety of settings and from a variety of sources.

1.3. Defining family and community interventions

Community: A group of people who have common characteristics; communities can be defined by location, race, ethnicity, age, occupation, interest in particular problems or outcomes, or other common bonds (Turnock 2004).

Family primarily refers to nuclear family members, and principal carers of children not living in a traditional family environment, although it may also include extended family members as appropriate.

1.4. Policies and initiatives relevant to young people

Many agencies, including the government, schools, commercial organisations and charities are supporting the promotion and development of physical activity

opportunities for young people. This section briefly outlines several of the key initiatives/policies in order to provide context for the current review.

Healthy weight, Healthy lives: A cross-government strategy for England (Department of Health and Department of Children, Schools and Families, 2008). This is a new cross-government strategy to help everyone lead healthier lives. One of its aims is to bring together employers, individuals and communities to build physical activity into our lives. There are five key elements to the strategy, two of which have particular relevance to the family and community review. One key element focuses on the healthy growth and development of children, and within this there is a £75 million marketing campaign to support and empower parents to make changes to their children's diet and increase levels of physical activity. The other relevant key element focuses on building physical activity into our lives and includes: the investment of £30 million into "Healthy towns" which will use infrastructure and whole town approaches to promote physical activity; to work with industry to develop tools to allow parents to manage the time their children spend watching TV or playing sedentary electronic games; and to review the overall approach to physical activity with the aim of producing fresh programmes to ensure there is a clear legacy of increased physical activity before and after the 2012 Olympic games.

Choosing Activity: a physical activity action plan (Department of Health, 2005). The aim of this plan is to promote physical activity for all in accordance with the Chief Medical Officer's report (Department of Health, 2004). The physical activity action plan sets out a cross-government plan that identifies an extensive range of commitments which cumulatively seek to achieve a more active England. One of the **Public Service Agreement** (PSA) targets linked to this plan is to increase the percentage of 5-19 year olds participating in at least 3 hours per week of sporting opportunities outside of PE and school sport. The involvement of families and communities is likely to be critical to achieving this target.

Choosing Health (Department of Health 2004) sets out the principles for supporting the public to make healthier and more informed choices with regards to their health. There is a commitment within this to develop a social marketing strategy which will build public awareness and influence attitudes in order to deliver health behaviour change in the long-term. In essence the 'Healthy Living' Social Marketing Initiative "provides a framework to deliver a concerted programme of work, backed by consistent messages, that drives deep-rooted shifts in cultural values and social

norms" (Jebb, Steer and Holmes, 2007; p.28). One of its key aims is to "create a positive climate that supports and facilitates the necessary changes in the diet and activity habits of parents and their children to achieve and maintain a healthy weight (Jebb, Steer and Holmes, 2007; p.28).

Gameplan (Department for Culture Media and Sport, 2002) is a publication from the Government's Strategy Unit. One of its four recommendations was for a range of initiatives to promote grassroots participation (in particular for young people, women and older people), by tackling barriers to participation and failures in provision.

There are many other relevant policy documents referred to in the initial Public Health Programme Guidance Scope and readers are referred to this.

Non-Government initiatives are also common in England. For example:

- **Children's Play Council** has several initiatives including *Home Zones* (designing streets to make them more attractive to pedestrians and cyclists by introducing traffic calming, parking areas, benches and play areas); *The Neighbourhood Play Toolkit*, (a CD-ROM published in 2006 to support and increase access to good play opportunities for children and young people in their neighbourhoods); and *Play England* (a new 5-year project which aims for all children and young people in England to have regular access and opportunity for free, inclusive, local play provision and play space).
- **Youth Sport Trust** has developed the *TOP programmes* which are a series of linked and progressive schemes for young people aged 18 months to 18 years. Resource cards, child-friendly equipment and quality training and support for the teachers and deliverers are core elements to the TOP programmes.
- **British Heart Foundation** has a number of initiatives/resources for promoting/facilitating physical activity in young people. Perhaps the most relevant in the context of this review is the '*Childs Play' Early Years Booklet* aimed at parents. This includes simple straightforward advice and guidance on physical activity and healthy eating. A key part of the booklet is encouraging parents to be active with their children through play by providing examples of some of the traditional games and activities of their generation.

1.5. Objectives

This review addressed the following questions:

- Which community interventions or programmes targeted at children and/or their families increase children's physical activity taken either alone or with their family?
- What are the characteristics of a physical activity intervention or programme targeted at children and/or their families which increases children's physical activity taken either alone or with their family?

1.6. Review team

This review has been carried out by a team from the Public Health Collaborating Centre (CC) for Physical Activity[1]. The Collaborating Centre is an alliance between the British Heart Foundation Health Promotion Research Group (University of Oxford) and the British Heart Foundation National Centre for Physical Activity and Health (Loughborough University).

[1] Lead reviewer: Dr Trish Gorely (Loughborough University). Collaborating Centre team members: Prof Stuart Biddle, Andrew Atkin (Loughborough University), Dr Charlie Foster, Nick Cavill (University of Oxford).

2. Methodology

2.1. Literature Search

Literature searches were conducted using the terms and databases listed below. References were downloaded into a Reference Manager database (see Figure 2 for data).

2.1.1. Search terms

All search strategies were designed by the Collaborating Centre and NICE. Tailored search terms were used appropriate to a particular database. Search terms followed the same order of (1) physical activity terms, (2) child terms and (3) location terms. A full search for MEDLINE is presented in Annex A. All searches were performed from January 1990 to the most recently published version of the database (usually August 2007).

2.1.2. Databases and other searches

Databases searched were: Cochrane Database of Systematic Reviews (CDSR), Database of Abstracts of Reviews of Effectiveness (DARE), Cochrane Central Register of Controlled Trials, MEDLINE, EMBASE, PsycINFO, CINAHL, HMIC, SPORTDiscus, ASSIA, SIGLE, Current Contents, ERIC, TRANSPORT, Environline, EPPI Centre Databases, NRR.

Online contents pages for the Journal of Physical Activity and Health (JPAH) were browsed for relevant articles (this journal is not yet indexed in any electronic database), from first publication (Jan 2004) until latest available (September 2007) and no additional citations were retrieved. Reviews of intervention studies (Cale & Harris, 2006; Flodmark, Marcus, & Britton, 2006; Flynn et al., 2006; Hardeman, Griffin, Johnston, Kinmonth, & Wareham, 2000; Heroux, 2005; Kahn et al., 2002; McLean, Griffin, Toney, & Hardeman, 2003; Mèuller, Danielzik, & Pust, 2005; Pate et al., 2000; Salmon, Booth, Phongsavan, Murphy, & Timperio, 2007; Schmitz & Jeffery, 2000; Stice, Shaw, & Marti, 2006; Stone, McKenzie, Welk, & Booth, 1998; Strong et al., 2005; Summerbell et al., 2005; Taylor, Baranowski, & Young, 1998; Timperio, Salmon, & Ball, 2004; van Sluijs, McMinn, & Griffin, 2007) were also located and the reference lists searched and 67 references were added

2.2. Selection of studies for inclusion

After the initial screening (see Figure 2) 341 titles and abstracts were assessed for relevance against the following inclusion criteria:

- Is the study an **intervention study**?
- Is the age group studied **aged under 18 years**?
- Is the intervention based in a **family or community setting**?
- Is an outcome reported on **physical activity behaviour** or **core physical skills?**

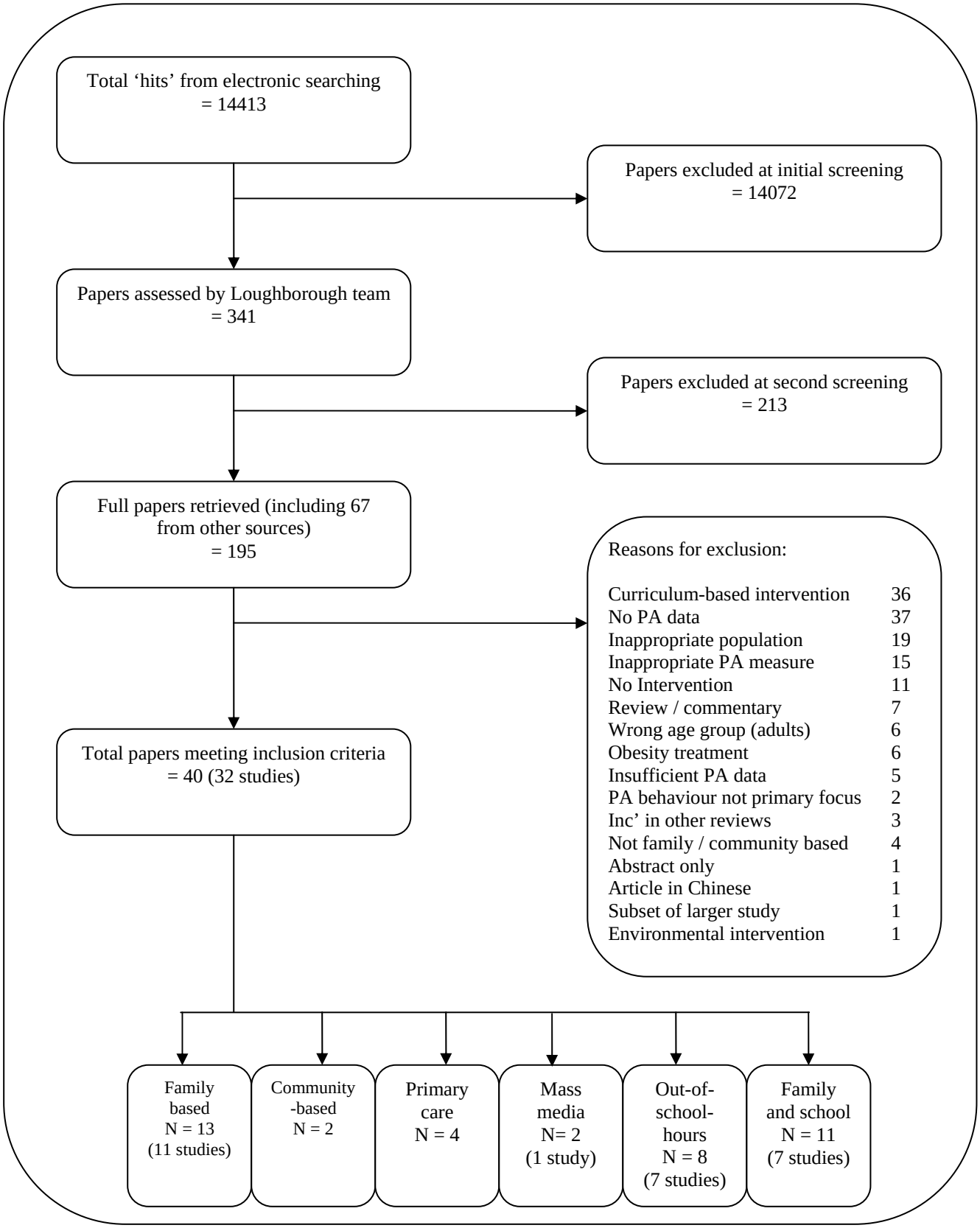
Consistency of screening was assessed by another researcher checking relevance on a 10% sample with no discrepancies found. In total 195 titles and abstracts (including 67 studies identified from other sources) were assessed to be potentially relevant and the full papers retrieved. These were checked by one person, against the above inclusion/exclusion criteria. In addition, studies were excluded, based on the agreed project scope, if:

- They had a main focus on treating obesity
- They were from less economically developed countries or they were studies primarily investigating ethnic groups that do not have large populations in England (labelled inappropriate population in Figure 2)
- The intervention was based primarily within the school curriculum
- The study involved a change to the built or natural environment (and thus had been covered in NICE guidance on the environment and physical activity) or had been included within one of the other four reviews in this series (e.g., adolescent girls).

Another researcher checked 10% of the excluded titles and all of the included titles against the inclusion/exclusion criteria and no discrepancies were found. In addition, this researcher independently assessed 11 full papers where there was uncertainty about inclusion. After discussion agreement could still not be reached on four of these papers and they were sent to a third reviewer for resolution. 40 papers (representing 32 studies) were accepted for full data extraction (see Evidence Tables) and 155 were rejected (see Annex B). See Figure 2 for flow diagram of the study selection procedure.

Studies varied in scale from 26 to 5,106 participants. The studies were conducted in the family, primary health care, after-school clubs, mass media, community agencies

Figure 2. Flow diagram of study selection.



and combined family and school settings. The interventions targeted physical activity alone or in combination with other health behaviours. Of the two outcomes under investigation (physical activity and core physical skills/physical literacy), studies were only located for physical activity. Studies were conducted in the USA (n=22), other European (non-UK) countries (n=7), the UK (n=1), Canada (n=1) and New Zealand (n=1).

25 interventions studied children under 13 years, with seven studying adolescents 13yrs or older (one study did not provide age information, and one study provided data separately for both the under 13 and 13+ age groups). The measurement of physical activity involved objective assessment only (n=5), validated self-reported assessment only (n=7), self-reported assessment of unknown validity (n=11), parental proxy (n=1) and a combination of objective and validated self-report measures (n=8). Time from baseline to follow-up measurement varied from being immediately at the conclusion of the intervention to 5 years. Of the 32 studies, one investigated boys only, seven investigated girls only, and 24 investigated both boys and girls.

2.2.1. Included studies

See Evidence Tables.

The main reasons for exclusion of studies were (a) no physical activity or core physical skills data presented (b) the intervention was curriculum based (c) the study was focused on an inappropriate population (e.g., native Americans) or (d) the study employed an inappropriate measure of physical activity (e.g., fitness) (see Annex B for list of excluded studies).

2.3. Study type and quality appraisal

Each study was categorised by research design, as shown in Table 1. Studies were graded using a code '++', '+' or '-', based on the extent to which the potential sources of bias had been minimised. The included studies were quality assessed independently by two reviewers using the design specific quality assessment tools in Appendix A of the NICE manual (National Institute for Health and Clinical Excellence, 2006). Any discrepancies were resolved through discussion.

Grading criteria were:

++ **All or most** of the criteria have been fulfilled. Where they have not been fulfilled the conclusions are thought very unlikely to alter.

+ **Some** of the criteria have been fulfilled. Those criteria that have not been fulfilled or not adequately described are thought unlikely to alter the conclusions.

- Few or no criteria have been fulfilled. The conclusions of the study are thought likely or very likely to alter.

Table 1: Classification of research designs and summary quality assessment

Design	Abbreviation	Randomisation?		Control group?	Number of studies by quality grading criteria			TOTAL
		By individual	By group		-	+	++	
Randomised controlled trial	RCT	✓	X	✓	2	7	2	11
Cluster randomised controlled trial	CRCT	X	✓	✓	1	4		5
Controlled non-randomised trial	CNRT	X	X	✓	4	4	2	10
Randomised non-controlled trial[2]	RNCT	✓	X	X	2	1		3
Uncontrolled before and after	UBA	X	X	X	3			3
TOTAL					12	16	4	32

Notes: ✓ = yes; X = no. For example, in a Randomised Controlled Trial Randomisation occurred by individuals, not by group, and a control group was employed.

Table 2 summarises study quality and outcomes. The main reason for studies being assessed as low quality [-] was the use of a measure of physical activity of unknown reliability and validity. There are 15 interventions showing positive physical activity behaviour change, 16 showing no effect, and one showing a negative effect (see Evidence Tables). Of the 15 showing a positive effect, two are of high quality (++), eight are of good quality (+) and five are of low quality (-). Of the 16 showing no effect, two are of high quality (++), eight are of good quality (+), and six are of low

[2] Two interventions groups compared, therefore one might be considered a 'comparison' group.

quality (-). The study reporting a negative finding was of low quality (-). Research quality does not seem to be related to the reported physical activity behaviour change outcomes.

Table 2: Study type and quality.

Study Type	Authors	Study Quality	Physical activity change?
RCT	Patrick et al (2006)	++	No change
	Rodearmel et al (2007)	++	Positive
	Baranowski et al (2003)	+	No change
	Beech et al (2003)	+	No change
	Nader et al (1992)	+	No change
	Ransdell et al (2004)	+	Positive
	Robinson et al (2003)	+	No change
	Rodearmel et al (2006)	+	Positive
	Story et al (2003)	+	No change
	Baranowski et al (1990)	-	Negative
	Ortega-Sanchez et al (2004)	-	No change
CRCT	Haerens et al (2006, 2007)	+	Positive
	Jago et al (2006)	+	No change
	Luepker et al (1996) & Nader et al (1996)	+	No change
	Simon et al (2004, 2006)	+	Positive
	Wilson et al (2002)	-	No change
CNRT	Taylor et al (2006, 2007)	++	No change
	Wilson et al (2005)	++	Positive
	Huhman et al (2005, 2006)	+	Positive
	Jurg et al (2006)	+	Positive
	Pate et al (2003)	+	No change
	Salminen et al (2005)	+	Positive
	Annesi et al (2007)	-	Positive
	Baxter et al. (1997)	-	No change
	Christodoulos et al (2006)	-	Positive
	Kelder et al (1993) & Perry et al (1994)	-	Positive
RNCT	Ransdell et al (2003a, 2003b, 2004)	+	Positive
	Kelleher et al (2001)	-	No change
	Patrick et al (2001)	-	Positive
UBA	Cookson et al (2000)	-	Positive
	Hawley et al (2006)	-	No change
	Ransdell et al (2001)	-	No change

2.4. Description of studies

The review sought to answer the following research questions:

1. Which community interventions or programmes targeted at children and/or their families increase children's physical activity/core physical skills taken either alone or with their family?
2. What are the characteristics of a physical activity intervention or programme targeted at children and/or their families which increases children's physical activity/core physical skills taken either alone or with their family?

No studies were located concerning core physical skills, therefore only interventions addressing increasing levels of physical activity are now considered.

The key characteristics and findings from each study are summarised in Evidence Tables (Section 12). The overall effectiveness of interventions is mixed, with 18 studies showing positive effects and 14 showing no intervention or negative effects. To guide readers towards possible practical implications of the findings, the 32 studies are presented under the following main categories based primarily on setting:

- Interventions based within the family (n=11)
- Interventions based within community agencies (e.g., boy scouts) (n=2)
- Interventions based within primary health care (n=4)
- Interventions based in clubs outside of school hours (n=7)
- Interventions based within both the family and the school (n=7)
- Social marketing interventions (n=1)

A settings approach was selected as this is the most common approach taken in the literature and, in our opinion, provides the most practical grouping of a diverse body of work. Within each setting, we looked to identify studies that employed similar populations and/or intervention approaches.

2.5 Assessing applicability

Each study was assessed on its external validity: that is, whether or not it was directly applicable to the target population(s) and setting(s) in the scope. This assessment took into account whether the study was conducted in the UK, and any barriers identified by studies or the review team (NICE 2006).

2.6 Synthesis

It was not appropriate to use meta-analysis to synthesise the outcome data as interventions, methods and outcomes were heterogeneous. This review is restricted to a narrative overview of all studies that met the inclusion criteria and contained sufficient data for data extraction and quality assessment. The effects of physical activity studies were examined by setting, stratified by study quality. The evidence statements were developed using NICE criteria (NICE 2006) outlined below:

- The best available evidence
- The strength (quality and quantity) of supporting evidence and its applicability to the populations and settings in question
- The consistency and direction of the evidence.

It is noted that for some intervention settings included within this review only one or two studies met the inclusion and quality criteria. Evidence statements were drafted for these sections but caution should be taken in generalising due to this limitation. This review did not produce evidence statements based upon any cost-effectiveness data which will be considered in the economic review.

3. Interventions based within the family

These interventions targeted families directly and the family was the unit of intervention. Within these studies family was generally defined as at least one child and parent/adult who reside in the same household and have a common emotional bond.

3.1 Overall summary of studies identified

Eleven studies evaluated family-based interventions. Of these four were conducted at the family home (Cookson et al., 2000; Ransdell et al., 2004; Rodearmel et al, 2006, 2007), two in the home and school (Nader et al., 1992; Salminen et al., 2005), two in community centres (Baranowski et al., 1990; Beech et al., 2003), one in the home and on a university campus (Ransdell et al., 2003a, 2003b, 2004 – all report on the same study), one in the home and at summer day camps (Baranowski et al., 2003) and one on a university campus (Ransdell et al., 2001). Four of the eleven studies targeted children who were or were at risk or overweight/obesity. Of these four, two showed positive physical activity outcomes and two showed no change. Seven of the eleven studies targeted all young people regardless of weight status. Of these seven, four showed positive changes in physical activity, two showed no change and one showed a negative effect. All but three studies (Baranowski et al., 1990, Cookson et al., 2000, Ransdell et al 2001) had a positive quality grading. Nine of the studies were conducted in the USA and none were conducted in the UK.

3.2 Evidence of efficacy

3.2.1 Studies targeted at overweight/obese children, and/or those at risk for overweight/obesity

Rodearmel et al (2007) [RCT ++] assessed the effectiveness of a small-changes lifestyle intervention targeting all members of the family. The target population was families with overweight or at risk of overweight children. 218 children (48% male; 7-14 yrs old, Intervention mean 11.1 yrs, control mean 11.3 yrs) took part in the 6 month programme (America on the Move). No theoretical basis for the intervention was given. This study was conducted in the USA. Families in the intervention group were asked to make two small lifestyle changes: (1) increase walking by 2000 steps/day above baseline as measured by pedometers, and (2) eliminate 100 kcal/day from their normal diet (through the replacement of dietary sugars with a non-

calorie sweetener). All members of the family were requested to follow the programme. Control families were asked to self-monitor their daily steps but were not asked to change their diet or physical activity level. They did not receive any information or education regarding physical activity or diet until the end of the study. Baseline physical activity levels were average daily steps taken in weeks 1 and 2, outcome physical activity levels were average daily steps taken in weeks 2-18, and at week 24.

There was no difference between groups at baseline for children. Although intervention children did not fully meet their step goals, they reported significantly more steps/day throughout the intervention than control participants ($p<0.05$; actual step values estimated from published graph 10700 vs 10200).

Beech et al. (2003) and Baranowski et al. (2003) are both pilot studies from the multi-site GEMS intervention – *Girls health Enrichment Multi-site Studies* – in the USA. The multi-site project funded four centres to test interventions designed to prevent excess weight gain in African-American girls aged 8-10 years. Intervention sites had similar eligibility criteria and measurement tools, but tested different interventions.

Beech et al (2003) [RCT +] evaluated the effectiveness of parent or child targeted weight gain prevention interventions in 60 African American girls (mean age Child Targeted = 8.7yrs, Parent Targeted = 9.1yrs, Control = 8.9). The intervention lasted 12 weeks and was based on Social Cognitive Theory (see Annex C). The girls were all above the 25th percentile of age and sex specific BMI. The child targeted group received 12 x 90 min sessions that included an introduction (15 min), a physical activity component (30 min), a nutrition components (30 min), and a 'take it home' segment (15 min review of the day with incentives and motivation for following week). The activity components were selected from a review of literature and findings from focus groups. Hip Hop aerobics served as the main activity for the majority of this segment. Other activities (e.g., walking, jogging, active games, swimming) were included and/or encouraged. During the warm-up, interventionists suggested ways to reduce sedentary activity, such as exercising during commercial breaks. In the parent targeted group, parents/caregivers received 12 x 90 min sessions that included physical activity (25 min), nutrition education (25 mins), food preparation/nutrition-related games (25 min), and a 'take it home' segment (15 min). In the physical activity segment parents/caregivers danced to popular songs from the 70s and 80s, and were encouraged to share popular dances from their youth with

their daughters and to learn their daughters' current dances and music. Childcare was provided during the sessions. The control group received 3 x 90 min sessions to enhance and prevent declines in self-esteem among 8- to 10-year-old girls and to be neutral with respect to dietary practices and physical activity. Physical activity was assessed using accelerometers (worn on 3 consecutive days) and a self-report measure, the GEMS activity questionnaire (GAQ) was used to assess physical activity for the previous day.

Relative to the control group, the two intervention groups combined demonstrated an increase in moderate to vigorous physical activity (MVPA) minutes of about 12%, but these differences were not significant. However, our own calculation of post-intervention effect sizes[3], showed some small to moderate effects (child targeted vs control accelerometer counts/min: 361.0 vs 347.3 (p = .59, ES=.17); child targeted vs control minutes of moderate-to-vigorous physical activity (MVPA) 12-6pm 72.0 vs 67.5 (p=.71, ES=.12); parent targeted vs control accelerometer counts/min: 387.9 vs 347.3 (p = .21, ES= .75); and parent targeted vs control minutes MVPA 12-6pm 78.8 vs 67.5 (p=.35, ES=.45). This suggests that there may have been a small intervention effect but that the study was statistically under powered[4], and in fact, Beech et al. state that the study was under powered for detecting differences in the primary outcome variable of BMI and other main outcome variables. Physical activity outcomes from the parent targeted group tended to be greater than those from the child targeted group, although these differences were not significant. Again our own calculations of effects sizes suggest these differences may in fact be important (child targeted vs parent targeted accelerometer counts/min, p = .47, ES=.47; child targeted vs parent targeted minutes MVPA 12-6pm p=.56, ES = .25). There was a slight increase in physical activity preference for girls in the child targeted group versus the control group (p < .05). However there were no differences in physical activity self-concept, sedentary activity preference, positive expectancy for physical activity or self-efficacy for physical activity.

[3] Effect Size (ES) = (INT mean – CON mean / SD_{pooled}). 0.2=small, 0.5=moderate, 0.8=large

[4] Power is the ability to detect an effect (e.g., difference between groups in intervention outcome) given that the effect exists. Among other things power is determined by sample size. If too few subjects are used, an intervention may have such low power that there is little chance to detect a significant effect even when it exists.

Baranowski et al (2003) [RCT +] evaluated the effectiveness of a 12-week pilot obesity prevention intervention in 35 African American girls (mean age intervention = 8.3 yrs, control = 8.4 yrs). The girls were all above the 50th percentile of age and sex specific BMI. The intervention lasted 12 weeks and was based on Social Cognitive Theory (see Annex C). The intervention group girls attended a 4 week summer day camp (approx 9 hrs / day). During the camp GEMS activities targeted at increasing fruit, fruit juice, and vegetable consumption, and physical activity were blended with usual camp activities. GEMS activities included buddy groups, decision making skills, problem solving, asking behaviours, dance lessons, educational games, and goal setting. The camp was followed by an 8 week home-internet programme for children and parents. There were separate internet programmes for parents and children. The programmes included problem solving, weekly challenges, web links, 'ask the expert', and encouraging parental modelling. The control group attended summer camp following the usual programme and completed a low-intensity internet-based component (they were asked to log on once a month and the information provided included links to other general health and homework exercises). New links were provided each month. As with Beech et al physical activity was assessed using accelerometers (worn for 3 days) and a self-report measure, the GEMS activity questionnaire (GAQ) which assessed physical activity for the previous day.

There were no differences on most physical activity measures although there was a (non-significant) trend towards increased self-reported physical activity for Intervention girls. However, our own calculation of post-intervention effect sizes, showed some small to large effects (intervention vs control accelerometer counts/min: 369.9 vs 364.0 (p = .86, ES=.25); intervention vs control minutes MVPA 67.5 vs 74.8 (p=.54, ES=-.89); intervention vs control self-reported physical activity score 5.1 vs 4.3, (p=.19, ES=1.79)). It is important to note that for the MVPA minutes variable the effect size indicates the intervention had negative effect (i.e., the intervention group decreased relative to the control). It is possible then that there may have been some positive intervention effects but that the study was statistically under powered. Baranowski et al (2003) state that the Baylor GEMS intervention was under powered for detecting differences in the primary outcome variable of BMI and other main outcome variables. Overall attendance rates at the summer camp were 92% for the intervention group and 81% for the control group. Participation in the internet component was low with overall log-on rates of less than 50% in the intervention group and less than 25% in the control group. There was no difference

($p > .05$) between intervention and control group participants on physical activity preference post-intervention.

Rodearmel et al (2006) [RCT +] assessed the effectiveness of a lifestyle intervention targeting all members of the family for weight gain prevention in at risk youth. The study was conducted in the USA. No theoretical basis was given for the intervention. Participants were families with overweight or at risk of overweight children 8-12 years old (intervention n=68, control n=20). The intervention lasted 12 weeks and involved small lifestyle modifications: increase walking by 2000 steps/day above baseline, and consume 2 servings per day of ready to eat cereal. All members of the family were requested to follow the programme. Control families were asked to maintain their usual eating and step patterns. Both intervention and control families attended three family meetings (at the beginning, middle and end of the study) in which measurements were taken, step data were collected, questions were answered, and encouragement for continued participation was provided. All families (intervention and control) were given refrigerator magnets and stickers for bathroom mirrors with written reminders to record daily steps. Physical activity was measured as number of steps per day from a pedometer. Participants reported their number of steps/day for all weeks of the intervention with week 1 acting as baseline and weeks 2-14 as follow-up. Both intervention boys (+1919 steps/day) and girls (+1707 steps/day) increased their steps/day significantly compared to control participants (boys +40 steps/day, girls -553 steps/day, $p<0.05$).

A brief summary of the studies in this section is provided in Table 3.

Table 3. Summary of key characteristics of family based studies targeted at overweight/obese children, and/or those at risk for overweight/obesity

Study	Outcome	Population	Age	Theory	Intervention	Location of intervention	Measurement
Rodearmel et al (2007) RCT [++]	+	Boys and girls	7-14 yrs Mean 11.2yrs		Small lifestyle changes (PA and dietary)	home	Pedometer
Rodearmel et al (2006) RCT [+]	+	Boys and girls	8-12 yrs Mean 9.9yrs		Small lifestyle changes (PA and dietary)	home	Accelerometer and self report
Beech et al (2003) RCT [+]	No change	African American girls	8-9 yrs Mean 8.9yrs	SCT	Physical activity and nutrition sessions	Community centre	Accelerometer and self report
Baranowski et al (2003) RCT[+]	No change	African American girls	8-9 yrs Mean 8.3yrs	SCT	Physical activity and nutrition sessions	4-wk Camp and then 8-wk internet at home	Pedometer

3.2.2 Studies targeted at all young people regardless of weight status

Nader et al (1992) [RCT +] assessed the effectiveness of a cardiovascular disease risk reduction intervention targeting Anglo- and Mexican-American families living in the USA. 323 children aged approximately 12 years took part in a 1-year intervention based on Social Cognitive Theory (see Annex C) and principles of self-management. The intervention group received 18 x 90 min physical activity and nutrition education sessions (conducted at local schools) that focused on self-monitoring, goal setting, problem solving, self-rewarding goal achievement, and social support. There were 12 sessions in the first 3 months and 6 sessions during the final 9 months. Average attendance for Anglo families was 71% in the initial 12 sessions and 42% for the 6 maintenance sessions. For Mexican-American families average attendance was 71% in the initial 12 sessions and 42% for the 6 maintenance sessions. The control group received no intervention. Physical activity was assessed by interviewer administered physical activity recall over the last 7 days and yielded energy expenditure in kilocalories per kilogram of body weight per day. Follow-up was at 1, 2 and 3 years post intervention.

Results showed no change in energy expenditure from physical activity for either Mexican-American boys, Mexican-American girls or Anglo-American girls at any

follow-up point. There was a small increase in energy expenditure from physical activity in Anglo-American boys at 2 yr (p = .02) and 4 yr follow-up (p = 0.02).

Ransdell et al (2004) [RCT +] evaluated a 6 month home-based intervention to increase physical activity in 3 generations of women (GET FIT – Generations exercising together to improve fitness). The study was conducted in the USA. The theoretical basis for the intervention was not reported. Participants were 17 grandmother, mother and daughter triads (Intervention N = 10 triads (10 girls), Control N = 7 triads (7 girls)). Average age was 10.7yrs in intervention girls and 9.4 years in control girls. The intervention lasted for 6 months. The intervention group attended two 2-hour introductory sessions which provided instructions on how to complete study measures and how to use the information pack. Participants received a home information pack comprising a calendar of recommended activities, photos of strength and flexibility-training activities, a schedule for completing an activity log, pedometer, and paid return envelopes. Participants were requested to participate in lifestyle, aerobic, muscular strength and flexibility activities at least 3 times per week. Control participants were asked to continue their usual pattern of physical activity. Physical activity was assessed by The Physical Best Physical Activity Questionnaire (self-report, yielding days per week of aerobic activity, weight training, and flexibility activities) and by Yamax Pedometer (steps/day).

Physical activity outcome data were collapsed across daughters, mothers and grandmothers, with participants in the intervention group having significantly higher daily step counts post intervention relative to the control group (+37% vs. -13%, p=0.001, Eta^2 = .28) [5]. There was also a significant increase in participation in self-reported flexibility activities for intervention versus control subjects (+305% vs -15%, p=0.000, Eta^2 = .44). Although not significant (p>.0125), self reported changes in aerobic activity and muscular strength building activities, favoured the intervention group and showed large effects (Aerobic activity Eta^2 = .17, Muscular strength building activity Eta^2 = .15).

Baranowski et al (1990) [RCT-] assessed the effectiveness of a centre-based intervention to increase aerobic activity in African American families living in the USA. There were 64 children in the intervention group (mean age 10.6 yrs) and 56 children

[5] Eta^2 is a measure of effect size. .01=small, .06=moderate, .14 large.

in the control group (mean age 10.9 yrs). The intervention was based on Social Cognitive Theory (see Annex C). Intervention participants were encouraged to participate in one educational session and two fitness sessions per week for 14 weeks. Education sessions took place at a former high-school located within the community and included individual counselling, small group education, aerobic activity, and snack components. The fitness sessions took place on the same site in a gym refitted as a modern fitness facility. The fitness sessions provided opportunities to participate in a variety of activities, such as, aerobic dance, walking, jogging, aerobic weight lifting, bicycling. Free transportation and babysitting were provided. No contact was made with the control group during the programme. Physical activity was assessed using the self-report Stanford seven day recall, frequency of aerobic activity form. This yielded energy expenditure per week in METS and Kcals.

For children, energy expenditure in METS and Kcals increased more from pre to post testing in control versus intervention participants. It is worth noting that participation in the intervention activities was low, with only about 20% participating in the desired fitness centre sessions by the end of the program. There were no changes in knowledge or self-efficacy in either group.

Ransdell et al (2003a, 2003b, 2004) all report on the same study known as DAMET (Daughters and Mothers Exercising Together; [RNCT +]). The study took place in the USA and compared home based and community based interventions promoting physical activity in mothers and daughters. A total of 17 mother-daughter pairs took part in the intervention: 7 mother-daughter pairs were assigned to the home based intervention and 10 mother-daughter pairs were assigned to the centre-based intervention. The mean age of the daughters was 15.7yrs in the home based group and15.2yrs in the centre based group. The intervention was based on Social Cognitive Theory (see Annex C) and lasted for 12 weeks. Home based participants (n=7 mother daughter pairs) received a home information pack comprising a calendar of recommended activities, photos of strength and flexibility-training activities, a schedule for completing an activity log, pedometer, and paid return envelopes. They were asked to participate in a physical activity programme 3-days/week but were not specifically asked to participate in physical activity sessions together. Centre-based participants (n=10 mother daughter pairs) attended 2 x fitness sessions per week. These sessions consisted of a 5 min warm-up, 30 min aerobic activity, 30 min weight training, 5-10 min stretching/abdominals. In addition

they attended 1 x lifestyle activity session per week (rock climbing, skiing). Centre-based sessions were conducted on a University campus. Physical activity was assessed using the Fitnessgram Physical Activity Questionnaire (self-report). It asked participants about the number of days per week they participate in aerobic, resistance training and flexibility exercise.

Over the course of the intervention and regardless of group girls significantly increased their self-reported participation in aerobic (home based =+.71 days/wk, centre based +2.05 days/wk; p=0.02 Eta^2 = .33), resistance (home based =+1.45 days/wk, centre based +1.92 days/wk; p=0.001 Eta^2 = .53) and flexibility (home based =+1.85 days/wk, centre based +3.86 days/wk; p=0.000 Eta^2= .58). The effect sizes were all large. There were no between group differences over time (p>.05), that is, both interventions were equally effective. The home-based group completed 70% of scheduled exercise sessions and the centre based attended 77% of scheduled sessions. Girls in both groups showed significant improvements in perceived sports competence and body attractiveness (p<.01).

Salminen et al (2005) [CNRT +] evaluated the effectiveness of a health education / counselling intervention targeting children with familial history of cardiovascular disease. The intervention took place in Finland. The theoretical basis for the intervention was not reported. 1238 boys and girls (6-17 years; mean approx 11 yrs) took part (Intervention n=515, Control 1 n=245 (high risk children), Control 2 n=523 (low risk children). The intervention lasted approximately 3 years. No theoretical basis for the intervention was stated but the intervention used the health education approach with individual counselling sessions (2 for children delivered in school, 3 for children and their family members delivered at home) with shared decision making. Sessions covered a range of issues including diet and nutrition, exercise, smoking, drugs and alcohol. Reading materials provided by voluntary organisations (e.g., Heart Disease Association of Finland) were handed out during the whole intervention. Control group children and adolescents received no health education/counselling intervention; they used the regular health service options available to anyone. Physical activity was assessed by self report but the instrument was not reported in detail, making it difficult to interpret the results. For girls physical activity was reported as exertion of exercise but for boys physical activity was reported as frequency of exercise/week.

When girls in the intervention group were compared to girls in the control groups there was a significant difference ($p < .05$) in the patterns of change over time. At baseline, fewer girls in the intervention group reported exercising at either a moderate or vigorous level (88% vs 97% in control 1 and 94% in control 2), but by the end of the intervention these proportions were similar (96% vs 95% vs 94%), suggesting the intervention had some positive effect on the proportion of girls exercising at higher intensities. When boys in the intervention group were compared to boys in the control groups there was a significant difference ($p < .05$) in the patterns of change over time. At baseline, boys in the intervention group were less likely to report exercising on 2 or more days of the week compared to boys in the control groups (73% vs 86% in control 1 vs 82% in control 2), but by the end of the intervention these proportions were similar (77% vs 72% vs 73%). This result suggests the intervention had some positive effect on maintaining active lifestyles.

Cookson et al (2000) [UBA -] evaluated the HeartSmart Family Fun Pack – a home based physical activity, nutrition and smoking intervention targeting Canadian families with children. The intervention was based on the Transtheoretical Model (see Annex C). The HeartSmart pack was publicised through a media campaign on the issue of children's heart health conducted by the Heart and Stroke Foundation. The pack was free and could be ordered via a toll-free number. No age data were provided. At pre-intervention n=1387, at post-intervention n=300 (chosen at random from pre-intervention group). The intervention was a mail delivered intervention pack for parents and children comprising games, posters, children's health quiz, brochures and a growth chart. Child physical activity levels were obtained by parental proxy through a telephone interview. Outcomes were reported as frequency of active play (never or 1-2 times/week, 3 or more times per week, once a day or more). The proportion of parents reporting their child participated in active play 1-2 days per week or less decreased from 22% at pre-test to 11% post-test ($p<0.001$) . The proportion of parents indicating their child was active once or more per day increased from 28% to 55% ($p<0.001$).

Ransdell et al (2001) [UBA -] evaluated the effectiveness of a family based intervention to increase physical activity in mothers and daughters. This was the pilot study of DAMET (Daughters and mothers exercising together, see Ransdell et al 2003a, 2003b, 2004). The study was based in the USA and involved 12 mothers and 14 daughters (mean age 13.9 yrs). The intervention was based on Social Cognitive Theory (see Annex C) and lasted for 12 weeks. The intervention consisted of 24 x

90-120 min sessions held on a university campus (1 recreational activity session and 1 classroom-based education session per week). The recreational and education sessions were designed for both mother and daughter but when necessary the groups were separated for age appropriate activities. Participants were also requested to increase lifestyle activity (e.g. active commuting) and to undertake 1-2 additional exercise sessions per week. Participants received monthly newsletters for 6 months post-intervention. Physical activity was assessed by self-report using two questions from the Behavioural Risk Factor Surveillance Survey. Outcomes were assessed for days per week of physical activity. No changes in exercise participation were observed for girls at post intervention or 6-month follow up (baseline 2.6 days/wk, post intervention 3.6 days/wk, 6 month follow-up 3.3 days/wk; no statistical values were reported). For mothers and daughters data combined there were improvements in sports competence, perceived strength and muscularity and perceived physical condition at follow-up. Attendance at intervention sessions was approximately 65%.

A brief summary of studies in this section is provided in Table 4.

Table 4. Summary of key characteristics of family based studies targeted at all children regardless of weight status

Study	Outcome	Population	Age	Theory	Intervention	Location of intervention	Measurement
Ransdell et al (2004) RCT [+]	+	Girls	10-11 yrs Mean 10.1yrs		PA info packs, encouraged grandmothers, mothers and daughters to exercise together	Home	Pedometer & self report
Ransdell et al (2003a,b, 2004) RNCT [+]	+	Girls	14-17 yrs Mean 15.4yrs	SCT	Group 1: PA info pack Group 2: PA sessions Both encouraged mothers and daughters to exercise together	Home Community centre	Self report
Salminen et al (2005) CNRT [+]	+	Boys & girls	6-17 yrs. Mean approx. 11 years		Health education and counselling focused on diet, exercise, smoking, drugs and alcohol.	School (children only) and home (family)	Self report
Cookson et al (2000) UBA [-]	+	Boys & girls	Not given	Stages of change	Info pack focused on healthy eating, smoking behaviour, and active play every day.	Home	Self-report
Nader et al (1992) RCT[++]	No change	Boys & girls	5th/ 6th grade Mean 12 yrs	SCT	PA and nutrition sessions	School and home	Self-report
Ransdell et al (2001) UBA[-]	No change	Girls	11-17 yrs Mean 13.9 yrs	SCT	PA and education sessions	University campus	Self-report
Baranowski et al (1990) RCT[-]	-	African-American boys and girls	Mean 10.8 years	SCT	PA and education sessions	Community centre	Self-report

3.3 Applicability

All eleven studies were conducted outside of the UK and therefore the success of broader application is uncertain. However, there are no obvious reasons why the format of the majority of the interventions could not be employed within the UK, with appropriate adaptation for different cultural context and working practices in the UK.

3.4 Implementability

All of the studies can be implemented in the UK with suitable resources and appropriate cultural adaptation.

Interventions based within the family: Evidence statements

Interventions targeted at overweight/obese children, and/or those at risk for overweight/obesity

There is evidence from two randomised controlled trials in the USA (Rodearmal et al., 2007 [++]; Rodearmel et al., 2006 [+]) that family-based physical activity interventions targeting overweight/obese children and/or those at risk for overweight/obesity, can lead to increases in physical activity in young people. However, two randomised controlled trials in the USA (Baranowski et al., 2003 [+]; Beech et al., 2003 [+]) failed to show an effect in the same target group. Characteristics of successful interventions included being located in the home and therefore not involving attendance at external sites and focused on small, specific lifestyle changes (2000 more steps/day and a single dietary target). In contrast, unsuccessful interventions required regular attendance at sites external to the home for education and/or physical activity sessions, broader physical activity and dietary behaviour change, and were with 8-9 year old African-American girls.

Interventions targeted at all young people regardless of weight status

There is evidence from one randomised controlled trial in the USA (Ransdell et al., 2004 [+]), one randomised non-controlled trial in the USA (Ransdell et al, 2003a, 2003b, 2004 –all report on the same study [+]), one controlled non-randomised trial (Salminen et al., 2005 [+]) and one uncontrolled before and after study (Cookson et al., 2000 [-]) that family-based interventions, targeting physical activity, can lead to increases in physical activity in young people. One randomised controlled trial in the USA (Nader et al., 1992 [++]) and one uncontrolled before and after study in the USA (Ransdell et al., 2001 [-]) failed to show an effect. One randomised control trial in the USA (Baranowski et al., 1990 [-] showed a negative effect. Successful interventions were located mostly in the home and predominantly involved information packs. Two of the successful interventions involved either mothers and daughters or grandmothers, mothers, and daughters exercising together. Unsuccessful interventions all involved regular attendance at physical activity and education sessions outside of the home. Other differences between successful and unsuccessful interventions were not consistent.

4 Interventions based within the community

These interventions were conducted within a community setting, and targeted young people within this setting (eg scout groups)

4.2 Overall summary of studies identified

There were two studies within this group. Jago et al (2006)[+] evaluated a physical activity intervention within boy scout troops. Baxter et al (1997)[-] used a combination of broad-based education and policy initiatives within the community and schools. Neither study reported significant effects for physical activity. One of the studies was conducted in the UK (Baxter et al., 1997).

4.3 Evidence of efficacy

Jago et al. [CRCT +] reported the results of a boy-scout based physical activity intervention using limited troop time and an internet programme targeting physical activity self-efficacy and preference change. Participants were 473 10-14 year old (mean 13 yrs) Boy Scouts in the USA. No theoretical basis was stated. The 9-week intervention was the “Fit for Life” physical activity badge, which included skill building activities at troop meetings and internet-based role modelling, goal setting, goal review and problem solving. Trained staff led 20-min physical activity sessions during troop meetings and were provided with a Boy Scout drills booklet to help them do so. The knowledge component of the sessions introduced boys to different types of activity, intensity, safety guidelines, weightlifting, asking skills (e.g., to gain travel to physical activity events) and how to maintain physical activity. The activity component introduced boys to various sports related activities (e.g., flexibility for basketball, baseball drills). The website used a comic-book programme to develop problem-solving, decision-making and negotiation skills. Participants were asked to log onto the website at least twice a week. Points were awarded for attending troop sessions and setting and achieving activity goals. Badges were awarded at programme end to participants who obtained 70% of the available points. The control group received a mirror image fruit and vegetable intervention. Physical activity was assessed by accelerometer, worn over 3 consecutive days. The intervention was conducted in two waves (spring and autumn) to control for seasonal effects.

The intervention resulted in increased light physical activity among spring participants relative to control at the end of the programme, however this was not maintained at 6 month follow-up (mean mins (SE) baseline 143.6 (4.9), end 155.9 (4.9), 6-months, 136.2 (5.3), p =0.011). Participants in the intervention group from the Spring wave only, showed a trend towards decreased sedentary behaviour at the end of the intervention but there was no significant difference at 6 month follow-up (mean mins (SE) baseline 908.4 (6.2), end 896.3 (6.3), 6-months 912.2 (6.7), p=0.051). For spring participants there were no significant differences in minutes of MVPA (baseline 27.1 (2.2), end 25.3 (2.2), 6-months 29.4 (2.4); all p > .05). For the autumn participants, there were no physical activity changes at any intensity at any time point (light activity (baseline: 136.7 (4.2), end: 129.9 (3.9), 6-months: 136.1 (4.5); sedentary behaviour (baseline 919.5 (5.4), end 925.9 (4.9), 6 months 916.7 (5.7)) MVPA(baseline 23.9 (1.9), end 24.1 (1.7), 6-months 27.2 (1.9), p>.05). Physical activity preferences were greater (p < .001) at the end of the intervention and at 6-month follow-up irrespective of intervention group or wave (i.e. both groups changed in both waves). There were no differences in physical activity self-efficacy for either group or wave at any time point (p>.05).

Baxter et al. [CNRT -] reported the results of a 3-year broad-based intervention (Action Heart) in the UK targeting lifestyle risk factors for CHD. The participants were 370 boys aged 11 years at baseline. Details and outcomes for girls were reported in the adolescent girls review. No theoretical basis for the intervention was given. The intervention components were largely school based, with some wider community elements including publicity and policies. The former comprised educational and policy initiatives such as educational materials, peer-led projects, and school policies. The latter included the implementation of policies in establishments working with people in the intervention area; Action Heart worker-facilitated activities for general heart health promotion; activities targeted at individual risk behaviours; publicity; and community-based family exercise initiatives. Overall the intervention is poorly described. Control participants were from a distinctly geographically different community, and received no specific intervention. Using a self-report measure of unknown validity, results show an 11% increase in physical activity for boys in the intervention schools compared to a 6% increase for those in the control schools. No tests of statistical significance were reported. Other health behaviours showed mixed results with positive changes in diet but negative changes in smoking. The overall odds ratio for boys and girls combined showed a negative effect for the intervention

(OR = .65 in intervention schools), that is, overall they were less active than controls at the end of the intervention.

4.4 Applicability

One of the studies (Baxter et al., 1997) was conducted in the UK and therefore provides directly applicable evidence. The other study (Jago et al., 2006) is likely to be applicable to similar populations and settings within the UK, particularly as it worked through the Scouting movement, which is international in nature.

4.5 Implementability

All of the studies can be implemented in the UK with suitable resources.

Interventions based within the community: Evidence statement

There is evidence from one randomised controlled trial in the USA (Jago et al., 2006 [+]) and one controlled non-randomised trial in the UK (Baxter et al., 1997 [-]) that community-based interventions do not lead to increases in physical activity in adolescents. Characteristics of these interventions included targeting early adolescent boys (10-14 y) through a voluntary sector group with strategies that included skill-building activities at group meetings and internet role-modelling, problem solving, goal-setting and review, and physical activity knowledge games. Other strategies included broad-based education and policy initiatives aimed at both adolescent boys and girls.

5 Interventions based within Primary Care

5.2 Overall summary of studies identified

Four studies of interventions based in primary care were identified. Of these two also included a home element (Patrick et al., 2001, 2006). All of the studies involved brief counselling from a GP or nurse practitioner. One of the four studies showed positive physical activity effects. Only one study had a positive quality rating. Two of the studies were conducted in the USA and none were conducted in the UK.

5.3 Evidence of efficacy

Patrick et al (2006) [RCT ++] took place in a primary health care environment in the USA. Participants were aged 11-15 years (mean 12.7±1.3 yrs at baseline). The intervention targeted boys (n=202) and girls (n=222). The intervention was based on Social Cognitive Theory and the Transtheoretical Model (see Annex C). The intervention, located in private health clinics in California, used the Patient-centered Assessment and Counselling for Exercise + Nutrition (PACE+) protocol and had two components. First, the intervention participants undertook a computerised assessment of their physical activity and nutritional status, including stage of change. The computer then guided the adolescent to develop stage appropriate and tailored behaviour change plans for one nutrition and one physical activity behaviour. These plans were then discussed in a 3-5 min one-to-one counselling session with their health care provider. The purpose of the counselling was to endorse or modify the plans and encourage full participation. In addition, the intervention participants received a guidance booklet for use at home. The booklet contained information/worksheets on diet and physical activity issues and advice on modifying behaviour. Participants were supported with postal prompts and advice and eleven telephone counselling (calls 10-15 mins duration) over the next 12 months. The control participants (boys n=179, girls n=216) received a sun protection programme. Physical activity was assessed at baseline, 6 months and 12 months (end of intervention) using self-reported 7-day recall, with a sub-sample also assessed using accelerometers (n=150 boys, n=180 girls). Only boys' results are reported here as the results for girls were reported in the adolescent girls review.

Results showed that the intervention was not effective in changing objective measures of physical activity in the intervention group relative to the control (p=0.76). Self-report data showed that boys in the intervention group increased their number of

active days per week compared to the control group (7.3% change compared to 0% change (p=.01)). However, self-reported MVPA min/week increased in both groups (INT 16.2% increase; CON 12.2% increase) and these changes did not differ between groups (p=.17). There was a significant (p=.001) reduction in sedentary behaviour for the PACE+ intervention (-24%) over controls (+2.4%).

Ortega-Sanchez et al [RCT -] examined whether advice about exercise provided to adolescent patients by their physicians in the office was effective in increasing or maintaining the adolescents' current levels of physical activity. The intervention was conducted in Spain. Participants were 448 boys and girls aged 12-21yrs (mean 17±2.4 yrs). Intervention participants (n=222) answered questions from the physician about their physical activity and were classified as active, partially active, or inactive. The intervention groups then received brief counselling from their physician based on their current physical activity behaviour. Active participants were provided with counselling to maintain their current levels of activity (reinforcement counselling: offer congratulations for healthy lifestyles, explain health benefits provided by lifelong exercise, encourage continued participation). Partially active participants were provided with counselling to increase their current activity levels (increase counselling: explain health benefits provided by lifelong exercise, explain conditions that exercise should satisfy to be useful for health maintenance, point out frequency, duration and/or intensity condition not satisfied, provide guidance on how to satisfy it). Inactive participants were provided with counselling to begin exercise (initiation counselling: explain health benefits provided by lifelong exercise, encourage initiation of exercise, explain the frequency, duration and intensity required). Physical activity assessment and counselling sessions occurred at baseline and at 6 months. Only physical activity assessment occurred at 12 months. Each counselling session took 5-10 minutes. The control group (n=226) were provided with no intervention. Physical activity was assessed using a self report measure of unknown validity of physical activity outside school. Participants reported on the frequency (days/week), duration (min/wk) and intensity (3 point scale: 1 = mild, 2 = moderate, 3 = vigorous).

The authors reported that at 6 months (i.e. at end of intervention period) the intervention group had 36.8% more active adolescents (p=.008), 34% higher physical activity duration (p=.016), 26.9% higher physical activity frequency (p=.01) and 17.6% higher intensity (p=.007) than the control group. In the intervention group physical activity duration increased by 36.8 min/wk (95% CI: -0.9 to 74.5 min/wk; p =.06), physical activity frequency increased by .49 days/wk (.12 to .86 days/wk; p

=.01) and physical activity intensity increased by .28 points (on the 3-point scale) (.07 to .49 points p=.01). By contrast in the control group physical activity duration decreased by 28.1 min/wk (-65.7 to 9.5 min/wk; p =.14); frequency decreased by .19 days/wk (-.55 to .18 days/wk; p =.31) and intensity decreased by .11 points (-.31 to .09 points p=.27). The authors reported a large number of tests (approx. 40) and did not adjust p-values to account for this and therefore there is a high chance (87%) that they will report a false positive. When we applied an adjusted p-value to the above results (p = .05/40 = .00125) none of the 6-month results were significant.

At 12 months (i.e. 6 months after the intervention finished) the authors report that the intervention group had 42.7% more active adolescents (p=.003), 48.9% higher physical activity duration (p=.002), 34.4% higher physical activity frequency (p=.002) and 30.3% higher intensity (p<.001) than the control group. In the intervention group duration increased 48.3 min/wk (10.1 to 86.5; p =.01), frequency increased .71 days/wk (.34 to 1.08 p =. 001) and intensity increased .33 points (.12 to .54 points p=.002). By contrast in the control group duration decreased 36.6 min/wk (-75.1 to 2.0; p =.06), frequency decreased .13 days/wk (-.50 to .25; p =.50) and intensity decreased .20 points (-.41 to .01 points p=.06). When we applied the adjusted p-value to the 12-month results (p = .05/40 = .00125) only the intensity result between groups and the frequency result within the intervention group remained significant.

Patrick et al., (2001, RNCT [-]) took place over 4 months in a primary health care environment in the USA. The intervention targeted 148 adolescents (90 males, 58 females) aged 11-18 yrs (mean 14.4±2.0 yrs). The theoretical basis for the intervention was the Transtheoretical Model, Social Cognitive Theory and the Relapse Prevention Model (see Annex C). The intervention followed the PACE+ protocol which has 3 primary components: interactive computer programme, provider counselling, and extended follow-up by telephone and/or mail. All participants completed a computerized assessment of key diet / physical activity behaviours in the waiting room. Comparison with health recommendations were fed back to the participant who then chose one physical activity and one nutrition behaviour to target. The computer then assisted the participant to develop a behaviour change plan (included desired benefits of change, specific goals and strategies, identification of a social support provider, anticipated barriers). At the end of the computer assessment the computer generated a summary record. For all participants this was followed by a 3-5min one-to-one health care provider (physician or nurse practitioner) counselling session (to endorse or modify the plans). After this participants were randomised to

one of four groups with each group receiving differing levels of follow-up contact (which started 1 week after the clinical encounter):

1. **No contact control**: no further contact after initial consultation
2. **Mail only**: received mail contact every 2 weeks (cover letter, age-appropriate tip sheet appropriate to the adolescent's goals).
3. **Infrequent**: mail contact every 6 weeks (similar content to mail only group), and 3 counselling phone calls (i.e. one call every 6 weeks). Calls were about 10 min in length and assessed goal achievements, praised progress, developed solutions to barriers, and revised goal where necessary.
4. **Frequent**: mail contact every 2 weeks (as for the mail only group) and weekly telephone contact (this phone contact alternated between 10 min counselling calls (as for infrequent group) and brief (1-3 min) prompt calls which acted as reminders to continue with the changes suggested the previous week in the counselling call.

Physical activity was assessed by self-report of the number of days/week they participated in at least 20 min of vigorous physical activity and the number of days/week they participated in at least 30min of moderate physical activity.

Results indicated that neither sex or participation in an extended intervention (groups 2-4) were associated with measurable improvements in behaviour beyond those provided by the PACE+ computer and provider counselling alone (i.e. group 1). The authors did not report any statistics or data for the different groups. Moderate physical activity improved over time for all participants (p=.01, 17% increase). Vigorous physical activity demonstrated a trend towards a significant increase for all participants (p=.07, 10% increase). There was evidence that participants who targeted an increase in moderate physical activity improved more over time than participants who did not target moderate physical activity behaviour (increase 1.4 days/wk vs decrease of 0.18 days/week, p = .001, *d*=.60)[6]. There was no evidence that participants who targeted an increase in vigorous physical activity improved more over time than participants who did not target vigorous physical activity behaviour (increase .4 days/wk vs increase of .41 days/week, p = .97 *d*=-.01).

[6] d = Cohen's d, a measure of effect size. 0.2=small, 0.5=moderate, 0.8=large

Kelleher et al (1999) (RNCT [-]) took place GP practices in Ireland. The intervention targeted 203 boys and girls aged 8-11 years and 111 male and female adolescents aged 12-15 years. The participants were of higher socio-economic status. No theoretical basis for the intervention was given. Twelve GP practices were randomised into one of four groups: Opportunistic/nurse (participants n=75), Recall/nurse (participants n=160), opportunistic/GP (participants n=56), Recall GP (participants n=23). In opportunistic practices it was planned to offer the lifestyle session as families visited the surgery for other reasons. These children were either invited back for a special session or given the consultation at the time. In recall practices, names and addresses were drawn up by a research nurse or GP and an invitation to attend was issued by letter. Children completed a baseline lifestyle and demographic questionnaire before seeing either GP or nurse. Participants attended a 10 minute interview which covered a checklist of topics and background educational materials were provided. Participants received an information card/wall-chart to take home. Physical activity was measured by self-report at baseline and 1 year. The actual measure was very poorly described but appears to have been a single item about exercise participation with responses of: Most days, 3x/wk, 1-2/wk, none.

In both 8-11 year olds and 12-15 year olds there was no change in the proportions reporting the different exercise frequencies (p=.294 and p=.191). Results were presented for the whole sample, and were not broken down by intervention group. The adolescents recognised that playing video games and snooker/pool were not aerobic activities. The knowledge levels of children (8-11 yrs) did not change.

5.4 Applicability

All four studies were conducted outside of the UK and are therefore directly applicable only to the populations or settings included in the studies. The likely success of application within the UK is uncertain as the level of free medical provision, GP attendance, appointment length and GP roles vary between countries.

5.5 Implementability

The studies could be implemented in the UK with appropriate adaptation to the UK primary care environment and suitable resources.

Interventions based within Primary Care: Evidence statement

There is evidence from two randomised controlled trials - one in the USA and one in Spain (Patrick et al. 2006 [++], Ortega-Sanchez et al. 2004 [-]); and one randomised non-controlled trial in Ireland (Kelleher et al. 1999 [-]) that interventions in primary care do not lead to an increase in physical activity among adolescents. One randomised non-controlled trial in the USA (Patrick et al. 2001 [-]) did show an increase in physical activity among children and adolescents. Studies involved assessment of health behaviours (usually physical activity and nutrition), development of a behaviour change plan/goal, and brief counselling from a GP or nurse practitioner. Three of the studies provided some level of follow-up support (either by mail, phone call) after the clinic visit. Studies involved male and female adolescents over 11 years old, although one study also included a younger group (8-11 yrs).

6 Interventions based in clubs out of school hours

These interventions targeted young people in the after school setting (e.g., after school clubs) or provided opportunities for physical activity during the school day (e.g., at lunchtimes, break-times or after school). Some also included a family component.

6.1 Overall summary of studies identified

Seven studies derived data from interventions conducted in the out of school hours community setting (Annesi et al., 2007; Pate et al., 2003; Robinson et al., 2003; Story et al., 2003; Taylor et al., 2006, 2007; Wilson et al., 2002, 2005), with the two papers by Taylor et al. reporting on one intervention. Some included a family component (Pate et al., 2003; Robinson et al., 2003; Story et al., 2003; Taylor et al., 2006, 2007).

The objective of three of the seven studies was the prevention of weight gain (Story et al., 2003, Robinson et al., 2003, Taylor et al., 2006, 2007). Two of the three studies targeted African-American girls. All studies targeted children 12yra or younger. None of the studies showed an effect on physical activity. One study received a [++] quality rating and the other two received a [+] quality rating.

Four of the seven studies were not focused on weight gain prevention. Of these two showed positive changes in physical activity (Wilson et al., 2005; Annesi et al., 2007). Both studies were conducted with African-American boys and girls 11 yrs or younger. One study received a [++] quality rating and the other a [-]. Two of the four studies showed no change (Wilson et al., 2002; Pate et al., 2003). These studies were conducted with African-American boys and girls 11 yrs or younger. One study received a [+] quality grading and the other a [-] grading.

6.2 Evidence of efficacy

6.2.1 Studies targeted at weight gain prevention

Story et al. (2003) and Robinson et al. (2003) are both pilot studies from the multi-site intervention – *Girls Health Enrichment Multi-site Studies (GEMS)* – in the USA. The multi-site project funded four centres to test interventions designed to prevent excess weight gain in African-American girls aged 8-10 years. Intervention sites had similar eligibility criteria and measurement tools, but were free to test different interventions.

Story et al. (2003) [RCT +] used SCT to develop a 12 week after-school programme in Minnesota called “Girlfriends for KEEPS” - ‘Keys to eating, exercising, playing and sharing’. The intervention was based on Social Cognitive Theory (see Annex C). The girls (n=54) were all in the top 25th percentile for BMI. Meetings were held twice per week for one hour and targeted key constructs from a). the environment: peer support, opportunities and role models; b). personal factors: knowledge, values and self-efficacy; and c). behaviour: practice, goal-setting, social reinforcement. A youth development, resiliency based approach was employed, acknowledging the importance of building on individual and family strengths.

Club meetings consisted of fun, culturally appropriate, interactive, practical activities, emphasising skill building and practice of the health behaviour message for that week. Messages included information about the benefits of healthy nutrition (and what to eat/drink), increasing physical activity, watching less TV, and enhancing self-esteem. Each meeting included physical activity. Incentives (e.g., water bottles, pedometers, t-shirts) were built into the programme for attendance, setting short term goals, and completing activities.

A family involvement element reinforced the after-school club messages through weekly family packets, family night events, phone calls to parents, and fridge magnets with practical suggestions about that week’s message. A control group attended monthly Saturday GEMS Club meetings. This was designed as an active placebo condition – a non-nutrition/physical activity condition focused on promoting self-esteem and cultural enrichment. Physical activity was assessed using accelerometers (worn for 3 days) and a self-report measure, the GEMS activity questionnaire (GAQ) which assessed physical activity for the previous day.

After adjustment for baseline, physical activity was consistently greater in the intervention group relative to controls at post intervention. However, differences were not significant. Our own calculation of post-intervention effect sizes showed the effects to generally be small (accelerometer counts/min: 503.7 vs 446.2 (p = .12, ES=.62); minutes MVPA 119 vs 116.1 (p=.83, ES=0.08); self-report usual day physical activity score 4.6 vs 4.3, (p=.53, ES=.26)). The authors state that the pilot study was under powered for detecting differences in the primary outcome variable of BMI. Girls in the intervention group reported significantly higher scores for physical activity preference at post-intervention compared with the control group. There were

no differences between groups at post-intervention for physical activity self-concept, sedentary activity preference, positive expectancy for physical activity, self-efficacy for physical activity and physical activity home environment.

Robinson et al. (2003) [RCT +] also conducted a pilot study from the multi-site GEMS intervention in low income areas of Oakland and East Palo Alto, California. The sample comprised 61 African-American 8-10 year old girls above the 50th percentile for BMI and with at least one overweight parent/guardian. Based on SCT, the 12 week intervention centred on increasing physical activity through dance and decreasing sedentary behaviour through a reduction of TV viewing time. Dance classes were offered 5 days/week at three community centres. Each session lasted up to 2.5 hours starting with a healthful snack, followed by 1h of homework and 45-60 minutes of MVPA (African dance, Hip-Hop, Step).

The TV arm of the intervention was labelled START ('Sisters taking action to reduce TV'). This intervention comprised five lessons delivered during home visits with participating families. Sessions involved the participating girl and any other available family member. Strategies included self-monitoring, 2-week TV turnoff, budgeting TV hours, and 'intelligent viewing'.

The control group was an active control condition whereby participants received a health education programme to promote healthful diet and physical activity patterns. Monthly community health lectures and newsletters to parents were included. Consistent with the other GEMS pilot studies Robinson and colleagues assessed physical activity using accelerometers for three days on completion of the 12-weeks of dance classes, and the self-report GAQ instrument. The GAQ reported on the previous day as well as 'usual activity'. The accelerometers collected data from 12.00h – 18.00h only.

Results showed that the mean counts per minute and minutes in MVPA increased about 7% in the intervention group. However, the adjusted difference between intervention and control groups of 55.1 counts per minute was small and not significant (*d* =.21, p=.53)[7]. The adjusted group difference for MVPA was also small

[7] d = Cohen's d, a measure of effect size. 0.2 = small, 0.5 = moderate, 0.8 = large

and not significant (7.3 minutes; *d* =.14, p= .67). Self-reported data reflected similar trends (*d* =.23, p= .38).

Despite no intervention effects for physical activity, the intervention group reported 23% less media use (TV, video, computer games) than controls, but this was small and not significant (adjusted group difference = -4.96 hrs/week, *d* =.40, p=.14), and a significant and moderate decrease in total household TV viewing (adjusted group difference = -.56 on 0-4 scale, *d* =.73, p=.007). However, as with the Minnesota GEMS pilot study reported by Story et al., Robinson et al. state that the Stamford GEMS intervention was under powered for detecting differences in the primary outcome variable of BMI and other main outcome variables.

Taylor et al. (2006, 2007) [CNRT ++] conducted a 2-year intervention with 5-12 year old children in New Zealand (n=572). Specifically, they sought to determine whether increasing extra-curricular levels of activity could reduce weight gain in children. The sample was predominantly white and middle-class. Four schools were selected for the intervention condition, and three for the control condition but random assignment was not undertaken. No theoretical framework was stated to guide the intervention protocol.

The intervention focussed on encouraging healthy eating and physical activity in children, rather than weight or obesity issues per se. The main initiative was the provision of Community Activity Co-ordinators in each intervention school. The Activity Co-ordinators sought to encourage the children to be a little more active every day, by increasing the variety and opportunities for physical activity beyond that which was currently provided in each school through break, lunchtimes, and after school. The focus was on encouraging lifestyle activity rather than structured sports. Activity Co-ordinators would run an activity session each day, and arranged community members to take sessions, set out equipment for children, and initiated games, particularly with the older children. They also encouraged increased involvement of parents and others in the community. Activity Co-ordinators were employed for 20 hours/week. Additional initiatives introduced in the second year of the intervention included activities promoting an increase in fruit and vegetable consumption, reduction in TV viewing time, and activity breaks during class-time.

Physical activity was assessed using accelerometers, worn for 1-2 days at baseline and 2-5 days at follow-up. Time in sedentary, light, moderate and vigorous activity

was recorded, with self-report values collated using a 7d recall of physical activity and TV viewing time.

Results at year 1 showed a positive effect for physical activity behaviour change. Specifically, after adjusting for baseline physical activity, age and sex, accelerometer counts per minute were 28% (95% CI: 11-47%) higher in the intervention group. This was true for physical activity during school hours (ratio INT:CON 1.38; 95% CI: 1.18-1.62) and at home (ratio INT:CON 1.20, 95%CI 1.04-1.37). Moreover, the intervention group spent less time in sedentary activity (ratio INT:CON 0.91, 95%CI .85-.97) and more time in moderate intensity physical activity (ratio INT:CON 1.07, 95% CI: 1.03-1.12). However, results at year 2 showed no effect for physical activity behaviour change. The differences in mean accelerometer scores were not significant (-75; 95% CI: -215, 65).

Self-report data showed that intervention children reported less physical activity than did control children at both 1 year (-0.2, 95% CI -0.4, -0.1) and 2 years (-0.2, 95% CI -0.4, -0.0), thus showing inconsistency with the accelerometer data. At year 1 intervention children spent 6% (95% CI 1 – 9%) less time watching TV however at year 2 there was no intervention effect for TV viewing time.

6.2.2 Studies targeted at young people regardless of weight status

Wilson et al. (2002) [CRCT -] studied 53 African-American adolescent boys and girls, aged 11-15 years. They investigated the effect of a 12-week after-school club-based intervention on increasing physical activity and fruit and vegetable intake. Specifically, participants were randomised by school to one of three arms: Social Cognitive Theory (SCT) only, SCT plus motivational intervention (SCT+MI)[8], and education only (control) condition.

The SCT intervention focussed on education, behavioural skills training, feedback and reinforcement. At baseline, participants provided information on food intake and physical activity, and were given information on serving sizes and monitoring heart rates. From week two, the focus was on increasing daily fruit and vegetable intake to 6-8 servings and physical activity to 30-60mins. Weeks 3-12 focused on a variety of

[8] MI is the abbreviation used in the original paper. It should not be confused with 'motivational interviewing', a commonly used intervention counselling method.

behavioural skills for increasing fruit and vegetable intake and physical activity (e.g., reinforcement plans, restructuring environmental cues, positive self-talk, confidence building, increasing social support, maintaining long-term behaviour-change strategies). Participants took part in an after-school intramural sports programme on three days a week.

For the SCT+MI condition, participants received the same SCT intervention plus 30 minutes of strategic self-presentation videotapes. The participant's role was to develop videotaped interviews demonstrating for 'beginners' their positive coping strategies for increasing fruit and vegetable intake and physical activity. The control/comparison group was provided with educational materials about general health-related issues for 12 weekly sessions. Accelerometers (worn for 4 days) were used to assess physical activity.

The intervention was not successful in changing physical activity. There were no significant differences in groups over time, although no statistics were reported. Interestingly, the SCT+MI condition showed a decrease in moderate physical activity (9.4%) and vigorous physical activity (29%), while the SCT condition increased in both moderate physical activity (6.1%) and vigorous physical activity (50%). The comparison group declined in both values. The study may be under powered, with only 69% remaining in the control group and attrition of 17% and 30% in the intervention groups. There were no differences in physical activity self-concept or motivation over time or between groups ($p > .05$). The SCT-MI group reported greater increases in physical activity self-efficacy than the control group ($p < .05$).

Wilson et al. (2005) [CNRT ++] conducted an after-school study to examine the effects of a 4-week student-centred intervention on increasing physical activity in 'underserved', predominantly African-American, male and female 10-12 year-olds (mean 11±0.65 yrs). The intervention was small-scale, with 28 students from the intervention school matched with 20 from another school, with no randomisation. Using self-determination and social cognitive theories (see Annex C), the intervention emphasised increasing intrinsic motivation and behavioural skills for physical activity. Specifically, adolescents in the student-centred intervention condition took part in a 2-hour intervention after school on three days each week. The participants took ownership of selecting a variety of activities and generating coping strategies for making effective physical activity behaviour change. The intervention comprised a 30 min homework-snack component, 60 min of self-selected moderate-to-vigorous

physical activity (MVPA), and 30 min of a SCT and motivational component, including self-monitoring, goal setting, and developing strategies for engaging in physical activity with family and friends. In addition, participants took part in a 'strategic self-presentation' videotape session. This is a motivational strategy involving participation in programme development, and developing a programme name and motto. Those in the control condition received 4 weeks (equivalent in hours to the intervention group) of general health education during regular school hours that did not emphasise physical activity.

Using accelerometers for 5 consecutive weekdays, there was a significant school (condition) by time interaction for moderate physical activity, MVPA and vigorous physical activity (all p<.02). Specifically, those in the intervention group increased their activity while those in the control group decreased theirs. Patterns were similar across the three types of physical activity: moderate physical activity (adjusted means[9] (SE) 99.36±5.88 vs. 72.63±5.88 min/day), MVPA (adjusted means (SE) 113.94±6.27 vs. 78.78±6.27 min/day), and vigorous physical activity (adjusted means (SE)11.33±1.07 vs. 5.31±1.07 min/day). Students in the intervention group showed a greater increase in measures of physical activity motivation and positive self-concept. There was no effect on physical activity self-efficacy or self-efficacy for behavioural skills.

Pate et al. (2003) [CNRT +] conducted the 'Active Winners' intervention to test the effects of a community-based physical activity intervention designed to increase activity and change psycho-social determinants of physical activity in rural, predominantly African-American, boys and girls (n=436) aged 10-11 years (mean 10.9±.65 yrs). The conceptual framework for the intervention was Social Cognitive Theory and Pender's Health Promotion Model (see Annex C).

The intervention comprised after school and summer activity programmes ('Active Kids'), plus home ('Active Home'), school ('Active School'), and community ('Active Community') components. The 'Active Kids' element comprised 'Fit for fun', focussing on physical fitness, where participants learnt knowledge and skills needed to be physically active and activities to enhance cardiovascular endurance and muscular strength. In addition, the 'Be a Sport' element focussed on learning skills for non-

[9] Adjusted for sex and BMI

competitive games and sports. The objectives of the 'Social Rap' element were to; understand social influences on perception of physical self and physical activity; understand barriers to physical activity; learn social skills that promote physical activity; practice respect for others; and to learn decision-making skills. 'Brain games' was a supervised study component to improve academic attainment. These activities took place in summer camps of varying duration (e.g., Summer I - 3x2wk sessions for 5hrs/day for 4 days/wk) and through after school programmes (e.g., 2 hrs after school for 5 days/week for 15 weeks).

The 'Active Home' element comprised regular newsletters, homework assignments designed to assist family members to be active with the participants, and family participation nights. 'Active School' involved a school health team and wellness committee. Both elements were designed to affect social and physical health by providing positive social influences, cues to action, and increased opportunities to be physically active. Finally, the 'Active Community' element intended to keep the community informed about the Active Winners intervention and encourage community members to be physically active.

The comparison group were another rural community who received no specific intervention. Physical activity was assessed using the validated Previous Day Physical Activity Recall (PDPAR), a self-report instrument. This was used for three consecutive school days between 15.00h and 23.30h only, and average daily number of 30 min blocks of vigorous physical activity or MVPA were the main outcome measures.

There were no significant differences in numbers of blocks of MVPA or vigorous physical activity between the intervention and comparison groups for both boys and girls ($p<.05$). Moreover, there were no changes in the hypothesised psycho-social mediators of change (intentions, beliefs, support seeking, and overcoming barriers). A comprehensive analysis was undertaken of the study through a process evaluation. A number of implementation challenges were noted, and the home, school and community components were not implemented as planned.

Annesi et al. (2007) [CNRT -] conducted an intervention with predominantly African-American 9-12 year-old girls and boys (n=241). The purpose of the intervention was to compare the effects of a 12-week physical activity and health behaviour change protocol ('Youth Fit for Life') delivered on 3 days per week through after-school care,

with a 2 days per week physical education (PE) format. Social cognitive theory was the theoretical framework adopted.

The after-school care condition was administered in a multi-purpose room by school counsellors who had received training in exercise methods. The counsellors were supported by YMCA exercise specialists for one session every two weeks. Participants took part in three sessions/week for 45 minutes, including cardiovascular non-competitive activities for 20 minutes each session, and for two of the days, 20 minutes of resistance training. The third day involved 20 minutes of reviewing various self-management and self-regulatory skills consistent with social cognitive theory (goal-setting, self-monitoring, self-talk/cognitive restructuring, recruiting social support), supplemented by a workbook. General health and nutrition information was provided in each session for about 5 minutes, supported by posters.

The PE version of the intervention was delivered by PE specialists for 2 sessions per week with components the same as in the after-school condition. However, these were delivered in the school gymnasium. Self-regulatory skills were delivered on the 4th day (therefore fortnightly rather than weekly for the after-school care condition). Therefore, the key differences between the conditions appear to be leadership (non-specialist leaders trained briefly vs. PE specialists), location (multi-purpose room vs. gymnasium), and time (3 d/wk vs. 2d/wk), although content remained similar across conditions.

Physical activity was assessed using a single item self-report measuring the number of days a participant voluntarily completed a bout of MVPA or exercise over the previous week, excluding physical activity completed during school or after-school programmes. Results showed that the number of days of voluntary MVPA per week increased significantly in both groups. The after-school group showed a small, significant increase from 2.20 to 2.91 ($p<.001$, d =.35), and the PE group a moderate increase from 2.38 to 3.13 ($p=.005$, d =.64). There were significant ($p<.05$) improvements in mood (tension and vigour subscales), and self-appraisal constructs (physical appearance, self-concept, exercise self-efficacy, and general self-scales) for both groups. The improvements in self-appraisal constructs were greater in the PE group.

6.3 Applicability

None of the studies were conducted in the UK, with the majority (6/7) involving African-Americans, therefore the interventions are not directly applicable to the UK without adaptation for different ethnic groups and cultural context.

6.4 Implementability

All of the studies can be implemented in the UK with suitable resources.

Interventions based in clubs out of school hours: Evidence statements

Interventions targeted at weight gain prevention

There is evidence from one controlled non-randomised trial in New Zealand (Taylor et al., 2006, 2007 [++]) and two randomised controlled trials in the USA (Story et al., 2003 [+]; Robinson et al., 2003 [+]) that interventions targeted at weight gain prevention through out of school hours clubs/activities do not lead to increases in physical activity in boys and girls under 12 years. Children in two of these studies were African-American.

Interventions targeted at all young people regardless of weight status

There is evidence from two controlled non-randomised trial in the USA (Wilson et al., 2005 [++]; Annesi et al., 2007 [-]) that interventions delivered during the after-school period lead to increases in physical activity in boys and girls below the age of 11 years. However, there is evidence from one cluster randomised controlled trial in the USA (Wilson et al., 2002 [-]), and one cluster non-randomised controlled trial in the USA (Pate et al., 2003 [+]) that interventions delivered during the after-school period do not lead to increases in physical activity in boys and girls below the age of 11 years. Activities undertaken during the after school period included physical activity and education sessions; behavioural skills training; and homework sessions. The after school period varied in length from 45mins to 2 hours, with frequency varying from daily to 3 times per week. Characteristics of successful and unsuccessful interventions were not obviously or consistently different, and all four studies focused on African-American children.

7 Interventions based within families and schools

These interventions targeted children at school usually through curricular based activities, however, they were included within this review where they also included a substantive non-curriculum component and/or a substantive family/community component. These might be newsletters to parents, family fun nights, family homework assignments, encouraging community facilities to open doors to young people, targeting activity at break times or after school. Curriculum could include physical education, but other aspects of the curriculum must also have been employed.

7.1 Overall summary of studies identified

Seven interventions were identified in this category. Six of the seven studies showed positive physical activity effects and one showed no effects. Four studies had a positive quality score. Three of the studies were conducted in the USA and four were conducted in non-UK European countries. None were conducted in the UK.

7.2 Evidence of efficacy

Luepker et al (1996) and Nader et al (1996) both report on the same study, CATCH (The Child and Adolescent Trial for Cardiovascular Health), a CRCT [+] assessing the physical activity outcomes of health behaviour interventions focusing on the elementary classroom and environment plus home programmes over three years. Participants were 5106 boys (51.8%) and girls (48.2%) from 96 elementary schools and were initially in third grade (8.8±0.5 yrs). Social cognitive theory guided development of the intervention materials. The intervention was conducted in the USA. The intervention had three arms: school-based, school plus family, and control. School-based participants received classroom curricula, a school food service intervention and school physical education intervention. The school physical education aimed to increase the amount of enjoyable moderate intensity physical activity during taught PE classes. School plus family participants received the school-based elements plus a home curriculum that mirrored school activities. The home curriculum required an adult to participate. Nineteen packs were taken home over 3 years and usage was rewarded with score cards to indicate the level of child/adult participation. During two years the schools also offered “family fun nights”. These involved dance performances, games and health food treats. Control participants received the usual approach to health and physical education at their school. Physical activity was measured using the self-administered physical activity

checklist (SAPAC) which assess frequency, intensity, duration and type pf physical activity.

Most of the results presented were for the combined intervention groups versus the control group. At the end of the intervention results demonstrated a non-significant difference in means for total minutes of daily physical activity between intervention and control schools (intervention=145.5 min vs. control =154.8 min)[10]. However, a significant difference was reported for mean minutes of vigorous physical activity between intervention and control schools (intervention=58.6 min vs control=46.5 min; $p < 0.003$). Despite high levels of implementation of the family component physical activity did not increase more in the school-plus-family intervention compared to the school-only intervention. The number of minutes of MVPA was related to dose of the family programme with students with moderate dose levels reporting the highest number of minutes of activity (Nader et al, 1996). No significant differences in self-efficacy and positive or negative social support were found between intervention and control schools at the end of the intervention.

Haerens et al. (2006, 2007) [CRCT +] conducted an intervention with 2991 Belgian 7th and 8th graders (mean age 13.1±0.8 yrs) whereby physical activity and nutritional behaviours were targeted. The sample included both boys (63.3%) and girls (36.7%) No theoretical basis was given for the intervention. The intervention combined mediated and environmental approaches. Specifically, the participants in the intervention groups received either the intervention plus parental involvement or the intervention alone. The intervention consisted of a fitness test plus computer tailored advice. The parental arm comprised educational input to enable parents to create a supportive home environment for physical activity and/or nutrition. For both intervention groups, schools were also encouraged to create a more supportive environment, such as through provision of breaks and support materials. The authors do not state what happened in control schools between testing periods. The Flemish Physical Activity Questionnaire was used to assess self-reported leisure-time physical activity with a subgroup (n=77) also wearing an accelerometer for 6 days. Only the boys' data are reported here as the girl's data were reported in the adolescent girls review

[10] No other data (e.g., standard deviations) were given

Haerens et al (2006) reported results using combined intervention groups. In boys, there were significant effects on levels of physical activity at the end of the two year intervention, but the effects appear context specific. For example, school related physical activity increased more in the intervention groups compared with the control group (+6.9 min/day vs +1.2 min/day, $p < .05$). However, there was no intervention effect on self-reported leisure time physical activity (intervention +2.1 min/day vs control +15.4 min/day $p>.05$). Accelerometer data revealed lower decreases in light intensity physical activity in the intervention groups compared with controls (-6 min/day vs -39 min/day, $p<.001$). MVPA was stable in the intervention group but decreased in the control group (-18 min/day). This difference approached significance ($p<.08$).

Haerens et al (2007) examined the results by gender and intervention groups (I = INT, I+P = INT + parent) after 1 year of the study. The effects for school physical activity did not vary by gender but did increase more in the I+P (22.6 min) and I groups (20.5 min) versus the control group (18.5 min, $p < .05$). There were no significant intervention effects on self-reported leisure time sports ($p>.05$). For leisure time active transport, the results varied by gender and showed that in boys there were no significant differences ($p>.05$). Accelerometer data revealed significantly ($p<.05$, $d=.54$) lower decreases in light intensity physical activity in the intervention groups (I+P = -21.5 min/day, and I = -29.2 min/day) compared with controls (-56.7 min/day). For MVPA, there was a moderate and significant difference between the I+P group and the control group ($p <.05$, $d=.46$). Specifically MVPA increased by 4 min/day in the I+P group but decreased by 7 min/day in the control group. There was no difference in MVPA between the I-group and the control group.

Simon et al. (2004, 2006) [CRCT +] evaluated the 6-month impact of a 4-year multi-level intervention on physical activity in initially 11.7±0.6 year old French adolescents (49% male). Four schools were randomised to the intervention condition (n=475) and four to the control (n=479). No theoretical basis was stated for the intervention. Psychological (knowledge, attitudes, beliefs and motivation), social (social support by parents, peers, teachers and physical activity instructors), and environmental (physical, structural and institutional) factors were targeted. In particular, new opportunities were provided during school (e.g., break times) and after school for extra physical activity, with attention being paid to reducing barriers. The control group followed their usual health and physical education curriculum. Physical activity was assessed using a self-report questionnaire yielding weekly frequency and

duration of “leisure-organised physical activity”. Time in sedentary activities (TV and computer games) was also assessed. Only the boys’ data are reported here as the girls data were reported in the adolescent girls review.

Data for the first 6 months only were reported. After correcting for baseline values of age, overweight, and parental socio-occupational status, participation in leisure-organised physical activity significantly increased from 69-81% among intervention boys compared to controls (48% to 50%; OR=1.87 $p<0.01$). There was a significant reduction of high (> 3hr/day) sedentary (screen-based) behaviour among intervention boys from 44% to 41% (OR=0.52; $p<0.0001$). There were no significant changes in self-efficacy or physical activity intentions.

Jurg et al [CNRT +] evaluated the effects of a primary school based multi-component intervention that used social and environmental supports to encourage physical activity over one year with particular focus on ethnic minority populations. The participants were 510 Dutch children aged 9-12 years old (grades 4-6; 49% male). The intervention was designed using theoretical input from the Theory of Planned Behaviour, a model of physical exercise and habit formation, the Precaution Adoption Process model, a social ecological model, and the Service Quality Model. The JUMP-in programme included: School Sports (easily accessible sports were offered to pupils in or near school and pupils were encouraged and supported to make integrated school and community choices); Pupil follow up systems (each pupil received a PE teacher delivered activity monitoring session to help them achieve a structured path to the current recommended level of physical activity for children); The Class Moves! (this programme offered regular breaks for physical activity, relaxation and posture exercises as part of normal lessons); Choose Your Card! (this was a card based game to promote physical activity at school and home. Cards focused on raising awareness on the importance of physical activity for heath, own levels of physical activity, self-efficacy, social support, planning skills, of both children and parents); Parental Information service (once a years sessions were delivered to parents to reinforce the activities delivered as part of JUMP-in with particular emphasis on the importance of regular physical activity for health; and Activity-week (parents were encouraged to participate in joint pupil/school events once a year. Events included meeting local clubs, performances, and sports activities). Control schools continued with their usual activities. Physical activity was assessed using a self-report questionnaire from which a summary physical activity score in minutes

was calculated. Minutes of activities performed at clubs or organised sports sessions were also reported as a sports score.

Descriptive results showed that minutes of overall physical activity in the control schools decreased in all grades, although the decrease was only significant in grade 6 children (-26.49 min/day, p <.01). There were non-significant increases in physical activity within intervention children in grades 4 and 5. In contrast, Grade 6 intervention children showed a non-significant decrease in physical activity of 3.52 min/day. Multilevel analysis showed that the JUMP-in intervention had a significant overall effect (all grades - β= 0.11, p<0.05) and this was largely due to prevention of a decrease in physical activity in grade 6 children (Grade 6 only - β= 0.22, p<0.001). The proportion of pupils achieving the recommended level of physical activity overall in the intervention group was odds ratio 1.63 (95% CI 1.05 to 2.51, p<0.05). This was due to the significant odds ratio reported for Grade 6 (OR 4.33 (95% CI 1.82-10.32, p<0.0001). Children in the intervention group were more than 4 times more likely to meet the recommended guidelines than control group children. The study also assessed awareness, attitude, encouragement, social modelling, self-efficacy, intention and habit but few consistent effects were found on determinants of physical activity either for the overall group or by grade. Only the perceived advantages of physical activity and habit strength was significantly higher in intervention participants in grade 4.

Christodoulos et al [CNRT -] evaluated the short term effects of a health education programme involving the family on 78 Greek schoolchildren aged 10-12.5 years (mean 11.2±0.4yrs; 54% male). No theoretical basis was given for the intervention. The intervention was school and family based with the aim of improving school and leisure time physical activity. School components included teacher led cross curriculum and PE based lessons, focusing on cooperative rather than competitive games, short pre-PE lesson health education talks and computer aided lessons. Family involvement included asking parents to support homework activities, sending educational materials home, and providing information on physical activity and nutritional guidelines. Parents were also sent information about local community based sports programmes and were encouraged to support active choices for their children's play and travel. The control group did not have any health education intervention and received their usual PE curriculum. Physical activity was assessed using self-report of moderate and vigorous physical activities undertaken at least 10

times during the past year. This yielded an assessment of total moderate to vigorous physical activity (Total-MVPA) and organised moderate to vigorous physical activities (Organised-MVPA). Organised-MVPA is a subset of Total-MVPA and comprises only leisure activities out of school, performed under the supervision of a trainer on a regular weekly basis, probably in a sports club.

Results showed that there were significant differences between the intervention and control groups reported levels of Organised-MVPA (hours/week mean ± SE; intervention =3.54±.32 vs control =2.54±.26 $p<0.05$). However there were no significant differences between groups for Total-MVPA (hours/week; intervention=7.50±.51, control=6.26±.40 $p>0.05$). There were significant within group changes in the number of pupils achieving recommended levels of physical activity between baseline and follow up (intervention =32.3% to 77.4% $p<.001$, control =26.5% to 55.1% $p<0.04$). The difference in the proportions achieving the recommendation after the intervention was significant between groups ($p < .05$). Pupils in the intervention group reported more positive attitude to physical activity and higher intentions for participation in physical activity than control pupils.

Kelder et al and Perry et al [CNRT -] report on the impact of the Class of 1989 intervention and the Minnesota Heart Health Programme (MHHP) on CVD risk profiles of young adolescents in the USA. The Class of 1989 intervention was part of the MHHP. MHHP involved 2468 initially 6th grade adolescent girls and boys over a 5 year period (1983 to 1989). The physical activity component of MHHP was delivered in conjunction with nutrition and anti-smoking initiatives using three common approaches: peer leadership, school-based programmes and community–wide activities. Intervention area schools were compared with comparison area schools. The theoretical basis was social learning theory. To coincide with the Los Angeles Olympics the physical activity component reflected this event with the “Health Olympics”. Students exchanged greeting cards with other children (from Australia, Norway and Sweden) who wrote back on their ideas for health with relationship to physical activity and smoking. The second component was an activity challenge where students were encouraged to exercise the equivalent energy expenditure as cycling 250 miles. All students received 1 hour of instruction on heart rate monitoring, choosing aerobic activities and learning safety procedures. For the following four weeks students monitored their aerobic activity, facilitated by trained peer leaders, to try and achieve their 250 mile target. Classes within intervention schools were also encouraged to exercise outside of school and competed to win

sports prizes from local shops for the highest active class. Participation was encouraged as each class received written cards from the research team. These activities were delivered from 1984-1985. The Slice of Life programme, ran from 1986-1987, and included a 7 session programme focusing on skills for healthy eating and exercise, supported by video and written materials. Students were encouraged to include planning for activity with their families. The comparison group acted as a reference community and did not receive the intervention. Physical activity was measured annually by self report of physical activity out of class. Hours per week of physical activity was assessed using a 6 item categorical scale ranging from "never" to "over 8 hours week" per physical activity. These response categories were coded to reflect the number of hours exercised per week. Frequency and duration questions were combined into an index ranging from 0 to 9. A score of 6 or greater indicated a level of activity where students regularly engaged in physical activity three times per week for at least 20 minutes, breathing somewhat harder than usual.

Comparisons were made between the intervention area and the comparison area communities at each annual survey. The results of gender specific models for hours of exercise per week showed a consistent decline in hours of exercise at each increase in grade for both intervention and comparison communities. However the decline was less severe in both genders in the intervention communities compared to the comparison community. Females in the intervention community reported significantly ($p<.05$) greater hours of exercise per week compared to females in the reference community at all but the 11th grade follow-up point. Intervention males also reported greater hours of exercising but these differences were only significant at the grade 7 and grade11 follow-up points ($p<0.05$). Females in the intervention community reported a significantly greater physical activity score than those in the reference community for 8th, 9th and 11th grade follow-up ($p<.05$). For males, the intervention community retained higher post-test mean physical activity scores, but these differences were non-significant.

Hawley et al [UBA -] evaluated the impact of a pilot community intervention programme within a rural middle school in the USA. The intervention was aimed at 6th grade students (ages 11-12 years) and 65 participated in the programme but only 25 provided measurements (64% male). The theoretical basis of the intervention was not stated. The school based programme focused on educating children and families in nutrition, fitness, goal setting, self-efficacy, and stages of change. The programme consisted of five 40 minute sessions (during PE classes) over 6 weeks.

Students were given a Family Field Guide that provided written information on starting physical activity, local opportunities etc. All students received incentives like water bottles and passes to local swimming pools. The school also organised a Family Fun Night at a local wellness centre. The physical activity measure was assessed using the self-administered physical activity checklist (SAPAC). Participants identified which of 20 activities they had engaged in for at least 15 minutes over the previous day outside of school. Activities were scored with equivalent MET values.

Results showed that there were no significant changes in students' individual physical activity behaviour from baseline to end of intervention. However, significant changes did occur among families across the 6-week intervention period. Families as a whole significantly increased their level of physical activity from a mean of 1.44 METs to 7.56 METs ($p < .01$). Over the course of the intervention there was a shift in the families (n=11) readiness for change in physical activity (e.g, the proportion of families in contemplation decreased from 21% to 0%, preparation increased from 25% to 46%, action decreased from 37% to 27% and maintenance increased from 17% to 27%). Families as a whole showed a significant improvement in fitness knowledge, but did not show significant improvements in their view of the importance of being physically active.

7.3 Applicability

All seven studies were conducted outside of the UK and are therefore applicable only to the populations or settings included in the studies. The success of broader application is uncertain particularly due to differences in education systems and curriculum demands between countries.

7.4 Implementability

All of the studies can be implemented in the UK with suitable adaptation and resources.

Interventions based within families and schools: Evidence statement

There is evidence from two cluster randomised controlled trials in Belgium and France (Haerens et al., 2006, 2007 [+]; Simon et al 2004, 2006 [+]) and three controlled non- randomised trials in the Netherlands, Greece and the USA (Jurg et al., 2006 [+], Christodoulos et al., (2006) [-], Kelder et al., 1993 & Perry et al., (1994) [-]), that interventions involving both the school and family and/or community agencies lead to positive changes in physical activity in boys and girls aged 13 or under. These positive outcomes may include an actual increase in physical activity or less of a decline in physical activity relative to controls. Successful interventions had multiple components. At the school level this included computer tailored advice, changes to the school environment, classroom sessions, physical activity sessions, and physical education. Family components included facilitating social support for physical activity, education on creating a supportive home environment, homework activities involving parents, and community sport information. One cluster randomised controlled trial in the USA (Luepker et al., 1996 & Nader et al. 2006 [+]) and one uncontrolled before and after study in the USA (Hawley et al., 2006 [-]) failed to show an effect. The characteristics of these unsuccessful interventions were not consistently different from those of successful interventions.

8 Social marketing interventions

8.1 Overall summary of studies identified

One study (Huhman et al., 2005, 2007; CNRT+) was identified that employed a 24-month social marketing campaign (VERB) in children aged 9-13 yrs (Year 1) and 11-15yrs (Year 2). By the end of year 2 significant increases in physical activity were observed. The study was conducted in the USA.

8.2 Evidence of efficacy

The primary intervention was a 24-month television advertising campaign, delivered through children's channels, such as Nickelodeon and Disney. The campaign was aimed at children aged 9-13 years and was based on principles of social marketing. The campaign employed the brand name 'VERB' and consisted of 20-30 second adverts featuring children or celebrities being active. The tag line encouraged children to "find their verb". Media time was purchased to deliver an average of 188 gross rating points (GRP)[11] per week in year 1 and 106 GRP/week in year 2. Secondary intervention components included provision of activity promotion kits for school or community groups, and an 'activity finder' on the VERB website directing children to activities in their postal (ZIP) code area. Participants were 3120 parent-child dyads, who responded to a telephone survey at baseline, 1- year and 2-years. Physical activity was assessed by self-report telephone interview. Children were asked questions about the number of sessions of 'organised' and 'free-time' physical activity on the day before the survey and in the previous 7 days.

After one year, there was no effect on the number of sessions in the past 7 days of organised or free-time physical activity for the population as a whole. However, the campaign had resulted in increased participation in free time physical activity for particular subgroups: 9-10 year old children, girls, children of parents with lower educational attainment, and children from urban areas (all $p<0.05$). Children who

[11] Gross rating points (GRPs) are an estimated percentage of the target audience exposed to advertising; they are calculated by multiplying the estimated reach of a medium (the percentage of children likely to see the adverts) by the frequency or number of times children have the opportunity to see the advertisement. With a media buy of 188 GRPs per week it was estimated that 85% of 9-13 yr olds had the opportunity to see a VERB advertisement, and that the average target audience member had the opportunity to see a VERB advertisement approx. 8.8 times throughout the month.

were 'low' active at baseline showed increases in both free-time sessions and organised physical activity. By the end of year 2, free time physical activity during the past week, and on the day before the survey had increased ($p<0.05$) for the whole population. In addition a dose-response effect was evident ($p<.05$), such that, as self-reported frequency of exposure to VERB increased, so did self-reported indicators of physical activity (free-time physical activity the previous day and median number of weekly sessions of physical activity during their free-time). There was no effect on participation in organised physical activity There was also an awareness effect of VERB on physical activity ($p<.05$) – children more aware of VERB engaged in significantly more free-time physical activity on the previous day (61.2% (CI=58.3-64.0) than children unaware of VERB (45.7% (CI=38.9-52.5). This approximated to about one more session of free-time physical activity in a typical week. Effect sizes[12] for the awareness effect on behaviour were r = 0.07 for median number of weekly sessions of free-time physical activity, r = 0.12 for physical activity on the day before the interview, and r = 0.06 for organised physical activity. The authors state that although small these effect sizes are similar to those found in other health communication campaigns, and when produced on a national scale are likely to be important. It is hypothesised that organised activity levels did not change because the campaign did not target organised sports, but rather encouraged playing "anywhere, anytime" and "by your own rules". The increase in effects at the end of year two suggests that the second year of advertising was important for sustaining the year 1 changes and producing more widespread behavioural effects.

8.3 Applicability

The study was not conducted in the UK and therefore is applicable only to the populations or settings included in the study. The success of broader application is uncertain, although there is no obvious reason why such a health social marketing campaign, with appropriate modification, would not be applicable in the UK.

8.4 Implementability

The study could be implemented in the UK with suitable resources.

[12] In this case effect size was reported as the correlation coefficient, r. 0.1 = small, 0.3 = moderate, and 0.5 = large.

Social marketing interventions: Evidence statement

There is evidence from one controlled non-randomised trial in the USA (Huhman et al., 2005, 2007 [+]) that social marketing interventions can increase levels of free-time physical activity in children and adolescents (9-15yr olds). The social marketing campaign employed engaging messages (primarily via TV advertisements) and promoted opportunities to incorporate physical activity into daily lives. The sustained nature of the campaign (2 years) was considered important to its success. Behavioural changes were seen in the activities targeted by the campaign (e.g, free-time activities) and there were no effects on participation in organised sport.

9 Focused questions

9.1 What interventions or programmes targeted at children and/or their families run by local authorities and councils are effective at increasing children's physical activity?

None identified

9.2 What non-curriculum school based interventions or programmes are effective at increasing children's physical activity?

Multi-level interventions that cross different sites and agencies are likely to be effective. For example interventions based in school with a substantive outreach to families and or community agencies were shown to be effective for promoting physical activity behaviour change. Such approaches enhance the likelihood of young people receiving consistent messages about physical activity behaviour in the different domains they engage with. There are challenges involved with making the connections between different groups and attention must be given to developing and supporting these relationships.

After-school clubs are a potentially important site for physical activity promotion but their effectiveness is uncertain. More work is needed to establish the characteristics of successful interventions in this setting.

9.3 What interventions or programmes run in private, voluntary and community sectors targeted at children and/or their families are effective at increasing children's physical activity taken either alone or with their family?

Positive evidence comes from the single study of a social marketing intervention, which showed a positive impact among 9-15yr olds. Other evidence for the effectiveness of interventions or programmes run in private, voluntary and community sectors targeted at children and/or their families was less convincing. There was little evidence for the effectiveness of interventions based in primary care and targeting primarily adolescents. The evidence for the effectiveness of community-based interventions showed that they did not lead to increases in physical activity in early adolescent boys.

10 Discussion

In discussing the evidence presented, it is important to recognise the parameters that delimit this review. First, the review sought to determine intervention effectiveness only in young people of cultural and socio-demographic background that has relevance to the UK. Second, interventions that focussed largely or entirely on school physical education lessons or the school curriculum were excluded because curriculum was not the focus of the guidance. Thirdly, interventions focusing on environmental change, active travel, adolescent girls, and children under 8 were excluded as these were dealt with by other reviews in this programme.

10.1 Overall effectiveness

Effectiveness across the 32 interventions was mixed with 47% showing positive changes in physical activity. This was also the case for the twenty interventions with strong (++) or good (+) research designs, and the twelve studies with weaker (-) designs. Although research design appears not to be associated with intervention effectiveness, it is a common theme in reviews in this field to recommend stronger research designs, including better measurement of physical activity (Salmon et al., 2007; Stone et al., 1998; van Sluijs et al., 2007). Of the interventions included in the current review, it is certainly the case that authors need to better report what they did, how they assessed physical activity and other outcomes, and to better document any process evaluation that took place.

10.2 Interventions in the family

The mixed nature of findings for interventions in the family supports the results of previous reviews (Kahn et al., 2002; van Sluijs et al., 2007). Many of the studies comprised samples that were small and ethnically homogenous, limiting the extent to which these findings can be generalised to the wider population. Despite diversity between studies, interventions in the family appear to be more successful when they promote activity that can be done in or from the family home. Constraining families to attend regular sessions at a set time seems to have a negative impact on compliance (ie attendance) and may limit the behaviour change that occurs. Proposing small and specific changes in behaviour (particularly among overweight/obese young people) and the use of physical activity information packs also appear to be useful strategies.

10.3 Interventions in the community

Only two interventions conducted in the wider community met the inclusion criteria, one of which was very poorly described and of low quality. Neither showed a positive effect on physical activity behaviour. There is no immediate or obvious reason why interventions in community groups such as boy scouts or church groups should not be successful and further research should be encouraged in this area.

10.4 Interventions in primary care

With only one high quality study concerning the primary health care setting, conclusions must be cautious. This study showed no intervention effectiveness. Two of the three low quality studies did show a positive effect. Van Sluijs et al (2007) reported inconclusive effects from two studies in this setting. In the case of the studies we included, it is difficult to ascertain whether the key issue is the setting or other features of the intervention. For example, studies targeted both physical activity and nutrition in boys and girls and used mediated and counselling approaches. Primary health care is likely to be a viable setting for health behaviour change but more needs to be known about its potential for effectiveness in physical activity with adolescents.

10.5 Interventions in clubs outside of school hours

The results of interventions based in clubs outside of school hours were mixed. All but one of the interventions targeted African American children aged 11 years or under making the applicability to the UK setting uncertain. There is no immediate or obvious reason why interventions in after school clubs should not be successful, particularly when integrated within broader promotion initiatives. Further research should be encouraged in this area.

10.6 Interventions based in families and schools

Interventions based in schools with a substantive outreach to the family appear to be successful in facilitating at least short term change in physical activity in children and preadolescents. There is little evidence demonstrating the impact of the family component over and above any impact from the school component. Research in this area would be useful, so that the added value of the family component can be

maximised. All of the interventions in this category targeted children or pre-adolescents (13 or under) so the effectiveness for older adolescents is uncertain It may be that as children get older they will be less interested/willing to engage with this approach. A number of the studies noted challenges in getting parents/families involved and this is an area which needs attention.

10.7 Social marketing interventions

Only one social marketing intervention (VERB) was reviewed and therefore conclusions must be drawn with caution. The VERB campaign employed engaging messages (primarily via TV advertisements) and promoted opportunities to incorporate physical activity into daily lives. In the first year VERB had little effect on behaviour change but after two years positive physical activity behaviour change was seen at all ages (9-15 year olds) demonstrating the importance of sustained interventions using this approach. Behavioural changes were seen in the activities targeted by the campaign (e.g, free-time activities) and there were no effects on participation in organised sport. This finding suggests that there is minimal generalisation of messages and if change is wanted in a broad range of activities (e.g., sport, free time and active travel) then a broad range of activities will have to be explicitly targeted.

10.8 Limitations of the studies reviewed

Few of the studies reviewed included a follow-up period and therefore it is not possible to comment on how sustainable any changes in behaviour were or to report on what strategies facilitate long-term change. Shepherd and Trudeau (2000) recommend that there is at least a 1-2 year follow-up to determine maintenance effects. Reilly and McDowell (2003) suggest that as short-term lifestyle change is relatively easy to facilitate and long-term change more difficult, short-term studies will be prone to bias.

Several of the studies were either described as under-powered or were likely to be underpowered due to small initial sample size or attrition. If too few subjects are used, an intervention may have such low power that there is little chance to detect a significant effect even when it exists.

Measurement of physical activity outcomes varied. Many studies using self-report instruments did not report any reliability or validity information. In addition, self-report measures often assessed only one aspect of physical activity (e.g., number of days

per week you exercise). As frequency, duration and intensity are all important components of physical activity recommendations it is crucial that where self-report instruments are employed that they assess all these components. Further there is the issue of whether self-report measures are sensitive to behaviour change (Salmon et al., 2007).

There was limited reporting of intervention fidelity (e.g., participant attendance, compliance of those delivering the intervention with implementation protocol, quality assurance) making it difficult, if not impossible, to determine why interventions may have been effective or ineffective (van Sluijs et al., 2007). For example, it may be that unsuccessful interventions were unsuccessful because the intervention was not implemented as planned, rather than the intervention itself being ineffective.

11 Conclusion

Interventions based in school with a substantive outreach to families and/or community agencies are likely to be effective in promoting short-term physical activity behaviour change. Such approaches enhance the likelihood of young people receiving consistent messages about physical activity behaviour in the different domains they engage in. Further high quality research exploring the effectiveness of interventions in other community settings (e.g., youth groups, boy scouts, after-school care) is warranted. Further evidence for the sustainability of interventions promoting physical activity is needed.

12. Evidence Tables

Evidence Table 1: Interventions based within the family

First author & date	Study design & quality	Setting	Research question	Study population, country, sample size	Description of intervention	Length of follow-up	Physical activity outcome variables (inc measures)	Main results	Non physical activity outcomes	Confounders / potential sources of bias	Applicability to the UK
Rodearmel et al (2007)	RCT (++)	Home	To assess the effectiveness of a lifestyle intervention targeting all members of the family for weight gain prevention in at risk youth	Families with overweight or at risk of overweight children USA Mean (SD) age (yrs): Int = 11.11 (2.08) Con = 11.28 (2.29) N = 218 (N Int = 116, N Con = 102) Int = 52% White, 14% Black, 14% Hispanic, 20% 'Other' Con = 51% White, 19% Black, 13% Hispanic, 16% 'Other'	6 months duration Lifestyle modification intervention with 2 strands: Increase walking by 2000 steps/day above baseline, and eliminate 420 kJ/day from normal diet (through the replacement of dietary sugars with a non-calorie sweetener All members of the family were requested to follow the programme	none	Number of steps per day Pedometer (participants reported number of steps/day during weeks 1 and 2 (baseline) and weeks 2-18 and 24 (follow-up)	Int children reported significantly more steps/day during follow up than Con ($P<0.05$). Figures not reported Int parents also reported significantly more steps/day during intervention than Con parents ($P<0.05$). Figures not reported	No secondary outcome measures	Programme was jointly sponsored by McNeil Nutritionals	Few resources and staffing required as minimal intervention. High applicability as study applied across different cultural groups.

First author & date	Study design & quality	Setting	Research question	Study population, country, sample size	Description of intervention	Length of follow-up	Physical activity outcome variables (inc measures)	Main results	Non physical activity outcomes	Confounders / potential sources of bias	Applicability to the UK
Beech et al (2003)	RCT (+)	Not stated – likely community centres	To evaluate the effectiveness of parent (PT) or child (CT) targeted weight gain prevention interventions in African American girls	African American girls at or above the 25th percentile of age- and sex-specific BMI USA Mean (SD) age (yrs): CT = 8.7 (0.8) PT = 9.1 (0.7) Con = 8.9 (0.8) N = 60 (CT N = 21, PT N = 21, Con N = 18)	Social Cognitive Theory 12 weeks duration CT: 12 x 90 min sessions (physical activity (Hip Hop aerobics) and nutrition components) PT: 12 x 90 min sessions (physical activity (dance), nutrition education, food preparation, nutrition-related games components) Con: 3 x 90 min sessions to enhance and prevent declines in self-esteem	none	Accelerometry (counts/min; mins MVPA) and MET adjusted usual activity CSA Accelerometer (worn for 3 days); GEMS Activity Questionnaire (GAQ) (self-report)	No significant differences post intervention. Accelerometer counts/min difference post intervention; Mean (SE) PT vs. Con = 31.6 (24.95) (P=0.21) CT vs. Con = 13.7 (25.18) (P=0.59) PT vs. CT = 18.0 (24.42) (P=0.47) Minutes MVPA (12pm – 6pm) difference post intervention; Mean (S.E.) PT vs. Con = 11.3 (11.85) (P=0.35) CT vs. Con = 4.45 (11.82) (P=0.71) PT vs. CT = 6.81 (11.75) (P=0.56) GAQ, met adjusted usually score difference post intervention; Mean (SE) PT vs. Con = 0.38 (0.67) (P=0.58) CT vs. Con = 0.29 (0.67) (P=0.67) PT vs. CT = 0.09 (0.06) (P=0.89)	Slight increase in physical activity preference for girls in the CT group versus Con (P=0.04). No significant differences in physical activity self-concept, sedentary activity preference, positive expectancy for physical activity or self-efficacy for physical activity.	Pilot study with low statistical power	Intervention format likely to be applicable, content would need modification for other ethnic groups. Resource/ staffing costs high: moderate applicability

First author & date	Study design & quality	Setting	Research question	Study population, country, sample size	Description of intervention	Length of follow-up	Physical activity outcome variables (inc measures)	Main results	Non physical activity outcomes	Confounders / potential sources of bias	Applicability to the UK
Baranowski et al (2003)	RCT (+)	Summer day camp and home	To test the effectiveness of a 12 week pilot obesity prevention intervention in healthy African American girls	African American girls at or above the 50th percentile of age- and sex specific BMI USA Mean (SD) age (yrs): Int = 8.3 (0.3) Con = 8.4 (0.3) N = 35 (Int N = 19; Con N = 16)	Social Cognitive Theory 12 weeks duration 4 wks: summer day camp (approx 9 hrs / day) (buddy groups, decision making skills, problem solving, asking behaviours, dance lessons, educational games, goal setting) 8 wks: home-internet programme for parents and children (problem solving, weekly challenges, web links, questions answered, parental modelling) Con: attended summer camp following the usual programme and completed a low-intensity internet-based component with links to general health and homework	none	Accelerometry (counts/min; mins MVPA) and MET adjusted usual activity CSA Accelerometer (worn for 3 days), GEMS Activity Questionnaire (self-report)	No significant differences in PA post intervention Accelerometer counts/min (24 hrs); Mean (SD) Int = 369.9 (22.0), Con = 364.0 (25.8), (P=0.86) Accelerometer minutes of MVPA; Mean (SD) Int = 67.5 (7.6), Con = 74.8 (8.9), (P=0.54) Accelerometer counts/min (12pm – 6pm); Mean (SD) Int = 606.2 (40.1), Con = 597.9 (46.9), (P=0.89) MET adjusted GAQ-usually; Mean (SD) Int = 5.1 (0.4), Con = 4.3 (0.5), (P=0.19)	No difference between Int and Con group physical activity preference post intervention (P=0.62)	Pilot study with low statistical power Girls in the Con group had higher BMI at baseline than Int girls (P<0.01) Participation in the home component was low – less than 50% of Int sample logged onto the website	Intervention format likely to be applicable, content would need modification for other ethnic groups. Resource/ staffing costs high: moderate applicability

First author & date	Study design & quality	Setting	Research question	Study population, country, sample size	Description of intervention	Length of follow-up	Physical activity outcome variables (inc measures)	Main results	Non physical activity outcomes	Confounders / potential sources of bias	Applicability to the UK
Nader et al (1992)	RCT (+)	School and home	To assess the effectiveness of a cardiovascular disease risk reduction intervention targeting Anglo- (AA) and Mexican (MA) American families	Anglo- and Mexican American families with 5th or 6th grade children USA Mean (SD) age (yrs): AA int = 12.1 (1.9) MA int = 12.1 (1.7) AA Con = 11.8 (1.4) MA Con = 12.0 (1.7) N = 323	Social Cognitive Theory 1 year duration 18 x 90 min physical activity and nutrition education sessions (self-monitoring, goal setting, problem solving, self-rewarding goal achievement, social support) Tapered intensity: 3 months intensive intervention (12 sessions) followed by 9 month maintenance period (6 sessions)	1, 2, 3 years	Energy expenditure in kilocalories per kilogram body weight per day Physical Activity Recall (interviewer administrated)	Small increase in Energy Expenditure from PA in Anglo-American boys at 24 (P=0.020) and 48 (P=0.021) month follow-up only. Energy Expenditure (Kilocalories per kilogram bodyweight per day) difference score; Mean (SE) AA boys; 3 months = -0.10 (0.26) (non-significant, P value not reported), 24 months = 1.76 (0.85) (P=0.020), 48 months = 2.23 (1.1) (P=0.021) AA girls; 3 months = -0.3 (0.87) (non-significant, P value not reported), 24 months = 1.38 (0.98) (P=0.079), 48 months = -2.66 (1.23) (non-significant, P value not reported) MA boys; 3 months = -1.11 (0.64) (non-significant, P value not reported), 24 months = -0.78 (0.77) (non-significant, P	No secondary outcome measures	Participants were self-selected volunteers	Long term intervention, high staffing/ resource costs, content likely to need modification for other ethnic groups. Moderate applicability

								value not reported), 48 months = -3.06 (0.94) (non-significant, P value not reported). MA girls; 3 months = -1.92 (0.57) (non-significant, P value not reported), 24 months = -1.17 (0.69) (non-significant, P value not reported), 48 months = -1.61 (0.90) (non-significant, P value not reported)			

First author & date	Study design & quality	Setting	Research question	Study population, country, sample size	Description of intervention	Length of follow-up	Physical activity outcome variables (inc measures)	Main results	Non physical activity outcomes	Confounders / potential sources of bias	Applicability to the UK
Ransdell et al (2004)	RCT (+)	Home	To evaluate a 6 month home based intervention to increase physical activity in 3 generations of women	Grandmother, mother and daughter triads USA Mean (SD) age (yrs): Int = 10.75 (1.42) Con = 9.42 (1.51) N = 51 (Int N = 30 (10 girls), Con = 21 (7 girls) Int = 89% white, 11% 'other' Con = 86% white, 14% 'other'	6 months duration Int group attended 2 x 2 hour introductory sessions – instructed on how to complete study measure and how to use the information pack. Participants received a home information pack comprising a calendar of recommended activities, photos of strength and flexibility-training activities, a schedule for completing an activity log, pedometer, and paid return envelopes Participants requested to undertake 3 structured exercise bouts per week	none	Days per week of aerobic activity, steps per day The Physical Best Physical Activity Questionnaire (self-report), Yamax Pedometer Aerobic fitness, muscular strength and endurance, flexibility	Participants in the Int group significantly increased pedometer assessed steps per day compared to the Con group (P=0.001) Pedometer steps/day % change (pre to post); Int = +37%, Con = -13% (P=0.001) Aerobic Activity % change (pre to post); Int = +107%, Con = -37% (P=0.03) Muscular strength days/week % change (pre to post); Int = +209%, Con = +20% (P=0.05) Flexibility days/week % change (pre to post); Int = +305%, Con = -15% (P=0.000)	No secondary outcome measures	Very small sample – only 10 girls in the Int group PA outcome data collapsed across daughters, mothers and grandmothers High drop out in Con group (43% completed pre and post testing)	Intervention content and format likely to transfer well, small, biased sample is a problem – may be less effective with lower SES groups. Moderate applicability

First author & date	Study design & quality	Setting	Research question	Study population, country, sample size	Description of intervention	Length of follow-up	Physical activity outcome variables (inc measures)	Main results	Non physical activity outcomes	Confounders / potential sources of bias	Applicability to the UK
Rodearmel et al (2006)	RCT (+)	Home	To assess the effectiveness of a lifestyle intervention targeting all members of the family for weight gain prevention in at risk youth	Families with overweight or at risk of overweight children USA Mean (SE)age (yrs): Int boys = 9.8 (0.2) Con boys = 9.9 0.2) Int girls = 10.1 (0.2) Con girls = 9.9 (0.4) N = 88 (Int = 68, Con = 20)	12 weeks duration Lifestyle modification intervention with 2 strands: Increase walking by 2000 steps/day above baseline, and consume 2 servings per day of ready to eat cereal. All members of the family were requested to follow the programme	none	Number of steps per day Pedometer (participants reported number of steps/day for all weeks of the intervention. week 1 = baseline; weeks 2-14 = follow-up)	Int boys and girls increased steps/day significantly compared to Con participants (P<0.05) Steps/day; Mean (SE) Specific P values not reported Int boys Pre = 9553, Post = 11482. Con boys Pre = 9428, Post = 9646. Significant increase for Int boys Pre to Post (P<0.0001), and Int group significantly different to Con group post intervention (P<0.05) Int girls Pre = 8347, Post = 10054. Con girls Pre = 10104, Post = 9551. Significant increase for Int girls Pre to Post (P<0.0001), and Int group significantly different to Con group post intervention (P<0.05)	No secondary outcome measures	The programme was jointly sponsored by Kelloggs Company	Minimal intervention, few resources and staffing required. Likely applicable across cultures. High applicability

First author & date	Study design & quality	Setting	Research question	Study population, country, sample size	Description of intervention	Length of follow-up	Physical activity outcome variables (inc measures)	Main results	Non physical activity outcomes	Confounders / potential sources of bias	Applicability to the UK
Baranowski et al (1990)	RCT (-)	Community-centres	To assess the effectiveness of a centre-based intervention to increase aerobic activity in African American families	African-American families USA Mean age (yrs): Int = 10.6 Con = 10.9 (SD / SE not reported) N = 120 (Int N = 64; Con N = 56)	Social Cognitive Theory 14 weeks duration Education session: 14 x 90 min evening sessions in 4 parts (behavioural counselling, small group education, aerobic activity, healthy snack) Fitness centre session: provided opportunities to partake in a variety of activities – aerobic dance, walking, jogging, aerobic weight lifting, bicycling Participants encouraged to attend 1 education session and 2 additional fitness sessions per week.	none	Energy expenditure per week in METS and Kcals Stanford seven day recall, frequency of aerobic activity form (self-report)	For children, energy expenditure in METS and Kcals increased more from pre to post testing in Con versus Int participants (P<0.01) Specific P values not reported Energy expenditure per week (METS); Mean (SD) Int Pre = 238.1 (22.3), Post = 231.2 (14.3) Con Pre = 231.2 (12.0), Post = 237.2 (21.8) (P<0.01) Energy expenditure per week (kcals); Mean only Int Pre = 9559, Post = 9684 Con Pre = 10226, Post = 11031 (P<0.01)	No changes in psychological variables – knowledge and self-efficacy (data not reported)	Participation was low – average attendance at intervention sessions was 28%	Intervention format likely to be applicable, content in need of modification for other ethnic groups. Provision of facilities may be problematic. High staffing and resource costs . Low applicability

First author & date	Study design & quality	Setting	Research question	Study population, country, sample size	Description of intervention	Length of follow-up	Physical activity outcome variables (inc measures)	Main results	Non physical activity outcomes	Confounders / potential sources of bias	Applicability to the UK
Ransdell et al (2003a; 2003b; 2004)	RNCT (+)	Home and Community (university)	To compare home (HB) and community (CB) based interventions promoting physical activity in mothers and daughters	Mothers and Daughters USA Mean (SD) age (yrs): Int = 15.2 (1.23) Con = 15.7 (1.50) N = 40 (N daughters = 20, N mothers = 20)	Social Cognitive theory 12 weeks duration HB: Participants received a home information pack comprising a calendar of recommended activities, photos of strength and flexibility-training activities, a schedule for completing an activity log, pedometer, and paid return envelopes CB: 2 x fitness sessions (aerobics, weight raining) and 1 x lifestyle activity (rock climbing, skiing) per week	none	Days per week of aerobic, resistance and/or flexibility exercise Fitnessgram Physical Activity Questionnaire (self-report) Parental bonding, physical self-perceptions, family and physical activity participation scale, aerobic fitness, muscular strength and endurance.	Daughters in both groups significantly increased (days/wk) their participation in aerobic (P=0.02), resistance (P=0.001) and flexibility (P=0.000) activity Aerobic activity (d/wk); Mean (SD). CB Pre = 2.25 (1.62), CB Post = 4.30 (1.16). HB Pre = 2.00 (1.82) HB Post = 2.71 (1.88). Sig increase for both groups (P=0.02, Eta^2=.33) Resistance activity (d/wk); Mean (SD). CB Pre = 0.95 (1.12) CB Post = 2.40 (1.27) HB Pre = 1.29 (1.80) HB Post = 3.21 (1.86). Sig increase for both groups (P=0.001, Eta^2=.53) Flexibility activity (d/wk); Mean (SD). CB Pre = 2.15 (2.33) CB Post = 4.00 (1.76) HB Pre = 1.00 (1.15) HB Post = 4.86 (1.22)Sig increase for both groups (P=0.000, Eta^2=.58)	Daughters in both HB and CB groups perceived mothers as being more controlling (Parental bonding instrument – caring and controlling subscales) at post intervention (P=0.04) Improvements in perceived sports competence and perceived body attractiveness for daughters (and mothers) in both HB and CB groups (P<0.01) Specific P value not reported	CB group attended 77% of intervention sessions HB group completed 70% of recommended session Participants were self-selected volunteers and predominantly white, wealthy and well-educated	Intervention format and content likely to be applicable. Relevance to lower SES groups primary obstacle. Moderate applicability

First author & date	Study design & quality	Setting	Research question	Study population, country, sample size	Description of intervention	Length of follow-up	Physical activity outcome variables (inc measures)	Main results	Non physical activity outcomes	Confounders / potential sources of bias	
Salminen et al (2005)	CNRT (+)	School and home	To evaluate the effectiveness of a health education / counselling intervention targeting children with familial history of cardiovascular disease	Children with a familial history of early onset cardiovascular disease Finland Mean (SD) age (yrs): Int boys = 10.7 (3.0) Int girls = 10.9 (2.9) Con1 boys = 11.4 2.9) Con1 girls = 11.9 (2.9) Con2 boys = 11.5 (2.8) Con2 girls = 11.7 (2.7) N = 1238 (Int N = 515, Con1N = 245, Con2 N = 523)	Approx. 3 years duration 5 health education / counselling sessions (2 delivered in school, 3 delivered at home) Sessions covered a range of issues including diet and nutrition, exercise, smoking, drugs and alcohol. Sessions involved risk assessment, provision of information and goal setting. Participants also received printed materials (adult / child specific) from the Heart Disease Association of Finland	none	Frequency (boys only) and intensity (girls only) of exercise (self-report) Data collection tool not described in detail	Significant increases in frequency of exercise (boys only P=0.001) and intensity of exercise (girls only P=0.030) for Int group at follow up Cumulative odds ratios for boys: Baseline Con1 vs. Int = 0.66, Con2 vs. Int = 0.68; Follow-up Con1 vs. Int = 1.49, Con2 vs. Int = 1.06. Interaction P=0.001 Cumulative odds ratios for girls: Baseline Con1 vs. Int = 0.47, Con2 vs. Int = 0.52; Follow-up Con1 vs. Int = 0.97, Con2 vs. Int = 1.08. Interaction P=0.030	No secondary outcome measures	Validity and reliability of physical activity outcome measure unknown	Format and content of intervention likely to be transferable. Provision of staffing may be problematic. High applicability

First author & date	Study design & quality	Setting	Research question	Study population, country, sample size	Description of intervention	Length of follow-up	Physical activity outcome variables (inc measures)	Main results	Non physical activity outcomes	Confounders / potential sources of bias	Applicability to the UK
Cookson et al (2000)	UBA (-)	Home	To evaluate the HeartSmart Family Fun Pack – a home based physical activity, nutrition and smoking intervention targeting children	Families with children Canada No age data Pre-Int N = 1387 Post-Int N = 300	Stages of change HeartSmart was promoted through a media campaign. Families ordered the intervention pack by phone. The intervention was a home-based, mail delivered information pack for parents and children comprising games, posters, children's health quiz, brochures and growth chart	none	Frequency of active play Parental proxy of child activity obtained by telephone interview	Proportion of parents reporting their child participated in active play 1-2 days per week or less decreased from 22% at pre-test to 11% post-test. Percentage of parents reporting that their child took part in active play once a day or more increased from 28% at pre-test to 55% at post test. Pre-test vs. Post-test: x^2= 83.08, P<0.001	Proportion of parents expressing concerns about their child's weight and / or physical activity decreased from 31% at Pre-test to 19% at Post test, P=0.001	Physical activity assessment was poor Participants were self-selected volunteers	Basic intervention format broadly applicable. Mode of delivery and content of media campaign not described. Ethnicity and SES of participants unknown. Moderate applicability.
Ransdell et al (2001)	UBA (-)	University campus	To evaluate the effectiveness of a family based intervention to increase physical activity in mothers and daughters	Mothers and daughters USA Mean (SD) age (yrs): Daughters = 13.9 (1.5) Mothers = 40.7 (6.4) N = 26 (N mothers = 12, N daughters = 14) 70% White, 30% Hispanic/Chicana	Social Cognitive Theory 12 weeks duration 24 x 90-120 min session (1 recreational activity session and 1 classroom-based education session per week) Participants also requested to increase lifestyle activity (e.g. active commuting) and undertake 1-2 additional exercise sessions per week Participants received monthly newsletters for 6 months post-intervention	6 months	Days per week of physical activity Modified version of Behavioural Risk Factor Surveillance Survey (self-report)	No changes in days/week exercise for daughters at post intervention or 6 month follow up. Days/week of exercise; Mean (SE) Daughters Pre intervention = 2.6 (0.73), Post intervention = 3.6 (0.50), 6 months = 3.3 (0.051) No statistical values reported	Improvements in perceived sports competence (P=0.01), perceived strength and muscularity (P=0.006), and perceived physical condition (P=0.005) at follow up (mother and daughter data collapsed)	Attendance at intervention sessions was approx. 65% Physical activity measure lacked sensitivity Participants were mid to high socio-economic status	Intervention format broadly applicable, content likely to need modification for other ethnic groups. Staffing and resources costs low. Moderate applicability

Evidence Table 2: Interventions based within the community

First author & date	Study design & quality	Setting	Research question	Study population, country, sample size	Description of intervention	Length of follow-up	Physical activity outcome variables (inc measures)	Main results	Non physical activity outcomes	Confounders / potential sources of bias	Applicability to the UK
Jago et al (2006)	CRCT (+)	Community – Scout troops	To assess the immediate and long-term effect of a Boy Scout based physical activity intervention using limited troop time and an internet programme targeting physical activity self-efficacy and preference change	10- to 14- year old Boy Scouts USA Mean (SE) age (yrs): 13 (0.1) Predominantly Anglo-American N = 473 (Int N = 240; Con N = 233)	9 weeks duration Delivered in two waves (Spring and Autumn) 9 x 20 min sessions during Troop meetings: knowledge component introduced boys to different types of activity, intensity, safety guidelines, weightlifting, asking skills and how to maintain physical activity. Activity component introduced boys to various sports related activities: flexibility for basketball, baseball drills Website: Comic-book programme to develop problem-solving, decision-making and negotiation skills. Asked to log-on to the website at least twice a week Con: Participants received a mirror image fruit and vegetable intervention	6 months	Minutes of sedentary, light and moderate-to-vigorous physical activity per day, and accelerometer counts per minute. MTI accelerometer (3 days)	Int participants in the Spring wave, increased light PA at the end of the intervention (mean mins (SE) 143.6 (4.9) at baseline, 155.9 (4.9) at end, p=0.011) but there was no significant difference at 6m follow-up (136.2 (5.3) p>0.05). Int participants from the Spring wave only, showed a trend towards decreased sedentary behaviour at the end of the intervention (mean mins (SE) 908.4 (6.2) at baseline, 896.3 (6.3) at end, p=0.051) but there was no significant difference at 6m follow-up (912.2 (6.7) (P>0.05). There were no effects on light PA (baseline: 136.7 (4.2), end: 129.9 (3.9), 6-months: 136.1 (4.5) or sedentary behaviour (baseline 919.5 (5.4), end 925.9 (4.9), 6 months 916.7 (5.7)) in the autumn wave. There were no effects on MVPA in either the spring (baseline 27.1 (2.2), end 25.3 (2.2), 6m	PA preferences were greater (p < .001) at end of intervention and at 6 month follow-up irrespective of intervention group or wave. There were no differences in physical activity self-efficacy for group or wave at any time point	Approx. 75% of Int and 78% of Con participants logged on to the website at least once a week Participant drop-out was higher amongst participants from low SES families or those with higher BMI	International nature of scouts may help applicability. No clear barriers to 'translation' from US tp UK. High applicability.

								29.4 (2.4)) or autumn (baseline 23.9(1.9), end 24.1 (1.7), 6m 27.2 (1.9)).			
First author & date	Study design & quality	Setting	Research question	Study population, country, sample size	Description of intervention	Length of follow -up	Physical activity outcome variables (inc measures)	Main results	Non physical activity outcomes	Confounders / potential sources of bias	Applicability to the UK
Baxter et al (1997)	CNRT (-)	Community	To evaluate the effects of a community-based heart health intervention on coronary heart disease lifestyle risk factors in school children aged 11 and 14	11 and 14 year old school children UK Aged 11 years at baseline Int N = 259 at follow-up	3 year duration – targeting community and schools "Action Heart" - School – various aspects, including policy, Action Heart Charter, My Body project, peer led projects Intervention components are unclear and not described in detail	3 years	"Exercise 3 or more times weekly" No information on measurement tool used	**Only boys data reported – Girls data were reported in the adolescent girls review** There were beneficial changes in reported exercise in the intervention schools. The percentage of pupils undertaking 3 or more bouts of exercise per week increased by 11% in the Int group and 6% in the Con group. No tests of statistical significance reported. Overall odds ratio for boys and girls combined showed a negative effect for the intervention (OR = .65) (ie they were less active than controls at the end of the intervention)		Intervention not described in sufficient detail Validity and reliability of physical activity assessment tool unknown	High as intervention was in the UK

Evidence Table 3: Interventions based within primary care

First author & date	Study design & quality	Setting	Research question	Study population, country, sample size	Description of intervention	Length of follow-up	Physical activity outcome variables (inc measures)	Main results	Non PA outcomes	Confounders / potential sources of bias	Applicabili the UK
Patrick et al (2006)	RCT (++)	Primary care and home elements	The PACE+ intervention was designed to promote adoption and maintenance of improved eating and PA behaviours through a computer-supported intervention initiated in primary health care settings.	Adolescents aged 11-15 Mean (SD) at baseline 12.7 (1.3) yrs USA INT N=424 – girls = 222, boys = 202 CON N = 395 – girls = 216; boys 179	Social Cognitive Theory. Transtheoretical Model. INT: 2 components. Primary care – computer assessment of key diet / PA behaviours and stage of change. Computer then guided the adolescent to develop stage appropriate and tailored behaviour change progress plans for one nutrition and one PA behaviour, computer then generated a summary record. This was followed by a 3-5min one to one health care provider counselling session (to endorse or modify the plans and encourage full participation). Home element – 12 month duration. Printed 'teen guide' containing information/worksheets on diet and PA issues, and advice on modifying behaviour. Supported with postal prompts and advice. 11 telephone counselling calls over 12 months 10-15 min duration. CON: comparison condition addressing sun exposure protection. Primary care component followed similar procedures. Home element was reduced (phone calls at 3 and 6 months, followed by mailed feedback report and tip sheet). Participants received incentives for completing measurement sessions	none	Self-report 7-Day PAR (by interview) – analysed days/wk obtained >30 minutes VPA, >60mins MPA, or >60mins MVPA Accelerometer CSA WAM 7164 – 7 days analysed as min/day of MVPA	**BOYS ONLY – girls reported in Adolescent girls review** **Self-report:** Compared to CON, INT boys increased their number of active days/week (from 4.1±2.0 days/wk to 4.4±2.1 days/wk, cf CON 3.8±2.1 days/wk to 3.8±2.1 days/wk, which represents 7.3% change in INT vs 0% change in CON, p= .01). Min/wk MVPA increased in both groups (INT 418.4±54.5 increased to 486.0±75.3 cf CON 374.0±55.0 increased to 419.8±79.2 which represents a16.2% change in INT and a 12.2% change in CON). The difference between groups was not significant (p=.17) **Accelerometers** (n=150) MVPA min/day was not different between groups (72.8±3.4 min/day vs 71.3±3.3 min/day, p=.76)	INT reduced sedentary behaviours by about 1hr/day (compared with no change in CON) (p=.001)	Sub-sample only assessed using accelerometer	Limited. Applicable USA population settings included in study (broa application uncertain)

First author & date	Study design & quality	Setting	Research question	Study population, country, sample size	Description of intervention	Length of follow-up	Physical activity outcome variables (inc measures)	Main results	Non PA outcomes	Confounders / potential sources of bias	Applicabili the UK
Ortega-Sanchez et al, 2004	RCT blocked on age and gender (-)	Primary care – family physicians offices	To examine whether advice about exercise provided to adolescent patients by their physicians in the office was effective in increasing or maintaining the adolescents' current levels of PA	Middle class adolescents aged 12-21 yrs (mean 17±2.4 yrs) Spain N =448 (261 boys, 187 girls) INT n=222 CON n=226	Participants answered questions from the physician about their PA and were classified as Active, partially active, or inactive. INT Group: received brief counselling from their physician based on current PA behaviour. Active participants were provided with counselling to maintain their current levels of activity. Partially active participants were provided with counselling to increase their current activity levels. Inactive participants were provided with counselling to begin exercise Counselling sessions took 5-10 minutes. No training was provided to physicians, but they received written guidance on how to provide the 3 types of counselling. PA assessment and counselling occurred at baseline. At six months participants were reclassified as active, partially active or inactive and provided with the appropriate, corresponding counselling. Only PA assessment occurred at 12 months. CON Group: provided with no intervention	6 months	Self-report of PA outside of school. Asked about frequency, duration and intensity	**6 months results:** INT had 36.8% more active adolescents (p=.008), 34% higher duration (p=.016), 26.9% higher frequency (p=.01) and 17.6% higher intensity (p=.007) in exercise and/or sports than CON. INT group duration increased 36.8 min/wk (95% CI: -0.9 to 74.5 min/wk; p =.06); Frequency increased .49 days/wk (.12 to .86 days/wk; p =.01); Intensity increased .28 points (.07 to .49 points p=.01) CON group duration decreased 28.1 min/wk (-65.7 to 9.5 min/wk; p =.14); Frequency decreased .19 days/wk (-.55 to .18 days/wk; p =.31). Intensity decreased .11 points (-.31 to .09 points p=.27) **12 months results:** INT had 42.7% more active adolescents (p=.003), 48.9% higher duration (p=.002), 34.4% higher frequency (p=.002) and 30.3% higher intensity (p<.001) in exercise than the control group. INT group duration increased 48.3 min/wk (10.1 to 86.5; p =.01); Frequency increased .71 days/wk (.34 to 1.08 p =. 001).	None reported	Non-validated self-report measure (participants may want to be seen to follow advice) High dropout rate (29.4%) but similar across INT and CON 40% of physicians dropped out	Good poter for applica of the interventio main barrie likely to be physician / primary ca staff time a resources

								Intensity increased .33 points (.12 to .54 points p=.002) CON group duration decreased 36.6 min/wk (-75.1 to 2.0; p =.06); Frequency decreased .13 days/wk (-.50 to .25; p =.50). Intensity decreased .20 points (-.41 to .01 points p=.06) The INT group had a significantly greater proportion classified as active at both 6months and 1 year (p = .002). The between group differences were greatest at one year (46.1% vs 33.7%) vs 6 months (49.8% vs 34.9%).			

First author & date	Study design & quality	Setting	Research question	Study population, country, sample size	Description of intervention	Length of follow-up	Physical activity outcome variables (inc measures)	Main results	Non physical activity outcomes	Confounders / potential sources of bias	Applicabili the UK
Patrick et al (2001)	RNCT (-)	Primary care with different levels of home follow-up	To develop and test a primary-care based intervention to improve young people's physical activity and nutrition behaviours and to assess the effects of differing levels of extended contact	Adolescents USA 11-18 yrs (mean 14.1±2.0 yrs) N=148 (90 males, 58 females) 54% white, 23% Af-Am	Transtheoretical model, social cognitive theory, relapse prevention model 4 months All participants completed a computerized assessment in the waiting room and received counselling from their health care provider. There were levls of extended follow-up by telephone and/or mail. 4 Groups **No contact control**: no further contact after initial consultation **Mail only**: received mail contact every 2 weeks (cover letter, age-appropriate tip sheet appropriate to the adolescents goals). **Infrequent**: mail contact every 6 weeks, and phone counselling every 6 weeks (about 10 min in length, assessed goal achievements, praise, solutions to barriers, goal revision if necessary) **Frequent**: mail contact every 2 weeks, weekly telephone contact (alternate counselling and brief (1-3 min) prompt calls (reminders to continue with changes suggested the previous week) All intervention components encouraged parental involvement but extent of this was determined by each participant	none	Self-report number of days/week they participated in at least 20 minutes of VPA and number of days/week they participated in at least 30 minutes of MPA	No sig 3-way interactions (condition x time x sex) indicating that neither sex or participation in an extended intervention was associated with changes in behaviour beyond those provided by PACE+ computer and provider counselling alone (no statistics or data provided) MPA improved over time for all participants (p=.01, 17% increase). VPA trended towards a significant increase for all participants (p=.07, 10% increase). (no specific data given) Participants who targeted an increase in MPA improved more than participants who did not target MPA (increase 1.4 days/wk cf decrease of .18 days/week, p = .001, *d*=.60)[13]. There was no evidence that participants who targeted an increase in VPA improved more than participants who did not target VPA (increase .4 days/wk cf increase of .41 days/week, p = .97, *d*=-.01).	None reported	No control group Greater dropout in Af-Am participants and from the Pittsburgh site (poss. reflecting low SES effect)	Interventio format like be applicab content ma need modificatio for UK.. Resource/ staffing co high: mod applicabili

[13] d = effect size. 0.2=small, 0.5=moderate, 0.8=large

First author & date	Study design & quality	Setting	Research question	Study population, country, sample size	Description of intervention	Length of follow-up	Physical activity outcome variables (inc measures)	Main results	Non physical activity outcomes	Confounders / potential sources of bias	Applicabili the UK
Kelleher et al (1999)	RNCT (-)	General practice	Is it feasible to deliver an effective CV health promotion programme to 8-15 yr olds in the context of Irish general practice	Children 8-15 years Ireland 8-11 yrs n=203 (102 males) 12-15 yrs N=111 (49 males) Higher SES	12 GP practices were randomised into one of four groups: Opportunistic/nurse (participants n=75), Recall/nurse (participants n=160), opportunistic/GP (participants n=56), Recall GP (participants n=23) In opportunistic practices it was planned to offer the lifestyle session as families visited the surgery for other reasons. These children were either invited back for a special session or given the consultation at the time In recall practices, names and addresses were drawn up by research nurse or GP. Invitation to attend was issued by letter. Children completed a baseline lifestyle and demographic questionnaire before seeing either GP or nurse Participants attended a 10 minute interview and covered a checklist of topics and background educational materials were provided. Participants received a info card/wall-chart to take home	12 months	Self-report Very poorly described, appears to be a single item about exercise participation with responses of: Most days, 3x/wk, 1-2/wk, none	8-11 yr olds: no change in proportions reporting the different exercise frequencies (p=.294, actual chi-square stat not reported). (Pre-intervention%, post-intervention%: most days 56% vs 60%; 3x/wk 22% vs 25%; 1-2/wk 10% vs 4%; none 8% vs 11%) 12-15 yr olds: no change in proportions reporting the different exercise frequencies (p=.191, actual chi-square stat not reported). (Pre-intervention%, post-intervention%: most days 47% vs 44%; 3x/wk 27% vs 40%; 1-2/wk 22% vs 7%; none 3% vs 9%) Results presented for whole sample, and not broken down by intervention group	12-15yr olds recognised that playing video games and snooker/ pool were not aerobic activities (p=.04 & p=.019 respectivel y) 8-11 yr olds: Knowledg e levels were unchanged	No control group 37% dropout in 8-11yr olds 39% dropout in 12-15yr olds	Limited. Applicable Ireland population GP setting included in study (broa application uncertain). (Ireland ha two-tier he system wit only 1/3 receiving f primary ca services)

Evidence Table 4: Interventions based within after-school clubs

First author & date	Study design & quality	Setting	Research question	Study population, country, sample size	Description of intervention	Length of follow-up	Physical activity outcome variables (inc measures)	Main results	Non physical activity outcomes	Confounders / potential sources of bias	Applicability to the UK
Story et al (2003) Minnesota GEMS pilot study	RCT (+)	School and home	To develop and evaluate an after school intervention programme designed to prevent excess weight gain in African American girls	8-10 year old African American girls at or above the 25th percentile for age- and sex-specific BMI USA Mean (SD) age (yrs): Int = 9.4 (0.9) Con = 9.1 (0.8) N=54 (Int N = 26; Con N = 28) 83% African American, 12% Caucasian, 5% Biracial	Social Cognitive Theory 12 week duration Programme entitled "Girlfriends for KEEPS" ('Keys to eating, exercising, playing and sharing') Meetings were twice a week for one hour. Targeted key constructs of (1) environment: peer support, opportunities and role models; (2) personal factors: knowledge, values and self-efficacy; and (3) behaviour: practice, goal-setting, social reinforcement. Club meetings consisted of fun, culturally appropriate, interactive activities, emphasising skill building and practice of health behaviours. Each meeting included PA – such as dancing, and step aerobics. Incentives (e.g.water bottles, t-shirts) were offered for attendance. Family involvement reinforced after-school club messages through weekly family packets and family night events	none	Accelerometry (counts/min; mins MVPA) and MET adjusted usual activity CSA Accelerometer (worn for 3 days); GEMS Activity Questionnaire (self-report)	After adjustment for baseline scores, PA was consistently greater for Int group versus Con, but no differences were significant (ES calculated by reviewers) Accelerometer counts/min ; Mean (SE) Int = 503.7 (26.9), Con = 446.2 (24.6), P=0.12, ES=2.23 Accelerometer minutes of MVPA; Mean (SD) Int = 119 (10.1), Con = 116.1 (9.2), P=0.83, ES=0.33 MET adjusted GAQ usually; Mean (SD) Int = 4.6 (0.3), Con = 4.3 (0.3), P=0.53, ES=1.0.	Girls in the Int group reported significantly higher scores for PA preference at post intervention compared with Con group (P=0.04) There were no differences between Int and Con groups for PA self-concept, sedentary activity preference, positive expectancy for PA, self-efficacy for PA, and PA home environment post intervention	Pilot study with low statistical power. Organised neighbourhood walks not well attended – only 2 families took part	Taught by trained Af-Am GEMS staff, format likely to be applicable to UK, content would need modification for other ethnic ans SES groups, high staffing and resource costs. Moderate applicability

First author & date	Study design & quality	Setting	Research question	Study population, country, sample size	Description of intervention	Length of follow-up	Physical activity outcome variables (inc measures)	Main results	Non physical activity outcomes	Confounders / potential sources of bias	Applicability to the UK
Robinson et al (2003) Stanford GEMS pilot study	RCT (+)	Community centres and home	To evaluate the effects of after school dance and reduced TV viewing on weight gain prevention in African American girls.	8-10 year old African American girls at or above the 50th percentile for age- and sex-specific BMI and/or having at least one overweight parent/guardian USA Mean (SD) age (yrs): Int = 9.5 (0.8) Con = 9.5 (0.9) N = 61 (Int N = 28; Con N = 33)	Social Cognitive Theory 12 week duration GEMS Jewel dance classes were offered 5 days/week at 3 community centres. Each session lasted up to 2.5 hours starting with healthful snack, 1h of homework, then 45-60 minutes of MVPA (African dance, Hip-Hop, Step). Sessions ended with 30 min talk on the meaning and importance of dance within African American culture and community The START ('Sisters taking action to reduce TV') intervention was 5 lessons delivered during home visits with participating families. Sessions introduced strategies such as self-monitoring, 2-week TV turnoff, budgeting TV hours, and 'intelligent viewing'. Control group: active control received health education programme to promote healthful diet and activity patterns. Monthly community health lectures, and newsletters to parents and girls	none	Accelerometry (12pm – 6pm only, counts/min and minutes MVPA) and previous day MVPA (self-report) CSA Accelerometer (worn for 3 days), GEMS Activity Questionnaire (self-report)	Average accelerometer counts per minute (12pm – 6pm) increased by about 7% for Int versus Con at post intervention, between group differences were not significant Accelerometer counts/min; Mean (SD) Int: Pre = 721.6 (298.4), Post = 744.9 (239.2). Con: Pre = 810.3 (329.7), Post = 750.8 (437.7), ES=0.21, P=0.53 Accelerometer minutes MVPA; Mean (SD) Int: Pre = 113.0 (53.1), Post = 102.1 (41.1). Con: Pre = 133.9 (68.1), Post = 106.6 (70.5), ES=0.14, P=0.67 Self reported previous day MVPA; Mean (SD) Int: Pre = 88.9 (64.4), Post = 87.1 (35.4) Con: Pre = 80.5 (35.9), Post = 75.5 (45.6), ES=0.23, P=0.38	There was a significant reduction in total household TV use for Int group compared to Con group (P=0.007) There was also a non significant trend toward reduced individual TV viewing for Int versus Con participants (P=0.14)		Taught by trained Af-Am GEMS staff, format likely to be applicable to UK, content would need modification for other ethnic and SES groups, high staffing and resource costs. Moderate applicability

First author & date	Study design & quality	Setting	Research question	Study population, country, sample size	Description of intervention	Length of follow-up	Physical activity outcome variables (inc measures)	Main results	Non physical activity outcomes	Confounders / potential sources of bias	Applicability to the UK
Wilson et al (2002)	CRCT (-)	School	To compare the effects of two after school intervention for increasing fruit and vegetable intake and physical activity	African American adolescents USA Age 11-15 yrs (No specific age data) N = 53 (Int1 N = 20, Int2 N = 17, , Con = 16) 58% male	Social Cognitive Theory 12 week duration Int1 = based on social cognitive theory, the intervention included education, behavioural skills training, feedback and reinforcement. Weeks 1 and 2 comprised collection of baseline data and establishing intervention goals. Weeks 3-12 focused on developing behavioural skills for increasing fruit and vegetable intake and physical activity behaviours (e.g., reinforcement plans, restructuring environmental cues, positive self-talk, increasing social support, and maintaining long-term behaviour-change) Int2 = As Int1 plus a 'motivational intervention' strand - 30 minutes of strategic self-presentation videotapes. Participants developed videotaped interviews demonstrating for 'beginners' their positive coping strategies for increasing physical activity Con = Comparison group were provided with educational materials about general health-related issues. 12 weekly sessions at their middle school.	none	Accelerometry (daily energy expenditure in kilocalories and average MET level and minutes in moderate and vigorous physical activity) CSA Accelerometer (worn for 4 days)	No significant differences in PA over time or between groups. P values not reported Energy expenditure in kilocalories; Mean (SD). Int1: Pre = 2751 (816), Post = 2818 (708). Int2: Pre = 2655 (529), Post = 2535 (493). Con: Pre = 2806 (975), Post = 2670 (911) Energy expenditure in METS; Mean (SD) Int1: Pre = 2.0 (0.2), Post = 2.0 (0.2). Int2: Pre = 2.0 (0.2), Post = 2.0 (0.2). Con: Pre = 2.1 (0.3), Post = 2.0 (0.3) MPA mins; Mean (SD). Int1: Pre = 98 (52), Post = 104 (50). Int2: Pre = 85 (39), Post = 77 (45). Con = Pre = 115 (52), Post = 88 (63) VPA mins; Mean (SD). Int1: Pre = 8 (7), Post = 12 (12). Int2: Pre = 14 (13), Post = 10 (7). Con: Pre = 19 (15), Post = 15 (15)	There were no differences in PA self-concept or motivation over time or between groups. Int2 reported greater increase in PA self-efficacy than Con group ($P<0.05$)	Con group comprised males only. Int1 and Con had greater loss to follow-up than Int2 (30%, 31% vs. 17% loss) Intention to treat analysis was not conducted	Format broadly applicable to UK, content likely to need modification for other ethnic groups, staffing and resourcing costs low. High applicability

First author & date	Study design & quality	Setting	Research question	Study population, country, sample size	Description of intervention	Length of follow-up	Physical activity outcome variables (inc measures)	Main results	Non physical activity outcomes	Confounders / potential sources of bias	Applicability to the UK
Pate et al (2003)	CNRT (+)	School, home, and community strands	To examine the effects of a community-based intervention to increase PA and improve psycho-social determinants of PA in rural, predominantly African American, children	5th grade students USA Mean (SD) age (yrs): Int = 10.9 (0.6) Con = 10.8 (0.7) N=436 (Int N = 175, Con N = 261) Int = 49% male Con = 49% male Int: 88% African American, 11% White, 1% other Con: 60% African American, 3% White, 7% other	Social Cognitive Theory, Pender's Health Promotion Model 18 month duration 4 key strands – Active Kids, Active Home, Active School, Active Community. Active Kids: - Learn knowledge and skills needed to be physically active, learn skills for non-competitive games and sports, understand social influences on perception of physical self and physical activity and supervised study component to improve academic attainment. These activities were delivered during summer camps (approx. 5 hrs per day - 4 days/week) and after school clubs (approx. 2 hrs day – 5 days/week) Active Home - Newsletter, homework assignments, family participation nights Active School - school health team and wellness committee designed to provide positive social influences, cues to action, and increased opportunities to be active Active Community – intended to keep the community informed about the Active Winners intervention and encourage community members to be physically active.	none	Previous day MVPA and VPA (3pm – 11.30pm only; average number of 30 minute blocks completed over 3 days) Previous Day Physical Activity Recall (self-report)	There were no significant differences in MVPA or VPA between Int and Con groups for boys or girls VPA: average number of 30 minute blocks; Mean (SE) Int boys: Pre = 2.1 (0.2), Mid = 2.6 (0.2), Post = 1.8 (0.2). Con boys: Pre = 2.4 (0.2), Mid = 2.7 (0.2), Post = 2.4 (0.2) (Group x Time P=0.31) Int girls: Pre = 1.1 (0.2), Mid = 1.4 (0.2), Post = 1.1 (0.2). Con girls: Pre = 1.4 (0.1), Mid = 1.4 (0.1), Post = 1.1 (0.1) (Group x Time P=0.43) MVPA: average number of 30 minute blocks; Mean (SE) Int boys: Pre = 2.9 (0.2), Mid = 3.3 (0.2), Post = 2.3 (0.2). Con boys: Pre = 3.4 (0.2), Mid = 3.7 (0.2), Post = 3.2 (0.2) (Group x Time P=0.19) Int girls: Pre = 2.0 (0.2), Mid = 2.1 (0.2), Post = 1.8 (0.2). Con girls: Pre = 2.4 (0.2), Mid = 2.4 (0.2), Post = 2.1 (0.2) (Group x Time P=0.74)	There were no significant Group x Time interactions in boys or girls for various psycho-social determinants of PA, including intentions, beliefs, support seeking and overcoming barriers.	The ethnic composition of Int and Con groups was different: Home, school and community components not implemented as planned.	Format may be applicable to UK, content likely to need modification for other ethnic groups, staffing and resource costs likely to be high. Moderate applicability

First author & date	Study design & quality	Setting	Research question	Study population, country, sample size	Description of intervention	Length of follow -up	Physical activity outcome variables (inc measures)	Main results	Non physical activity outcomes	Confounders / potential sources of bias	Applicability to the UK
Taylor et al (2006; 2007)	CBA (++)	School and community	To examine the effectiveness of a two year intervention to prevent obesity in 5 – 12 year old children by increasing extra-curricular physical activity	5 – 12 year old children New Zealand Mean (SD) age yrs: Int = 8.0 (1.7) Con = 7.9 (1.5) Number of participants providing baseline data = 469 (Int N = 250, Con = 219) Int = 55% male Con = 49% male 82% Caucasian, 17% Maori, 1% Pacific Island	2 years duration Main initiative was the provision of Community Activity Co-ordinators (ACs) in each Int school. Main role was to encourage all children to be a little more active every day, by increasing the variety and opportunities for physical activity. Focus was on encouraging lifestyle activity rather than structured sports. ACs would run an activity session each day, and arranged community members to take sessions, set out equipment for children, and initiated games, particularly with the older children. ACs also encouraged increased involvement of parents and others in the community. ACs were employed for 20 hours/week. Additional initiatives introduced in 2nd yr included activities to increase fruit and vegetable consumption, reduce TV viewing, and introduce activity breaks into lessons	none	Accelerometer counts/minute and minutes of sedentary, light, moderate and vigorous physical activity (8am – 8pm only) Mini-Mitter Actical accelerometer (worn for 1-2 days at baseline and 2-5 days at follow-up) Seven day physical activity recall and television time also assessed (self-report)	Year 1 results (adjusted for baseline PA, age and sex): Accelerometer counts per minute were 28% (95% CI: 11-47%) higher for Int group vs. Con The Int group spent less time in sedentary activity compared to Con group (ratio of geometric means = 0.91, 95%CI .85-.97) and more time in moderate intensity (ratio of geometric means = 1.07, 95% CI: 1.03-1.12). Self report data not reported <u>2 year results</u>: Differences in mean accelerometer counts/min were no longer significant (-75; 95% CI: -215, 65). Self-report data showed that intervention children reported less PA than did control children at both 1y (-0.2, 95% CI -0.4, -0.1) and 2y (-0.2, 95% CI -0.4, -0.0).	Year 1 results: Int children spent 6% (95%CI 1-9%) less time watching TV. Year 2 results: No intervention effect was observed for TV viewing (no data presented)	Int children were more physically active (P=0.001) and leaner (P=0.004) than Con group at baseline Proportion of participants providing follow-up data (Int and Con groups, years 1 and 2):74 – 83%	Intervention format broadly applicable to UK, content likely to need modification for UK population, staffing costs may be prohibitive. Moderate applicability

First author & date	Study design & quality	Setting	Research question	Study population, country, sample size	Description of intervention	Length of follow -up	Physical activity outcome variables (inc measures)	Main results	Non physical activity outcomes	Confounders / potential sources of bias	Applicability to the UK
Wilson et al (2005)	CBA (++)	School	To examine the effects of a 4-week student-centred intervention to increase physical activity in underserved adolescents	Grade 6 children USA Mean (SD) age (yrs): Int = 11 (0.6) Con = 11 (0.7) N = 48 (Int = 28, Con = 20) Int = 39% male Con = 15% male Int = 85% African American Con = 80% African American	Self-Determination Theory and Social Cognitive Theory 4 weeks duration Sessions took place 3 days a week for 2 hours after school: 30 mins homework-snack, 60 mins MVPA, 30 mins theory-based intervention to increase intrinsic motivation and behavioural skills for PA. Specific strategies included self monitoring, goal setting, and developing strategies to for engaging in physical activity with friends and family. Con – 4 weeks (equivalent hours to Int) of general health education during regular school hours that did not emphasize physical activity	none	Minutes of MPA, MVPA and VPA per day MTI accelerometer (worn for 5 days)	Int group significantly increased MPA, MVPA and VPA at follow up compared with Con group (P<.02). MPA; Mean (SE) Int = 99.36 (5.88) Con = 72.63 (5.88) (P<0.02) MVPA; Mean (SE) Int = 113.94 (6.27) Con = 78.78 (6.27) (P<0.02) VPA; Mean (SE) Int = 11.33 (1.07) Con = 5.31 (1.07) (P<0.02)	Int group significantly increased PA motivation (P<0.01) and self concept (P<0.056) compared to Con group	Drop-out approx. 14% - Intention to treat analysis not employed Within the Int group VPA was greater on programme versus non programme days (P<0.02) – there were no difference in MPA or MVPA	Format likely to be applicable, content may need modification, resources and staffing not excessive. High applicability

First author & date	Study design & quality	Setting	Research question	Study population, country, sample size	Description of intervention	Length of follow-up	Physical activity outcome variables (inc measures)	Main results	Non physical activity outcomes	Confounders / potential sources of bias	Applicability to the UK
Annesi et al, 2007	Non randomised comparison before and after (-)	School	To compare the effects of two physical activity and health behaviour change interventions delivered after school or during physical education	African American Pre-adolescents, USA Mean (SD) age yrs: After-school boys = 10.1 (0.8) After schoopl girls = 9.6 (0.7) PE boys = 10.1 (1.2) PE girls = 10.4 (1.1) N = 241 (After-school N = 128, PE = 113) Physical activity data: After-school N = 103, PE N= 48	12 week duration Youth Fit for Life protocol delivered after-school or during physical education After-school: 3 sessions/week for 45 minutes, CV activities for 20 minutes each session, 2 d/week there was 20 minutes of resistance training, other day was 20 minutes review of various self-management and self-regulatory skills (goal-setting, self-monitoring, self-talk/cognitive restructuring, recruiting social support), supplemented by workbook. General health and nutrition information 5 mins per session, supported by posters. PE: 2 sessions/week. Components were the same as after-school but delivered in gymnasium. Self-regulatory skills delivered fortnightly.	none	Previous week days of MVPA outside of intervention classes (single item self report)	Days of voluntary MVPA per week increased significantly in both groups. (P<0.05) Days per week of MVPA; Mean (SD) After-school Pre = 2.20 (2.05), Post = 2.91 (2.13) P<0.001, ES=0.35 PE Pre = 2.38 (1.18), Post = 3.13 (1.38) P=0.005, ES=0.64	There were significant improvements in mood (tension and vigour subscales, P<0.001) for both groups. There were also significant improvements in self-appraisal constructs (physical appearance, physical self-concept, exercise self-efficacy, and general self subscales, P<0.05) in both groups, with changes greater for the PE group than the after school group	Different frequency of exposure to intervention between groups (in theory to account for trained vs untrained leaders)	Format applicable, content likely in need of modification for UK population, few resources required. Moderate applicability

Evidence Table 5: Interventions based within families and schools

First author & date	Study design & quality	Setting	Research question	Study population, country, sample size	Description of intervention	Length of follow-up	Physical activity outcome variables (inc measures)	Main results	Non physical activity outcomes	Confounders / potential sources of bias	Applicability to the UK
Luepker et al. (1996) & Nader et al. (1996)	CRCT (+)	School and family	To assess the outcomes of a health behaviour intervention, focusing on the elementary classroom, school environment and home, on dietary and physical activity patterns over three years.	Elementary school children and their families USA Mean age yrs: Total sample = 8.76 N=5106 (Int N: not stated, participants recruited from 56 schools; Con N: not stated, participants recruited from 40 schools)	Social Cognitive Theory 3 years duration Three arms for the intervention, school-based, school plus family and control. School-based participants received classroom curricula, a school food service intervention and school physical education intervention. The physical education strand aimed to increase amount of enjoyable moderate intensity physical activity during taught classes. School plus family participants received school-based elements plus a home curriculum that mirrored school activities. Nineteen home activity packs were taken home over 3 years and usage was rewarded with score cards to indicate the level of child/adult participation. During two years, the schools also offered “family fun nights”. These involved dance performances, games and health food treats. Control participants received usual school approach to health and physical education.	none	Frequency, intensity, time and type of physical activity and sedentary behaviours. Self-Administered Physical Activity Checklist (SAPAC; self report)	Total PA minutes; Mean Int = 145.5 Con = 154.8, Non-significant, P value not reported VPA minutes; Mean Int = 58.6 Con = 46.5, P< 0.003 There were no PA differences between the school-plus-family intervention compared with the school only intervention. Regression analysis (Nader et al. 1996) indicated a significant effect of dose of participation in the family programme on self reported minutes of vigorous PA (P=0.022). Students with moderate dose levels (7-9 out of 15 sessions) had the highest numbers of minutes of activity	Nader et al. (1996) reported a dose response relationship between participation in family programme and acquisition of positive attitudes and knowledge for physical activity and self efficacy, interaction dose and race, 0.022) and diet (interaction Dose adjusted for gender and race, 0.023. There were no significant differences in self efficacy between intervention and control schools at follow up	Potential for misclassification of participation in family programme Implementation of school intervention elements varied across schools, and was not accounted for in analysis	Applicable to USA population and settings included in the study (Broader application is uncertain) Format likely to be applicable, high staffing and resource costs likely to be prohibitive. Low applicability.

First author & date	Study design & quality	Setting	Research question	Study population, country, sample size	Description of intervention	Length of follow-up	Physical activity outcome variables (inc measures)	Main results	Non physical activity outcomes	Confounders / potential sources of bias	Applicability to the UK
Haerens et al. (2006) Haerens et al. (2007)	CRCT (+)	School	To evaluate the effects of a middle school physical activity and healthy eating intervention, including an environmental and computer tailored component, and to investigate the effects of parental involvement	Middle school children Belgium Mean (SD) age yrs: Int = 13.2 (0.9) Int + Parent = 13.0 (0.8) Con = 12.9 (0.7) N = 2991 (Int N = 1006, Int + Parent N=1226, Con N = 759) 64% male	The Transtheoretical Model and Theory of Planned Behaviour. 2 years duration The intervention comprised PA, food and parental components. PA – focused on increasing PA to at least 60 mins per day. Schools were encouraged to create more opportunities to be physically active during breaks, at lunchtime and after school. Extra sports materials provided for break / lunchtime and after school. Pupils received a fitness test and a computer-tailored intervention for physical activity. Goal of parent component was to create supportive environment for PA outside of school – 3 times a year printed materials on healthy food and PA sent home. Parents also sent a CD-rom of a computer-tailored intervention for PA and fat intake – same as that completed by pupils. Food component – focused upon increasing fruit consumption, reducing soft drink consumption and increasing water consumption and reducing fat intake.	2 years	Minutes per day of LTPA (self-report) and minutes per day of sedentary, light and moderate to vigorous PA (accelerometer, sub-group N = 258 only) Flemish Physical Activity Questionnaire (self-report), CSA accelerometer (worn for 6 days, sub-group only)	There were no significant differences for boys or girls in LTPA minutes / day over time or between groups. Minutes in MVPA (accelerometer assessed) decreased less in Int group boys than Con group boys (P<0.05) Accelerometer MVPA minutes / day; Mean (SD) Int boys: Pre = 33.9 (19.3), Year1 = 32.1 (26.4), Year2 = 34.6 (26.2) Con boys: Pre = 53.4 (19.0), Year1 = 42.1 (28.1), Year2 = 35.0 (14.0), P<0.05 Int girls: Pre = 20.5 (17.7), Year1 = 25.5 (20.6), Year2 = 24.8 (13.6) Con girls: Pre = 18.7 (12.7), Year1 = 19.1 (15.7, Year2 = 22.9 (21.8), No significant differences, P values not reported There was a significant increase (boys and girls data collapsed) in total school physical activity for Int + Parent and Int	No secondary outcome measures	25% dropout Intention to treat analysis not employed in Haerens et al. (2006) Completers only analysis reported in Haerens et al. (2007) Data from Int and Int + Parent groups collapsed for analysis in Haerens et al. (2006)	Limited. Applicable to Belgian (Flemish) population and settings included in the study (broader application is uncertain).

								vs Con P<0.05; Mean minutes (SD) Int + Parent: Pre = 16.2 (16.6), Post = 22.6 (19.0) Int: Pre = 16.0 (18.4), Post = 20.5 (20.9) Con: Pre = 18.5 (13.8), Post = 18.5 (14.5), P<0.05			

First author & date	Study design & quality	Setting	Research question	Study population, country, sample size	Description of intervention	Length of follow-up	Physical activity outcome variables (inc measures)	Main results	Non physical activity outcomes	Confounders / potential sources of bias	Applicability to the UK
Simon et al. (2004)* Simon et al. (2006)	CRCT (+)	School	To evaluate the impact of a multi-level physical activity intervention on activity patterns, sedentary behaviour, and psychological predictors of physical activity among adolescents.	Adolescents France Mean (SD) age yrs: Int = 11.6 (0.6) Con = 11.7 (0.7) N = 954 (Int N = 475, Con N = 479) Int = 46% male Con = 51% male	4 years duration A multi-level programme designed to influence intrapersonal, social and environmental determinants of physical activity. 3 principal targets: 1. Knowledge, attitudes, beliefs and motivation towards physical activity developed through information provision, debates and supervised physical activity sessions 2. social support by parents, peers, teachers and physical activity instructors. 3. Environmental – physical, structural, and institutional conditions for physical activity that encourage the students to use the knowledge and skills they have learnt.	4 years (6-month data reported here)	Leisure organised physical activity Adapted version of the 'modifiable activity questionnaire for adolescents' (MAQ). Past year recall yielding weekly frequency and duration estimates.	Leisure organised physical activity increased significantly for Int boys and girls compared to Con (P<0.01) Leisure organised physical activity: Int boys: Pre = 69%, Post = 81% Con boys: Pre = 67%, Post = 66%, OR=1.87, 95% CI 1.12 to 2.66, P=0.01. Int girls: Pre = 59%, Post = 83% Con girls: Pre = 48%, Post = 50%, OR=3.38, 95% CI 1.42 to 8.05, P<0.01.	Follow-up LOPA was associated with improvements in self-efficacy and intentions to be active for both genders Significant reduction of high sedentary (screen-based media; > 3hrs/day) behaviour among intervention girls (P<0.0001) and boys (P<0.0001).	Randomised by schools Some differences between Int and Con groups at baseline. Intention to treat analysis not emplyed	Limited. Applicable to French population and settings included in the study (broader application is uncertain).

First author & date	Study design & quality	Setting	Research question	Study population, country, sample size	Description of intervention	Length of follow-up	Physical activity outcome variables (inc measures)	Main results	Non physical activity outcomes	Confounders / potential sources of bias	Applicability to the UK
Jurg et al. (2006)	Controlled non-randomised trial CNRT (+)	School	To evaluate the effects of a primary school based multi-component intervention that uses social and environmental supports to encourage physical activity over one year with particular focus on ethnic minority populations	Dutch children (aged 9-12 years old) The Netherlands N=510	Used theoretical input from the Theory of Planned Behaviour, a model of physical exercise and habit formation, the Precaution Adoption Process model, a social ecological model, and the Service Quality Model. Multi-component intervention JUMP-in programme which included: School Sports, . Pupil follow up systems, The Class Moves! Choose Your Card! Parental Information service, Activity-week Control schools continued usual activities	None	PA was assessed using a self reported questionnaire. The measure created a summary physical activity score in minutes. Minutes of activities performed at clubs or organised sports sessions were also reported as a sports score.	Results were reported stratified by school grade 4,5 and 6. Minutes of overall physical activity in the control schools decreased. Between-group comparisons (I vs. C) were not made. Multilevel analysis (I group only by grade) showed a prevention of a decrease in physical activity (Grade 6 only - β= 0.22, $p<0.001$), overall model (all grades - β= 0.11, $p<0.05$). The proportion of pupils achieving a recommended level of physical activity overall in I group was OR 1.63 (95% CI 1.05 to 2.51, $p<0.05$). NS OR reported in grades 4 and 5. Significant Or reported for Grade 6 OR 4.33 (95% CI 1.82-10.32, $p<0.0001$).	Few consistent effects were found on determinants of physical activity either in overall models (all grades) or grade specific models. Only perceived advantage of physical activity and habit of strength of physical activity was significantly higher in grade 4 pupils in I group compared to controls. NS variables included: perceived advantage, disadvantage, encouragement of mother, father, self-efficacy, intention, habit and awareness.	Not ITT analysis No information on validity of PA measure Weekend physical activities were not included in measure of physical activity	Limited. Applicable to Dutch population and settings included in the study (broader application is uncertain).

First author & date	Study design & quality	Setting	Research question	Study population, country, sample size	Description of intervention	Length of follow-up	Physical activity outcome variables (inc measures)	Main results	Non physical activity outcomes	Confounders / potential sources of bias	Applicability to the UK
Christodoulos et al. (2006)	Controlled non-randomised trial CNRT (-)	School	To examine the short term effects of a health education programme also involving the family on Greek schoolchildren	Greek pupils (aged 10-12.5 years old) Greece Mean age 11.2±.4yrs N=78	A school and family based intervention aimed at improving school and leisure time physical activity. School components included teacher led cross curriculum and PE based lessons, focusing on cooperative rather than competitive games, short pre PE lesson health education talks, computer aided lessons. Family involvement included asking parents to support homework activities, sending educational materials home, providing information on physical activity and nutritional guidelines. Parents were also sent information about local community based sports programmes and encouraged to support active choices for their children's play and active travel. The control group did not have any health education intervention and were asked to deliver their usual PE curriculum.	None	Physical activity measure recalled type of moderate and vigorous physical activities undertaken at least 10 times during the past year. Reported participation was verified by teachers and parents (method not specified). Measure included an assessment of total moderate to vigorous physical activity (TMVPA) and organised moderate to vigorous out of school physical activities (OMVPA).	There were significant differences between the intervention and control groups reported levels of OMPVA (hours/week), I=3.54±.32, C=2.54 ±.26 $p<0.05$. NS differences were reported between groups for TMVPA (hours/week), I=7.5±51, C=6.26 ±.40, $p>.05$). There were reported significant <u>within</u> group changes in the number of pupils achieving recommended levels of physical activity between baseline and follow up, I=32.3% to 77.4%, C=26.5% to 55.1% ($p<0.043$).	Pupils in the intervention groups report a more positive attitude to physical activity, and higher intentions to participation in physical activity, than control pupils.	High risk of contamination between groups as both groups were from same town and would be likely to participate in the same community organised sports programmes. The children had high levels of physical activity at baseline. High risk of misclassification of physical activity levels due to recall period of measure. No information on validity of PA measure	Limited. Applicable to Greek population and settings included in the study (broader application is uncertain).

First author & date	Study design & quality	Setting	Research question	Study population, country, sample size	Description of intervention	Length of follow-up	Physical activity outcome variables (inc measures)	Main results	Non physical activity outcomes	Confounders / potential sources of bias	Applicability to the UK
Kelder et al. (1993) Perry et al. (1994)	Controlled non-randomised trial CNRT (-)	School	To evaluate the impact of the Minnesota Heart Health Programme and Class of 1989 intervention on CVD risk profiles of young adolescents	6th Grade adolescents USA N=2468	Social Learning Theory The physical activity component of MHHP was delivered in conjunction with nutrition and anti-smoking initiatives using three common approaches peer leadership, school-based programmes and community –wide activities. Intervention area schools were compared with comparison area schools To coincide with the Los Angeles Olympics the physical activity component reflected this event called the "Health Olympics". Students exchanged greeting cards with other children (from Australia, Norway and Sweden) who wrote back on their ideas for health related to physical activity and smoking. The second component was an activity challenge where students were encouraged to exercise the equivalent energy expenditure as cycling 250 miles. All students received 1 hour of instruction on heart rate monitoring, choosing aerobic activities and learning safety procedures. For the following four weeks students monitored their aerobic activity, facilitated by trained	Annual surveys of intervention and comparison cohorts up to 12th Grade 1984 to 1989	Annual measure of all health behaviours including physical activity, self reported hours of physical activity out of class per week using an 8 item categorical scale ranging from "never" to "over 8 hours week" per physical activity. Measure focused on vigorous activities	Comparisons made between intervention area and comparison area communities at each annual survey. The results of gender specific models for hours of exercise per week showed a consistent decline in hours of exercise at each increase in grade for both intervention and comparison communities. However the decline was less severe in both genders in the intervention communities compared to the comparison community. Significant differences were reported for all grades for females except grade 11 ($p<0.05$). NS differences were reported for males except for grades 7 and 11 ($p<0.05$). Females in the intervention community reported a significantly greater physical activity score than those in the reference community for 8th, 9th and 11th grade follow-up ($p<.05$). For	None stated	Results adjusted for main confounder including baseline levels of physical activity, parent's occupation, age and gender. Results not adjusted for loss to follow up 45% at grade 12. Underpowered by loss to follow up No information on validity of PA measure	Limited. Applicable to USA population and settings included in the study (broader application is uncertain).

					peer leaders, to try and achieve their 250 mile target. Classes within intervention schools were also encouraged to exercise outside of school and competed to win sports prizes from local shops for the highest active class. Participation was encouraged as each class received written cards from the research team. These activities were delivered from 1984-1985. The Slice of Life programme, ran from 1986-1987, and included a 7 session programme focusing on skills for healthy eating and exercise, supported by video and written materials. Students were encouraged to include planning for activity with their families.			males, the intervention community retained higher post-test mean physical activity score, but these differences were NS. Actual data only presented in a graph.			

First author & date	Study design & quality	Setting	Research question	Study population, country, sample size	Description of intervention	Length of follow-up	Physical activity outcome variables (inc measures)	Main results	Non physical activity outcomes	Confounders / potential sources of bias	Applicability to the UK
Hawley et al. (2006)	Uncontrolled before and after UBA	School & family	To evaluate the impact of a pilot community intervention programme within a rural middle school	6Th Grade students USA N=65 in school 25 participated in measures	The school based programme focused on educating children and families in nutrition, fitness, goal setting, self-efficacy, and stages of change. The programme consisted of five 40 minutes session (during PE classes) over 6 weeks. Students were given a Family Field Guide that provided written information on starting physical activity, local opportunities etc. All students received incentives like water bottles and passes to local swimming pools. The school also organised a Family Fun Night at a local wellness centre.	none	Physical activity measure SAPAC. Participants identified which 20 activities they had engaged with for at least 15 minutes over the previous day outside of school. Activities were scored with equivalent MET values.	Proportions of families in different stage of change scores pre and post intervention were reported - Pre-contemplation no change 0% to 0% Contemplation decreased from 21% to 0% Preparation increase 25% to 46% Action decrease 37% to 27% Maintenance increased for 17% to 27% N=11 families.	Families as a whole showed a significant improvement in fitness knowledge, but did not show significant improvements in their view of the importance of being physically active.	No information on validity of PA measure No adjustment for potential confounders No comparison group No report of usefulness of materials in relation to outcome	Very Limited. Applicable to USA population and settings included in the study (broader application is uncertain).

Evidence table 6: Social Marketing interventions

First author & date	Study design & quality	Setting	Research question	Study population, country, sample size	Description of intervention	Length of follow-up	Physical activity outcome variables (inc measures)	Main results	Non physical activity outcomes	Confounders / potential sources of bias	Applicability to the UK
Huhman et al, 2005; 2007)	CNRT (+)	Mass media (Primary delivery vehicle: TV advertising)	To evaluate the effects of a social marketing mass media campaign on physical activity in children aged 9–13 (Year 1) and 11–15 (year 2).	All children aged 9-13 (and parents) USA Baseline N= 3084 parents Baseline N = 3120 children Year 1: 71% of dyads completed follow-up Year 2: 83% of dyads completed follow-up	Based on Social Marketing Principles Primary intervention was a 24 month television advertising campaign, delivered through children's channels, such as Nickelodeon and Disney. The campaign employed the brand name 'VERB' – 20-30 second adverts featuring children or celebrities being active. The tag line encouraged children to "find their verb". Media time was purchased to deliver an average of 188 gross rating points (GRPs)[14] per week in year 1 and 106 GRPs in year 2. Secondary intervention components included provision of activity promotion kits for school or community groups, and an 'activity finder' on the VERB website directing children to activities in their postal (ZIP) code area.	none	Number of sessions of 'organised' and 'free-time' physical activity on day before survey and previous 7 days Telephone survey (self-report) Acceptable reliability and validity	Year 1: For the total population, there was no effect on the number of sessions of organised or free-time physical activity. The campaign did lead to increased participation in free time activity for particular subgroups: 9-10 year old children, girls, children with parents of lower educational attainment l, children from urban areas and children who were 'low' active at baseline (all $p<0.05$) Year 2: free time physical activity during the past week, and on the day before survey increased ($p<0.05$) for the whole population. As self-reported frequency of	Year 1: no effects Year 2: Significant improvement in outcome expectations – beliefs about the benefits of participating in physical activity ($P< 0.05$)	Reverse causation (highly physically active children becoming more aware of the advertisements) may be a source of bias	Limited. Applicable to USA population and settings included in the study (broader application is uncertain).

[14] Gross rating points are an estimated percentage of the target audience exposed to advertising; they are calculated by multiplying the estimated reach of a medium (the percentage of children likely to see the adverts) by the frequency or number of times children have the opportunity to see the advertisement. With a media buy of 188 GRPs per week it was estimated that 85% of 9-13 yr olds had the opportunity to see a VERB advertisement, and that the average target audience member had the opportunity to see a VERB advertisement approx. 8.8 times throughout the month.

								exposure to VERB increased, so did self-reported indicators of free-time physical activity the previous day and median number of weekly sessions of physical activity during their free-time. There was no effect on participation in organised physical activity . Children more aware of VERB engaged in significantly (0<.05) more free-time physical activity on the previous day (61.2% (CI=58.3-64.0) than children unaware of VERB (45.7% (CI=38.9-52.5). Effect sizes[15] for the awareness effect on behaviour were r = 0.07 for median number of weekly sessions of fee-time physical activity, r = 0.12 for physical activity on the day before the interview, and r = 0.06 for organised physical activity.			

[15] In this case effect size was reported as the correlation coefficient, r. 0.1 = small, 0.3 = moderate, and 0.5 = large.

Annex A: Example search strategy

Medline

1. (local authorit$ or local council$ or health authorit$).tw.
2. (council$ adj2 (provision or facilit$ or service$)).tw.
3. public facilities/ or swimming pools/
4. Local government/
5. (County council$ or borough council$).tw.
6. (communit$ or settings).tw.
7. (neighbourhood$ or neighborhood$).tw.
8. "Residence Characteristics"/
9. ((fitness or sport$1) adj5 (centre$1 or center$1 or facilit$)).tw.
10. (leisure adj5 (centre$1 or center$1 or facilit$)).tw.
11. swim$ pool$.tw.
12. (fitness club$1 or wellness centre$ or wellness center$).tw.
13. gym$1.tw.
14. gymnasia$1.tw.
15. health club$1.tw.
16. health spa$1.tw.
17. health spa$1.tw.
18. (sport adj5 (centre$1 or center$1 or facilit$)).tw.
19. (recreation adj5 (centre$1 or center$1 or facilit$)).tw.
20. (open space$ or outdoor space$).tw.
21. (pitch or pitches).tw.
22. park$1.tw.
23. play area$.tw.
24. garden$.tw.
25. recreation ground$.tw.
26. playing field$.tw.
27. sports ground$.tw.
28. sports field$.tw.
29. (play ground$ or playground$).tw.
30. (Scout$1 or Girl Guid$3 or scouting or cubs or ranger guide$1 or explorer$1 or beavers or venturer$ or brownie$ or rainbow$).tw.
31. (youth club$ or youth center$ or youth centre$).tw.
32. ((exercise or swim$ or walk$ or running or biking or bicycl$ or bike$ or sport$ or horse riding or dance$1 or dancing or aerobics or football or rugby or netball or cricket or hockey or rounders or rollerblading or rollerskating or skating or skateboard$ or games or tennis or badminton or racquet$ or pilates or spinning or step$ or yoga or yogalates or ballet or squash or athletic$ or pilates) adj club$).tw.
33. parent$ group$.tw.
34. recreation club$.tw.
35. sport$ club$.tw.
36. (Society or societies).tw.
37. (church$2 or chapel$1 or sunday school$ or temple$ or synagogue$ or mosque$ or religious setting$ or place of worship$ or quaker house$).tw.
38. Child Day Care Centers/
39. creche$.tw.
40. (Carer$ or childminder$ or guardian$ or nanny$ or childcare$ or child day care$ or kindergarten).tw.
41. (play group$ or play centre$ or play center$).tw.
42. ((after school$ or out of school) adj5 (club$ or care or scheme$ or service$ or playscheme$ or activit$)).tw.
43. (holiday scheme$ or holiday playscheme$ or extended school$).tw.
44. (home or homes).tw.
45. family/
46. family relations/

47. nuclear family/
48. parents/
49. mothers/
50. ((generation$2 or intergeneration$2) adj5 (event$ or activit$ or initiative$ or member$ or program$ or intervention$ or participat$ or together)).tw.
51. intergenerational relations/
52. parent-child relations/
53. mother-child relations/ or father-child relations/
54. (family adj5 (event$ or activit$ or initiative$ or target$ or program$ or intervention$ or participat$ or together)).tw.
55. (family based or family unit$).tw.
56. (families adj5 (event$ or activit$ or initiative$ or target$ or program$ or intervention$ or participat$ or together)).tw.
57. (parents adj5 (event$ or activit$ or initiative$ or target$ or program$ or intervention$ or participat$ or together)).tw.
58. (father$1 adj5 (event$ or activit$ or initiative$ or target$ or program$ or intervention$ or participat$ or together)).tw.
59. (mother$1 adj5 (event$ or activit$ or initiative$ or target$ or program$ or intervention$ or participat$ or together)).tw.
60. (parent adj5 (event$ or activit$ or initiative$ or target$ or program$ or intervention$ or participat$ or together)).tw.
61. (grandmother$ adj5 (event$ or activit$ or initiative$ or target$ or program$ or intervention$ or participat$ or together)).tw.
62. (grandfather$ adj5 (event$ or activit$ or initiative$ or target$ or program$ or intervention$ or participat$ or together)).tw.
63. (Grandparent$ adj5 (event$ or activit$ or initiative$ or target$ or program$ or intervention$ or participat$ or together)).tw.
64. (relatives adj5 (event$ or activit$ or initiative$ or target$ or program$ or intervention$ or participat$ or together)).tw.
65. (Aunties or aunty).tw.
66. ((Brother$ or sister$ or sibling$) adj5 (event$ or activit$ or initiative$ or target$ or program$ or intervention$ or participat$ or together)).tw.
67. (Uncles or uncle).tw.
68. (Cousins or cousin).tw.
69. (family support$ or families support$).tw.
70. siblings/
71. or/1-70
72. (physical$ adj5 (fit$4 or activ$3 or endur$4)).tw.
73. (exercis$3 adj5 (fit$4 or activ$3 or endur$4)).tw.
74. ((promot$ or uptak$ or encourag$ or increas$ or start$ or adher$ or maintain$ or sustain$) adj5 physical$ activit$).tw.
75. ((promot$ or uptak$ or encourag$ or increas$ or start$ or adher$ or maintain$ or sustain$) adj5 exercis$).tw.
76. ((decreas$ or reduc$ or discourag$) adj5 sedentary).tw.
77. motor skill$.tw.
78. (physical$ adj5 inactiv$3).tw.
79. physical$ litera$.tw.
80. ((promot$ or uptak$ or encourag$ or increas$ or start$ or adher$ or maintain$ or sustain$ or self esteem or confidence or self efficacy or abilit$ or enjoy$ or learn$) adj5 (swim$ or walk$ or running or biking or bicycl$ or bike$)).tw.
81. ((promot$ or uptak$ or encourag$ or increas$ or start$ or adher$ or maintain$ or sustain) adj5 (sport$ or horse riding or dance$1 or dancing or aerobics)).tw.
82. ((promot$ or uptak$ or encourag$ or increas$ or start$ or adher$ or maintain$ or sustain$ or self esteem or confidence or self efficacy or abilit$ or enjoy$ or learn$) adj5 (football or rugby or netball or cricket or hockey or rounders or rollerblading or rollerskating or skating or skateboard$)).tw.
83. ((promot$ or uptak$ or encourag$ or increas$ or start$ or adher$ or maintain$ or sustain$ or self esteem or confidence or self efficacy or abilit$ or enjoy$ or learn$) adj5 (play$1 or playing or playfulness or jump$1 or jumping or hopping)).tw.

84. ((promot$ or uptak$ or encourag$ or increas$ or start$ or adher$ or maintain$ or sustain$ or self esteem or confidence or self efficacy or abilit$ or enjoy$ or learn$) adj5 (tennis or badminton or racquet sport$ or pilates or spinning or step$ class$ or yoga or yogalates or ballet or squash or core skills)).tw.
85. ((promot$ or uptak$ or encourag$ or increas$ or start$ or adher$ or maintain$ or sustain$ or self esteem or confidence or self efficacy or abilit$ or enjoy$ or learn$) adj5 cycling).tw.
86. ((promot$ or uptak$ or encourag$ or increas$ or start$ or adher$ or maintain$ or sustain$ or self esteem or confidence or self efficacy or abilit$ or enjoy$ or learn$) adj5 games).tw.
87. physical education.tw.
88. exp "Physical Education and Training"/
89. exp Dancing/
90. exp Sports/
91. Recreation/
92. "Play and Playthings"/
93. Exercise/
94. ((skip$ or skipping) adj5 (play$ or game$ or playing or activ$ or rope$)).tw.
95. motor activity/
96. free play.tw.
97. ((self esteem or confidence or self efficacy or abilit$ or enjoy$ or learn$) adj5 (physical activit$ or exercise$ or sport$)).tw.
98. (activ$ adj1 (play$1 or playing or playfulness)).tw.
99. (family sport$1 day$1 or soft play or tumbletots or fun run$1).tw.
100. child$.tw.
101. (family or sibling$ or brother$ or sister$ or families).tw. or family/ or siblings/
102. kid$1.tw.
103. infant$1.tw.
104. (youth$1 or youngster$).tw.
105. toddler$1.tw.
106. (boy$1 or girl$).tw.
107. (baby or babies).tw.
108. child/
109. child, preschool/
110. infant/
111. exp adolescent/
112. (young people$ or young adult$ or young wom#n or young m#n).tw.
113. young person$.tw.
114. teen$1.tw.
115. (teenager$ or adolescent$).tw.
116. (under 18 or under 18s).tw.
117. or/72-99
118. or/100-116
119. (letter or editorial).pt.
120. 71 and 117 and 118
121. 120 not 119
122. limit 121 to (humans and english language and yr="1990 - 2007")

Annex B: Excluded studies

Study	Reason for exclusion
A systematic review of the effectiveness of peer/paraprofessional 1:1 interventions targeted towards mothers (parents) of 0-6 year old children in promoting positive maternal (parental) and/or child health/developmental outcomes [Electronic (2007). Version]. Database of Abstracts of Reviews of Effects, 4.	Review / commentary
Alexandrov, A. A., Maslennikova, G. Y., Kulikov, S. M., Propirnij, G. A., & Perova, N. V. (1992). Primary prevention of cardiovascular disease: 3-year intervention results in boys of 12 years of age. Prev Med, 21(1), 53-62.	No PA data
Annesi, J. J. (2004). Relationship between self-efficacy and changes in rated tension and depression for 9- to 12-yr.-old children enrolled in a 12-wk. after-school physical activity program. Percept Mot Skills, 99(1), 191-194.	No PA data
Annesi, J. J., Westcott, W. L., Faigenbaum, A. D., & Unruh, J. L. (2005). Effects of a 12-week physical activity protocol delivered by YMCA after-school counselors (Youth Fit for Life) on fitness and self-efficacy changes in 5-12-year-old boys and girls. Res Q Exerc Sport, 76(4), 468-476.	Inappropriate PA measure
Bayne-Smith, M., Fardy, P. S., Azzollini, A., Magel, J., Schmitz, K. H., & Agin, D. (2004). Improvements in heart health behaviors and reduction in coronary artery disease risk factors in urban teenaged girls through a school-based intervention: the PATH program. Am J Public Health, 94(9), 1538-1543.	Curriculum-based intervention
Beets, M. W., Eilert, A. G., Pitetti, K. H., & Foley, J. T. (2006). Student and parent self-reported changes in physical activity behavior while wearing an unsealed pedometer. Ped Exerc Sci, 18(4), 492-499.	No intervention
Bonhauser, M., Fernandez, G., Puschel, K., Yanez, F., Montero, J., Thompson, B., et al. (2005). Improving physical fitness and emotional well-being in adolescents of low socioeconomic status in Chile: results of a school-based controlled trial. Health Promot Int, 20(2), 113-122.	Inappropriate population
Bostick, A., & Ratliffe, T. (2001). Encouraging physical activity beyond class time: running and walking clubs. Teaching Elementary Phys Educ, 12(4), 24-26.	No PA data
Burke, V., Milligan, R. A., Thompson, C., Taggart, A. C., Dunbar, D. L., Spencer, M. J., et al. (1998). A controlled trial of health promotion programs in 11-year-olds using physical activity "enrichment" for higher risk children. *The Journal of Pediatrics, 132*(5), 840-848.	Curriculum-based intervention
Burke, V., Beilin, L. J., Milligan, R., & Thompson, C. (1995). Assessment of nutrition and physical activity education programmes in children. Clin Exp Pharmacol Physiol, 22(3), 212-216.	Review / commentary
Caballero, B., Clay, T., Davis, S. M., Ethelbah, B., Rock, B. H., Lohman, T., et al. (2003). Pathways: a school-based, randomized controlled trial for the prevention of obesity in American Indian schoolchildren. Am J Clin Nutr, 78(5), 1030-1038.	Inappropriate population
Cain, R. E. (1996). Effect of instruction on perceived physical ability and exercise adherence. Percept Mot Skills, 82(2), 494.	Wrong age group
Carter, B. J., Birnbaum, A. S., Hark, L., Vickery, B., Potter, C., & Osborne, M. P. (2005). Using media messaging to promote healthful eating and physical activity among urban youth. J Nutr Educ Behav, 37(2), 98-99.	No PA data
Choi, B. C., Pak, A. W., Choi, J. C., & Choi, E. C. (2007). Achieving the daily step goal of 10,000 steps: the experience of a Canadian family attached to pedometers. Clin Invest Med, 30(3), E108-113.	No intervention
Copperman, N., Haas, T., Arden, M. R., & Jacobson, M. S. (1997). Multidisciplinary intervention in adolescents with cardiovascular risk factors. Ann N Y Acad Sci, 817, 199-207.	No PA data
Crawford, M. (2000). If Mums exercise, will daughters follow suit? Prac Nurse, 20(8), 452.	No intervention
Currie, J. L., & Develin, E. D. (2000). The Strollers Pramwalking Program: A	No PA data

Community Interventionn Aimed at Increasing the Physical Activity Level of Mothers with Young Children. Health Promot J Aus, 10(1), 57-59.	
Davis, S. M., Going, S. B., Helitzer, D. L., Teufel, N. I., Snyder, P., Gittelsohn, J., et al. (1999). Pathways: a culturally appropriate obesity-prevention program for American Indian schoolchildren. Am J Clin Nutr, 69(4 Suppl), 796S-802S.	Inappropriate population
DeLany, J. P., Bray, G. A., Harsha, D. W., & Volaufova, J. (2004). Energy expenditure in African American and white boys and girls in a 2-y follow-up of the Baton Rouge Children's Study. Am J Clin Nutr, 79(2), 268-273.	No intervention
Donnelly, J. E., Jacobsen, D. J., Whatley, J. E., Hill, J. O., Swift, L. L., Cherrington, A., et al. (1996). Nutrition and physical activity program to attenuate obesity and promote physical and metabolic fitness in elementary school children. Obes Res, 4(3), 229-243.	Curriculum-based intervention
Dreimane, D., Safani, D., MacKenzie, M., Halvorson, M., Braun, S., Conrad, B., et al. (2007). Feasibility of a hospital-based, family-centered intervention to reduce weight gain in overweight children and adolescents. Diabetes Res Clin Pract, 75(2), 159-168.	Obesity treatment
Dzewaltowski, D. A., Estabrooks, P. A., & Johnston, J. A. (2002). Healthy youth places promoting nutrition and physical activity. Health Educ Res, 17(5), 541-551.	No PA data
Edmundson, E., Parcel, G. S., Feldman, H. A., Elder, J., Perry, C. L., Johnson, C. C., et al. (1996). The effects of the Child and Adolescent Trial for Cardiovascular Health upon psychosocial determinants of diet and physical activity behavior. Prev Med, 25(4), 442-454.	No PA data
Elder, J. P., McGraw, S. A., Stone, E. J., Reed, D. B., Harsha, D. W., Greene, T., et al. (1994). CATCH: process evaluation of environmental factors and programs. Health Educ Q, Suppl 2, S107-127.	No PA data
Engels, H. J., Gretebeck, R. J., Gretebeck, K. A., & Jimenez, L. (2005). Promoting healthful diets and exercise: efficacy of a 12-week after-school program in urban African Americans. J Am Diet Assoc, 105(3), 455-459.	Inappropriate PA measure
Epstein, L. H., Roemmich, J. N., Paluch, R. A., & Raynor, H. A. (2005). Physical activity as a substitute for sedentary behavior in youth. Ann Behav Med, 29(3), 200-209.	No intervention
Ernst, M. P., & Pangrazi, R. P. (1999). Effects of a physical activity program on children's activity levels and attraction to physical activity. Ped Exerc Sci, 11(4), 393-405.	Curriculum-based intervention
Fardy, P. S., White, R. E., Haltiwanger-Schmitz, K., Magel, J. R., McDermott, K. J., Clark, L. T., et al. (1996). Coronary disease risk factor reduction and behavior modification in minority adolescents: the PATH program. J Adolesc Health, 18(4), 247-253.	No PA data
Farley, T. A., Meriwether, R. A., Baker, E. T., Watkins, L. T., Johnson, C. C., & Webber, L. S. (2007). Safe play spaces to promote physical activity in inner-city children: results from a pilot study of an environmental intervention. *American Journal of Public Health, 97*(9), 1625-1631.	Environmental intervention
Felton, G., Saunders, R. P., Ward, D. S., Dishman, R. K., Dowda, M., & Pate, R. R. (2005). Promoting physical activity in girls: a case study of one school's success. J Sch Health, 75(2), 57-62.	Curriculum-based intervention
Flores, R. (1995). Dance for health: improving fitness in African American and Hispanic adolescents. Public Health Rep, 110(2), 189-193.	Inappropriate PA measure
Ford, B. S., McDonald, T. E., Owens, A. S., & Robinson, T. N. (2002). Primary care interventions to reduce television viewing in African-American children. Am J Prev Med, 22(2), 106-109.	PA behaviour not primary focus
Fragala-Pinkham, M. A., Haley, S. M., & Goodgold, S. (2006). Evaluation of a community-based group fitness program for children with disabilities. Pediatr Phys Ther, 18(2), 159-167.	Inappropriate population
Fragala-Pinkham, M. A., Haley, S. M., Rabin, J., & Kharasch, V. S. (2005). A fitness program for children with disabilities. Phys Ther, 85(11), 1182-1200.	Inappropriate population
French, S. A., Story, M., Fulkerson, J. A., Himes, J. H., Hannan, P., Neumark-Sztainer, D., et al. (2005). Increasing weight-bearing physical activity and	Inappropriate PA measure

calcium-rich foods to promote bone mass gains among 9-11 year old girls: outcomes of the Cal-Girls study. Int J Behav Nutr Phys Act, 2, 8.	
Frenn, M., Malin, S., Bansal, N., Delgado, M., Greer, Y., Havice, M., et al. (2003). Addressing health disparities in middle school students' nutrition and exercise. J Community Health Nurs, 20(1), 1-14.	Curriculum-based intervention
Frenn, M., Malin, S., Brown, R. L., Greer, Y., Fox, J., Greer, J., et al. (2005). Changing the tide: an Internet/video exercise and low-fat diet intervention with middle-school students. App Nurs Res: 18(1), 13-21.	Curriculum-based intervention
Golan, M., & Crow, S. (2004). Targeting parents exclusively in the treatment of childhood obesity: long-term results. Obes Res, 12(2), 357-361.	Obesity treatment
Golan, M., Fainaru, M., & Weizman, A. (1998). Role of behaviour modification in the treatment of childhood obesity with the parents as the exclusive agents of change. Int J Obes Relat Metab Disord, 22(12), 1217-1224.	Obesity treatment
Golan, M., Kaufman, V., & Shahar, D. R. (2006). Childhood obesity treatment: targeting parents exclusively v. parents and children. Br J Nutr, 95(5), 1008-1015.	Obesity treatment
Golan, M., Weizman, A., Apter, A., & Fainaru, M. (1998). Parents as the exclusive agents of change in the treatment of childhood obesity. Am J Clin Nutr, 67(6), 1130-1135.	Obesity treatment
Goran, M. I., & Reynolds, K. (2005). Interactive multimedia for promoting physical activity (IMPACT) in children. Obes Res, 13(4), 762-771.	Inappropriate population
Gortmaker, S. L., Cheung, L. W., Peterson, K. E., Chomitz, G., Cradle, J. H., Dart, H., et al. (1999). Impact of a school-based interdisciplinary intervention on diet and physical activity among urban primary school children: eat well and keep moving. Arch Pediatr Adolesc Med, 153(9), 975-983.	Curriculum-based intervention
Gortmaker, S. L., Peterson, K., Wiecha, J., Sobol, A. M., Dixit, S., Fox, M. K., et al. (1999). Reducing obesity via a school-based interdisciplinary intervention among youth: Planet Health. Arch Pediatr Adolesc Med, 153(4), 409-418.	Curriculum-based intervention
Grahn, P. (1996). Wild nature makes children healthy. J Swedish Build Res, 4, 16-18.	No intervention
Grandes, G., Sanchez, A., Torcal, J., Ortega Sanchez-Pinilla, R., Lizarraga, K., & Serra, J. (2003). Protocol for the multi-centre evaluation of the Experimental Programme Promotion of Physical Activity (PEPAF). Aten Primaria, 32(8), 475-480.	No PA data
Haerens, L., Deforche, B., Maes, L., Stevens, V., Cardon, G., & De Bourdeaudhuij, I. (2006). Body mass effects of a physical activity and healthy food intervention in middle schools. Obesity (Silver Spring), 14(5), 847-854.	No PA data
Haggerty, R. J., Aligne, C. A., Bell, M. K., & Limbos, M. A. (2007). Pediatrics in the community: the Earn-a-Bike program. Pediatr Rev, 28(1), 23-25.	No PA data
Halas, J., & Orchard, T. (2002). Culturally relevant physical activity for adolescent mothers: an action research study. . Phys Health Educ J, 68(1).	No PA data
Harrell, J. S., Gansky, S. A., McMurray, R. G., Bangdiwala, S. I., Frauman, A. C., & Bradley, C. B. (1998). School-based interventions improve heart health in children with multiple cardiovascular disease risk factors. Pediatrics, 102(2 Pt 1), 371-380.	Subset of larger study included in review
Harrell, J. S., McMurray, R. G., Bangdiwala, S. I., Frauman, A. C., Gansky, S. A., & Bradley, C. B. (1996). Effects of a school-based intervention to reduce cardiovascular disease risk factors in elementary-school children: the Cardiovascular Health in Children (CHIC) study. J Pediatr, 128(6), 797-805.	Curriculum-based intervention
Harrell, J. S., McMurray, R. G., Gansky, S. A., Bangdiwala, S. I., & Bradley, C. B. (1999). A public health vs a risk-based intervention to improve cardiovascular health in elementary school children: the Cardiovascular Health in Children Study. Am J Public Health, 89(10), 1529-1535.	Curriculum-based intervention
Harris, K. J., Richter, K. P., Paine-Andrews, A., Lewis, R. K., Johnston, J. A., James, V., et al. (1997). Community partnerships: Review of selected models and evaluation of two case studies. J Nutr Educ, 29, 189-195.	Review / commentary
Harrison, M., Burns, C. F., McGuinness, M., Heslin, J., & Murphy, N. M. (2006). Influence of a health education intervention on physical activity and	Curriculum-based intervention

screen time in primary school children: 'Switch Off--Get Active'. J Sci Med Sport, 9(5), 388-394.	
Heimendinger, J., Uyeki, T., Andhara, A., Marshall, J. A., Scarbro, S., Belansky, E., et al. (2007). Coaching process outcomes of a family visit nutrition and physical activity intervention. Health Educ Behav, 34(1), 71-89.	No PA data
Hermann, J. R., Parker, S. P., Brown, B. J., Siewe, Y. J., Denney, B. A., & Walker, S. J. (2006). After-school gardening improves children's reported vegetable intake and physical activity. J Nutr Educ Behav, 38(3), 201-202.	Inappropriate population
Hickman, S. A., Allert, C., Sallis, J. F., Hovell, M. F., Hofstetter, C. R., & Tai, M. (1994). Say YES to Sports and NO to Tobacco: A Fun and Effective Community Outreach Program for High-Risk Youth to San Diego. J Health Educ, 25(5), 316-317.	Insufficient PA data
Higgins, J. W., & Reed, N. (2001). The girlpower project--recreation, BC health goals and social capital. Can J Public Health, 92(6), 448-452.	No PA data
Hopper, C., Munoz, K. D., MacConnie, S., & Gruber, M. B. (1998). A Family Fitness Program for Children with Learning Disabilities in Remote Rural Regions. Rural Special Educ Q, 17(1), 28-32.	Inappropriate PA measure
Hopper, C. A., Gruber, M. B., Munoz, K. D., & Herb, R. A. (1992). Effect of including parents in a school-based exercise and nutrition program for children. Res Q Exerc Sport, 63(3), 315-321.	Inappropriate PA measure
Hopper, C. A., Munoz, K. D., Gruber, M. B., & Nguyen, K. P. (2005). The effects of a family fitness program on the physical activity and nutrition behaviors of third-grade children. Res Q Exerc Sport, 76(2), 130-139.	Inappropriate PA measure
Hortz, B., & Petosa, R. (2006). Impact of the "Planning to be Active" leisure time physical exercise program on rural high school students. J Adolesc Health, 39(4), 530-535.	Curriculum-based intervention
Howard, J. K., Bindler, R. M., Synoground, G., & van Gemert, F. C. (1996). A cardiovascular risk reduction program for the classroom. J Sch Nurs: 12(4), 4-11.	Inappropriate PA measure
Hsu, L. F., & Wang, R. H. (2004). The effectiveness of an intervention program to promote physical activity among female adolescents in a vocational nursing school. Hu Li Za Zhi, 51(5), 27-36.	Article in Chinese
Hunter, S. M., Johnson, C. C., Little-Christian, S., Nicklas, T. A., Harsha, D., Arbeit, M. L., et al. (1990). Heart Smart: A Multifaceted Cardiovascular Risk Reduction Program for Grade School Students. Am J Health Promot, 5(104).	Inappropriate PA measure
Ignico, A. A., & Ethridge, K. (1997). The effects of a physical activity program on low-fit children's activity level and aerobic endurance. Early Child Dev Care, 135, 103-108.	Inappropriate PA measure
Iversen, S., Ellertsen, B., Tytlandsvik, A., & Nodland, M. (2005). Intervention for 6-year-old children with motor coordination difficulties: Parental perspectives at follow-up in middle childhood. Adv Physio, 7(2), 67-76.	Inappropriate population
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Jiang, J., Xia, X., Greiner, T., Wu, G., Lian, G., & Rosenqvist, U. (2007). The effects of a 3-year obesity intervention in schoolchildren in Beijing. Child Care Health Dev, 33(5), 641-646.	Inappropriate population
Johnson, C. C., & Nicklas, T. A. (1995). Health ahead--the Heart Smart Family approach to prevention of cardiovascular disease. Am J Med Sci, 310 Suppl 1, S127-132.	No PA data
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Johnson, C. C., Osganian, S. K., Budman, S. B., Lytle, L. A., Barrera, E. P.,	No PA data

Bonura, S. R., et al. (1994). CATCH: family process evaluation in a multicenter trial. Health Educ Q, Suppl 2, S91-106.	
Jones, G., Stuart, J., Parkins, G., Millar, C., Stewart, K., Murray, A., et al. (2007). The effect of a 16-week implementation of intervention strategies into after-school activity lesson plans on the aerobic fitness and percentage body fat of children aged 8-14 years old. . Br J Sport Med, 41(2).	Abstract only
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Kelder, S. H., Perry, C. L., Lytle, L. A., & Klepp, K. I. (1995). Community-wide youth nutrition education: long-term outcomes of the Minnesota Heart Health Program. Health Educ Res, 10(2), 119-131.	No PA data
Klohe-Lehman, D. M., Freeland-Graves, J., Clarke, K. K., Cai, G., Voruganti, V. S., Milani, T. J., et al. (2007). Low-income, overweight and obese mothers as agents of change to improve food choices, fat habits, and physical activity in their 1-to-3-year-old children. J Am Coll Nutr, 26(3), 196-208.	Inappropriate population
Knutsen, S. F., & Knutsen, R. (1991). The Tromso Survey: the Family Intervention study--the effect of intervention on some coronary risk factors and dietary habits, a 6-year follow-up. Prev Med, 20(2), 197-212.	No PA data
Koontz, A. D. (2002). A mission-based program evaluation and outcome study of a diabetes summer camp. Dissertation Abstracts International: Section B: The Sciences and Engineering, 62(10-B).	Inappropriate population
Kozub, F. M. (2001). The family systems theory: adapted physical activity programming within the family. Palaestra, 17(3), 30-38.	Inappropriate population
Kushner, R. F., Blatner, D. J., Jewell, D. E., & Rudloff, K. (2006). The PPET Study: people and pets exercising together. Obesity (Silver Spring), 14(10), 1762-1770.	Wrong age group
Langnase, K., Asbeck, I., Mast, M., & Muller, M. J. (2004). The influence of socio-economic status on the long-term effect of family-based obesity treatment intervention in prepubertal overweight children. Health Educ, 104(6), 336-343.	Obesity treatment
LaRowe, T. L., Wubben, D. P., Cronin, K. A., Vannatter, S. M., & Adams, A. K. (2007). Development of a culturally appropriate, home-based nutrition and physical activity curriculum for Wisconsin American Indian families. Prev Chronic Dis, 4(4), A109.	Inappropriate population
Ledman, S. M., Thompson, B., & Hill, J. W. (1991). The EveryBuddy Program: an integrated after-school program. Child Today, 20(2), 17-20.	No PA data
Leonard, B., Byers, T., Campbell, C., & Wiese, W. (1991). HealthNet New Mexico: a community-based statewide health promotion program. Am J Health Promot, 5(5), 368-377.	No PA data
Leslie, J., Yancy, A., McCarthy, W., Albert, S., Wert, C., Miles, O., et al. (1999). Development and implementation of a school-based nutrition and fitness promotion program for ethnically diverse middle-school girls. J Am Diet Assoc, 99(8), 967-970.	Insufficient PA data
Levin, S., & Martin, M. (2002). Catch the Catawba SPARK: Physical Activity for Head Start Youths. J PE Rec Dance, 73(3), 39-52.	No PA data
Lewis, C. E., Raczynski, J. M., Heath, G. W., Levinson, R., Hilyer, J. C., Jr., & Cutter, G. R. (1993). Promoting physical activity in low-income African-American communities: the PARR project. Ethn Dis, 3(2), 106-118.	Wrong age group
Lubans, D., & Sylva, K. (2006). Controlled Evaluation of a Physical Activity Intervention for Senior School Students: Effects of the Lifetime Activity Program. J Sport Ex Psych, 28(3), 252-268.	Curriculum-based intervention
Luepker, R. V. (1993). An update and review of the Minnesota Heart Health Program. Ann Epidemiol, 3(5).	No PA data
Luepker, R. V., Murray, D. M., Jacobs, D. R., Jr., Mittelmark, M. B., Bracht, N., Carlaw, R., et al. (1994). Community education for cardiovascular disease	Wrong age group

prevention: risk factor changes in the Minnesota Heart Health Program. Am J Public Health, 84(9), 1383-1393.	
Luepker, R. V., & Perry, C. L. (1991). The Minnesota Heart Health Program. Education for youth and parents. Ann N Y Acad Sci, 623, 314-321.	No PA data
Manios, Y., Kafatos, A., & Mamalakis, G. (1998). The effects of a health education intervention initiated at first grade over a 3 year period: physical activity and fitness indices. Health Educ Res, 13(4), 593-606.	Curriculum-based intervention
Manios, Y., Moschandreas, J., Hatzis, C., & Kafatos, A. (1999). Evaluation of a health and nutrition education program in primary school children of Crete over a three-year period. Prev Med, 28(2), 149-159.	Curriculum-based intervention
Marks, J. T., Campbell, M. K., Ward, D. S., Ribisl, K. M., Wildemuth, B. M., & Symons, M. J. (2006). A comparison of Web and print media for physical activity promotion among adolescent girls. J Adolesc Health, 39(1), 96-104.	Included in adolescent girls review
Matsudo, V., Matsudo, S., Andrade, D., Araujo, T., Andrade, E., de Oliveira, L. C., et al. (2002). Promotion of physical activity in a developing country: the Agita Sao Paulo experience. Public Health Nutr, 5(1A), 253-261.	Inappropriate population
McKenzie, T. L., Nader, P. R., Strikmiller, P. K., Yang, M., Stone, E. J., Perry, C. L., et al. (1996). School physical education: effect of the Child and Adolescent Trial for Cardiovascular Health. Prev Med, 25(4), 423-431.	Curriculum-based intervention
McKenzie, T. L., Sallis, J. F., Prochaska, J. J., Conway, T. L., Marshall, S. J., & Rosengard, P. (2004). Evaluation of a two-year middle-school physical education intervention: M-SPAN. Med Sci Sports Exerc, 36(8), 1382-1388.	Curriculum-based intervention
McKenzie, T. L., Strikmiller, P. K., Stone, E. J., Woods, S. E., Ehlinger, S. S., Romero, K. A., et al. (1994). CATCH: physical activity process evaluation in a multicenter trial. Health Educ Q, Suppl 2, S73-89.	Curriculum-based intervention
Moon, A., Mullee, M., Rogers, L., Thompson, R., Speller, V., & Roderick, P. (1999). Helping schools to become health-promoting environments - an evaluation of the Wessex Healthy Schools Award. Health Promot Int, 14(2), 111-122.	Curriculum-based intervention
Muller, M. J., Asbeck, I., Mast, M., Langnase, K., & Grund, A. (2001). Prevention of obesity--more than an intention. Concept and first results of the Kiel Obesity Prevention Study (KOPS). Int J Obes Relat Metab Disord, 25 Suppl 1, S66-74.	Curriculum-based intervention
Mummery, W. K., Schofield, G., Hinchliffe, A., Joyner, K., & Brown, W. (2006). Dissemination of a community-based physical activity project: the case of 10,000 steps. J Sci Med Sport, 9(5), 424-430.	Wrong age group
Nader, P. R., Stone, E. J., Lytle, L. A., Perry, C. L., Osganian, S. K., Kelder, S., et al. (1999). Three-year maintenance of improved diet and physical activity: the CATCH cohort. Child and Adolescent Trial for Cardiovascular Health. Arch Pediatr Adolesc Med, 153(7), 695-704.	Curriculum-based intervention
Naylor, P. J., Macdonald, H. M., Zebedee, J. A., Reed, K. E., & McKay, H. A. (2006). Lessons learned from Action Schools! BC--an 'active school' model to promote physical activity in elementary schools. J Sci Med Sport, 9(5), 413-423.	Curriculum-based intervention
Palmer, S., Graham, G., & Elliott, E. (2005). Effects of a web-based health program on fifth grade children's physical activity knowledge, attitudes and behavior. Am J Health Educ, 36(2), 86-93.	Curriculum-based intervention
Pangrazi, R. P., Beighle, A., Vehige, T., & Vack, C. (2003). Impact of Promoting Lifestyle Activity for Youth (PLAY) on children's physical activity. J Sch Health, 73(8), 317-321.	Curriculum-based intervention
Pate, R. R., Saunders, R., Dishman, R. K., Addy, C., Dowda, M., & Ward, D. S. (2007). Long-term effects of a physical activity intervention in high school girls. Am J Prev Med, 33(4), 276-280.	Curriculum-based intervention
Pate, R. R., Trost, S. G., Mullis, R., Sallis, J. F., Wechsler, H., & Brown, D. R. (2000). Community interventions to promote proper nutrition and physical activity among youth. Prev Med, 31(2).	Review / commentary
Pate, R. R., Ward, D. S., Saunders, R. P., Felton, G., Dishman, R. K., & Dowda, M. (2005). Promotion of physical activity among high-school girls: a randomized controlled trial. Am J Public Health, 95(9), 1582-1587.	Curriculum-based intervention

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Perry, C. L. P. (1992). The Child and Adolescent Trial for Cardiovascular Health (CATCH): Overview of the intervention program and evaluation methods. Cardio Risk Factors, 2(1).	Curriculum-based intervention
Peters, J. M., & Wright, A. M. (1999). Development and evaluation of a group physical activity programme for children with developmental co-ordination disorder: An interdisciplinary approach. Physio Theory Pract, 15(4), 203-216.	Inappropriate population
Pratt, M., Macera, C. A., Sallis, J. F., O'Donnell, M., & Frank, L. D. (2004). Economic interventions to promote physical activity: application of the SLOTH model. Am J Prev Med, 27(3 Suppl), 136-145.	No intervention
Prochaska, J. J. (2002). The PACE+ school study: Evaluation of the efficacy of promoting change in a single versus multiple health behaviors. . Dissertation Abstracts International: Section B: The Sciences and Engineering, 63(4-B).	Included in adolescent girls review
Prochaska, J. J., & Sallis, J. F. (2004). A randomized controlled trial of single versus multiple health behavior change: promoting physical activity and nutrition among adolescents. Health Psych, 23(3), 314-318.	Curriculum-based intervention
Ransdell, L. B., Oakland, D., & Taylor, A. (2003). Increasing physical activity in girls and women: Lessons learnt from the DAMET project. J PE Rec Dance: 74(1), 37-55.	Review / commentary
Reid, J. (2001). The Play@Home programme. Pract Midwife, 4(2), 32-35.	No PA data
Renger, R., Steinfelt, V., & Lazarus, S. (2002). Assessing the effectiveness of a community-based media campaign targeting physical inactivity. Fam Community Health, 25(3), 18-30.	Wrong age group
Resnicow, K., Cohn, L., Reinhardt, J., Cross, D., Futterman, R., Kirschner, E., et al. (1992). A three-year evaluation of the know your body program in inner-city schoolchildren. Health education quarterly, 19(4), 463-480.	No PA data
Resnicow, K., Taylor, R., Baskin, M., & McCarty, F. (2005). Results of go girls: a weight control program for overweight African-American adolescent females. Obes Res, 13(10), 1739-1748.	Inappropriate PA measure
Resnicow, K., Yaroch, A. L., Davis, A., Wang, D. T., Lyn, R., London, J., et al. (1999). GO GIRLS!: development of a community-based nutrition and physical activity program for overweight African-American adolescent females. J Nutr Educ, 31(5).	No PA data
Ridgers, N. D., & Stratton, G. (2005). Physical activity during school recess: The Liverpool Sporting Playgrounds Project. Ped Exerc Sci, 17(3), 281-290.	No intervention
Rooney, B. L., Gritt, L. R., Havens, S. J., Mathiason, M. A., & Clough, E. A. (2005). Growing healthy families: family use of pedometers to increase physical activity and slow the rate of obesity. Wmj, 104(5), 54-60.	Not family / community – based intervention
Rowley, C., Dixon, L., & Palk, R. (2007). Promoting physical activity: walking programmes for mothers and children. Community Pract, 80(3), 28-32.	No PA data
Rowley, K. G., Daniel, M., Skinner, K., Skinner, M., White, G. A., & O'Dea, K. (2000). Effectiveness of a community-directed 'healthy lifestyle' program in a remote Australian aboriginal community. Aust N Z J Public Health, 24(2), 136-144.	Inappropriate population
Rudd, R. E., Goldberg, J., & Dietz, W. (1999). A five-stage model for sustaining a community campaign. J Health Commun, 4(1), 37-48.	No PA data
Saakslahti, A., Numminen, P., Salo, P., Tuominen, J., Helenius, H., & Valimaki, I. (2004). Effects of a three-year intervention on children's physical activity from age 4 to 7. . Ped Exerc Sci, 16, 167-180.	Inappropriate PA measure
Sadler, L. S., & Cowlin, A. (2003). Moving into Parenthood: a program for new adolescent mothers combining parent education with creative physical activity. J Spec Pediatr Nurs, 8(2), 62-70.	Not focused on PA behaviour
Sahota, P., Rudolf, M. C., Dixey, R., Hill, A. J., Barth, J. H., & Cade, J. (2001). Evaluation of implementation and effect of primary school based intervention to reduce risk factors for obesity. BMJ, 323(7320), 1027-1029.	Curriculum-based intervention

Sahota, P., Rudolf, M. C., Dixey, R., Hill, A. J., Barth, J. H., & Cade, J. (2001). Randomised controlled trial of primary school based intervention to reduce risk factors for obesity. BMJ, 323(7320), 1029-1032.	Curriculum-based intervention
Sakofs, M., & Schuurman, D. (1992). Assessing the Impact of the Wilderness Alternative for Youth Programme: An Outward Bound Programme for Adjudicated Youth. Journal of Adventure Education and Outdoor Leadership, 9(4), 16-21.	No PA data
Sallis, J. F., McKenzie, T. L., Conway, T. L., Elder, J. P., Prochaska, J. J., Brown, M., et al. (2003). Environmental interventions for eating and physical activity: a randomized controlled trial in middle schools. Am J Prev Med, 24(3), 209-217.	Curriculum-based intervention
Sallis, J. F. N. (1990). Family exercise: Designing a program to fit everyone. Physician and Sportsmedicine, 18(9).	No intervention
Salmon, J., Ball, K., Crawford, D., Booth, M., Telford, A., Hume, C., et al. (2005). Reducing sedentary behaviour and increasing physical activity among 10-year-old children: overview and process evaluation of the 'Switch-Play' intervention. Health Promot Int, 20(1), 7-17.	No PA data
Simons-Morton, B. G., Parcel, G. S., Baranowski, T., Forthofer, R., & O'Hara, N. M. (1991). Promoting physical activity and a healthful diet among children: results of a school-based intervention study. Am J Public Health, 81(8), 986-991.	Insufficient PA data
Stice, E., Shaw, H., & Marti, C. N. (2006). A meta-analytic review of obesity prevention programs for children and adolescents: the skinny on interventions that work. Psychol Bull, 132(5), 667-691.	Review / commentary
Stock, S., Miranda, C., Evans, S., Plessis, S., Ridley, J., Yeh, S., et al. (2007). Healthy Buddies: a novel, peer-led health promotion program for the prevention of obesity and eating disorders in children in elementary school. Pediatrics, 120(4), e1059-1068.	Insufficient PA data
Stolley, M. R. (1997). Developing an effective cardiovascular risk reduction program for inner-city African-American youth: "Hip-hop to health". Dissertation Abstracts International: Section B: The Sciences and Engineering, 58(4-B).	Published paper included in U8's
Stone, E. J., Osganian, S. K., McKinlay, S. M., Wu, M. C., Webber, L. S., Luepker, R. V., et al. (1996). Operational design and quality control in the CATCH multicenter Trial. Prev Med, 25(4), 384-399.	Curriculum-based intervention
Strong, W. B. (1990). Physical activity and children. Circulation, 81(5), 1697-1701.	Review / commentary
Teufel, N. I., Perry, C. L., Story, M., Flint-Wagner, H. G., Levin, S., Clay, T. E., et al. (1999). Pathways family intervention for third-grade American Indian children. Am J Clin Nutr, 69(4 Suppl), 803S-809S.	Inappropriate population
Tuzin, B. J., Mulvihill, M. M., Kilbourn, K. M., Bertran, D. A., Buono, M., Hovell, M. F., et al. (1998). Increasing physical activity of children with cystic fibrosis: A home-based family intervention. Ped Exerc Sci, 10(1), 57-68.	Inappropriate population
Walker, Z., Townsend, J., Oakley, L., Donovan, C., Smith, H., Hurst, Z., et al. (2002). Health promotion for adolescents in primary care: randomised controlled trial. Bmj, 325(7363), 524.	Inappropriate PA measure
Wang, Y., Tussing, L., Odoms-Young, A., Braunschweig, C., Flay, B., Hedeker, D., et al. (2006). Obesity prevention in low socioeconomic status urban African-american adolescents: study design and preliminary findings of the HEALTH-KIDS Study. Eur J Clin Nutr, 60(1), 92-103.	Insufficient PA data
Watson, D. L., Poczwaradowski, A., & Eisenman, P. (2000). After-School Physical Activity Programs for Adolescent Girls. J PE Rec Dance, 71(8), 17-27.	No PA data
Webber, L. S., Osganian, S. K., Feldman, H. A., Wu, M., McKenzie, T. L., Nichaman, M., et al. (1996). Cardiovascular risk factors among children after a 2 1/2-year intervention-The CATCH Study. Prev Med, 25(4), 432-441.	No PA data
Werch, C., Moore, M., DiClemente, C. C., Owen, D. M., Jobli, E., & Bledsoe, R. (2003). A sport-based intervention for preventing alcohol use and promoting physical activity among adolescents. J Sch Health, 73(10), 380-	Not family or community based intervention

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Werch, C. C., Moore, M. J., DiClemente, C. C., Bledsoe, R., & Jobli, E. (2005). A multihealth behavior intervention integrating physical activity and substance use prevention for adolescents. Prev Sci, 6(3), 213-226.	Not family or community based intervention
Williams, E. A., & Bedward, J. (1999). Games for the Girls: The Impact of Recent Policy on the Provision of Physical Education and Sporting Opportunities for Female Adolescents. A Report of a Study Funded by the Nuffield Foundation. Winchester:: Winchester King Alfred's College . .	No intervention
Williams, K., Prevost, A. T., Griffin, S., Hardeman, W., Hollingworth, W., Spiegelhalter, D., et al. (2004). The ProActive trial protocol - a randomised controlled trial of the efficacy of a family-based, domiciliary intervention programme to increase physical activity among individuals at high risk of diabetes [ISRCTN61323766]. BMC Public Health, 4, 48.	No PA data
Williamson, D. A., Copeland, A. L., Anton, S. D., Champagne, C., Han, H., Lewis, L., et al. (2007). Wise Mind project: a school-based environmental approach for preventing weight gain in children. Obesity (Silver Spring), 15(4), 906-917.	Curriculum-based intervention
Wormald, H., Waters, H., Sleap, M., & Ingle, L. (2006). Participants' perceptions of a lifestyle approach to promoting physical activity: targeting deprived communities in Kingston-upon-Hull. BMC Public Health, 6, 202.	No intervention
Wright, J. E., Webb, P. I., Rowland, G. S., Vialle, W. J., & Wilsmore, G. (2000). Linking Young People with Community Sport: An Evaluation of the Sport Search Program. Healthy Lifestyles J, 47, 9-14.	Inappropriate PA measure
Zizzi, S., Vitullo, E., Rye, J., O'Hara-Tompkins, N., Abildso, C., Fisher, B., et al. (2006). Impact of a three-week pedometer intervention on high school students' daily step counts and perceptions of physical activity. Am J Health Educ, 37(1), 35-40.	Not family / community – based intervention

Annex C: Theoretical Frameworks: A Summary

Some of the interventions reported in this review have used theoretical frameworks to inform the intervention protocol. Social Cognitive Theory (SCT) has been the theoretical framework most used, but others are Self-Determination Theory, theTranstheoretical Model (TTM), and Pender's Health Promotion Model.

Social Cognitive Theory

The contemporary SCT framework tends to be based on the work of American psychologist Dr Albert Bandura (Stanford University). His early work can be described as adopting a 'social learning theory' perspective (Bandura, 1977) which he developed as a clinical psychologist treating patients. This was modified into what is now referred to as SCT (Bandura, 1986). One well known element of SCT is self-efficacy (Bandura, 1997).

SCT suggests that we learn and modify our behaviours through an interaction between personal, behavioural, and environmental influences. This is the so-called model of 'reciprocal determinism', as shown in Figure A1. In other words, we are not merely a function of the environment, nor are we merely passively following our psychological characteristics. Moreover, our own and others' behaviour can influence us. Put together, all three factors influence how we think, feel, and act.

Key cognitive elements of SCT comprise the ability of humans to think about the likely consequences of their actions. Bandura refers to this as our 'symbolising capability', or our ability to think about and anticipate future courses of action. Similarly, SCT comprises a self-regulation component. Here, we regulate our behaviour based on our own goals, behaviours, and feelings. For example, people may adopt a certain goal of exercise that helps motivate action. Attempting to meet that goal regulates our thoughts and behaviour.

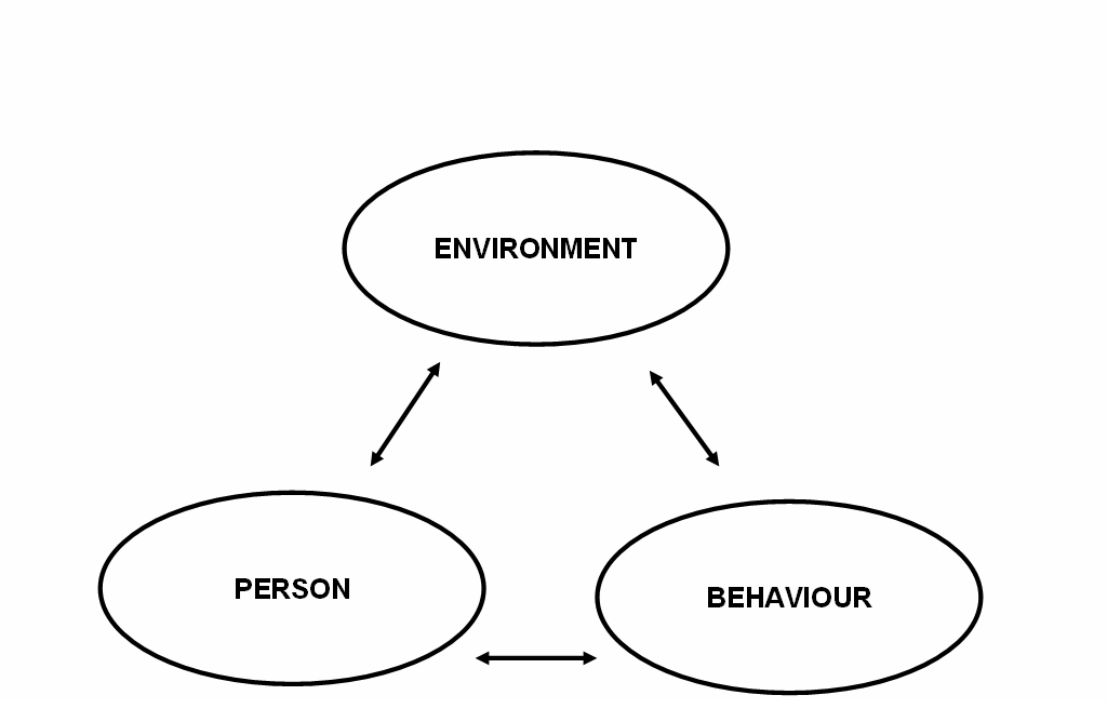

Figure A1. The reciprocal interaction between person, behaviour and environment, as proposed by SCT.

We also reflect on our actions, particularly in respect of thinking about the consequences of our behaviours ('outcome expectancies') and our own capabilities ('efficacy expectancies'). Thinking about consequences is best illustrated in physical activity by the way we think about the benefits and costs of being more active. In other words, if I am more active, what are the consequences? I could believe these to be positive (better health, fitness, functionality, social relations) or negative (injury, perception of inappropriate use of time, expense).

Self-Efficacy. The element of SCT concerning self reflection of our capability has led to Bandura's most significant contribution, that of 'self-efficacy'. This is situation-specific confidence to undertake a certain behaviour. It refers, therefore, to efficacy beliefs and expectations, or, in simple terms, the 'can I?' question. This will determine many behaviours, especially those that challenge us, such as being more physically active, or giving up smoking. If someone believes they can adopt and maintain the behaviour in question, they are more likely to do so.

Research on self-efficacy in physical activity shows this to be a very important antecedent of behaviour (i.e., a correlate of physical activity), as well as an outcome of participation (i.e., positive experiences boost self-efficacy) (McAuley & Blissmer, 2000; McAuley & Morris, 2007). In addition, self-efficacy beliefs are most potent for a specific situation or task. In other words, if you gain positive experiences through walking, you will gain self-efficacy for walking. This does not necessarily mean that you are confident attending a local dance class. There could be overlaps between different physical activity behaviours, but this will not necessarily be the case.

There are four main sources of information that we might use to develop our levels of self-efficacy:

- *prior success and performance attainment*: what happens in the past will affect how you feel about future efforts at the same, or similar, behaviours. Obviously, continued perceived 'failure' or bad experiences (with PE at school, for example), are likely to create feelings of low self-efficacy. Alternatively, positive experiences of 'success' (however defined) can boost self-efficacy.
- *imitation and modelling*: we learn from watching others. Evidence suggests that confidence can be obtained from observing people similar to ourselves being successful ("if they can do it, so can I!"). This influence is likely to be stronger if the behaviour in question is new to us, and hence we have limited or no prior experience. In addition, observing how people cope with adversity, can boost self-efficacy. For example, watching someone like you walk to work (which you find boring and uncomfortable on the feet), use an *i-pod* and training shoes, might help increase confidence.
- *verbal and social persuasion*. Encouragement from others. If others show confidence in your abilities, particularly for difficult tasks, you may boost your feelings of efficacy. While this may not be a particularly powerful source of self-efficacy, it can be influential, and more so if the source of encouragement is seen to be knowledgeable and credible (e.g., GP, teacher).
- *judgements of physiological states*. For stressful or phobic behaviours, it is important to control physiological signs of anxiety and arousal. This may not apply directly to physical activity behaviours, but it does mean that confidence will more likely be enhanced through an environment that is positive and relaxing, and does not induce feelings of anxiety.

Self-Determination Theory

Developed by psychologists Ed Deci and Rich Ryan (University of Rochester), Self-Determination Theory (SDT) is a theory of motivation (Deci & Ryan, 2002; Hagger & Chatzisarantis, 2007). While it contains several mini theories, the basic premise of SDT centres on a) satisfying psychological needs, and b) a continuum of intrinsic-extrinsic motivation that describes why we choose to do certain behaviours.

SDT proposes that we are driven by our innate desire to satisfy the three needs of:

- *autonomy*: the need to be the origin of one's behavior
- *competence*: the need to interact effectively within the environment
- *relatedness*: the need to feel connected, cared for, and close with others and one's community.

An autonomy-supportive environment (one that supports choice, initiation and understanding), rather than a controlling environment (one defined as authoritarian, pressuring and dictating), facilitates a more intrinsic style of motivation, healthy development and positive psychology. Perceptions of self-determination and autonomy – having choice – are central to feelings of high intrinsic motivation and well-being. Similarly, we feel more positive and have greater intrinsic motivation and interest in tasks when we satisfy our need to feel competent. This could be through demonstrating superiority over others or through personal improvement and effort. The latter is usually considered psychologically more healthy and sustainable over time.

Self-determination theory (SDT) is an approach to understanding why we take part in certain actions and behaviours. Understanding the differing intrinsic and extrinsic reasons why people act has been a central theme of SDT research. According to SDT, different types of motivation fall along a continuum of self-determination (see Figure A2). At the self-determined pole of the continuum is intrinsic motivation. This refers to behaviors that are performed for the activity's sake with no external reason (i.e., it's for the interest and pleasure it provides). In the middle of the continuum reside various forms of extrinsic motivation that vary in their degree of autonomy. Ranging from high to low autonomy, the reasons for our behaviour ('behavioural regulations') are identified regulation, introjected regulation, and external regulation. The left of the continuum describes behaviours that are 'controlling' and, therefore, lacking in choice, autonomy and self-determination.

Identified regulation occurs when the individual freely chooses to carry out an activity that is thought of as being important and consistent with one's sense of self or identity ('it's important to me'). Introjected regulation is when a behavior is performed to avoid feelings of guilt ('I would feel guilty if I didn't …'). External regulation occurs when an individual engages in a behavior solely to receive a reward or to avoid punishment ('I here because I have to be'). Clearly, we need to try to move people away from the external end of the continuum to the more self-determined (intrinsic) end. We can do this by looking for ways to satisfy the needs for autonomy (e.g., allow for choice), competence (e.g., boost feelings of competence through appropriate progression and personalised feedback), and social relatedness (e.g., develop social support and networks). Autonomy is best enhanced if you:

- provide a meaningful rationale for doing the activity: e.g., education, consciousness raising
- acknowledge the person's perspective, view points and experiences
- convey choice rather than control: e.g., through the environment you create or your style of interaction.

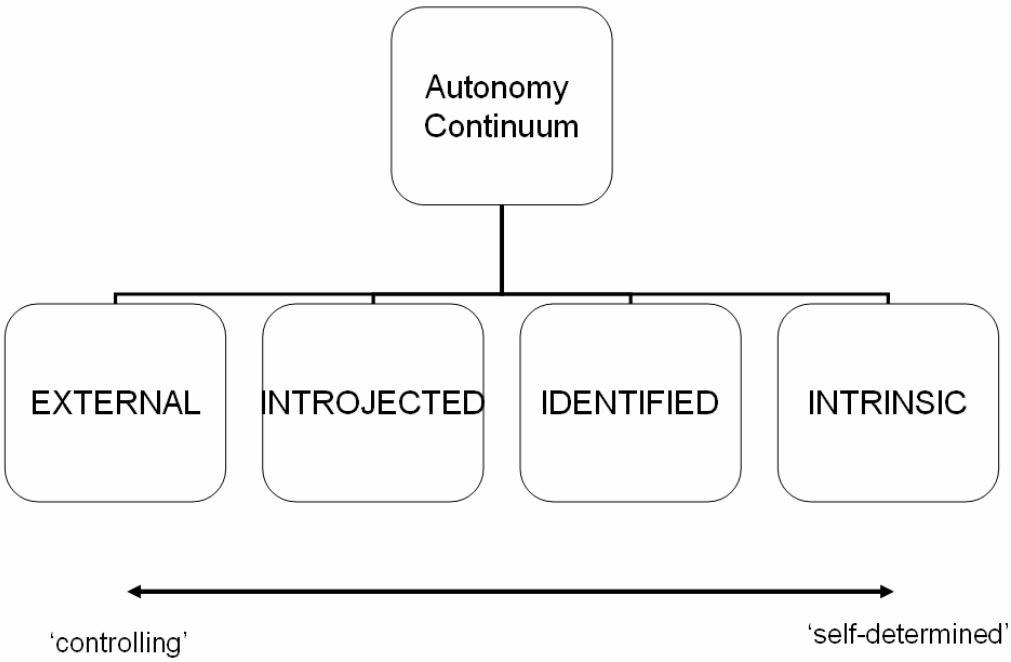

Figure A2. A self-determination continuum describing reasons for behaviours that range from controlling reasons to more self-determined reasons.

The Transtheoretical Model

Research into the nature of behaviour change in smokers and those presenting themselves for psychotherapy has suggested that recovery from problem behaviours, or successful behaviour change, involves movement through a series of stages. This has now been applied to physical activity (Marcus & Forsyth, 2003; Marshall & Biddle, 2001). The term 'transtheoretical model' has been used to describe the wider framework that encompasses both the ‘when’ (stages) and the ‘how’ of behaviour change, including the processes of change and moderators of change such as decisional balance and self-efficacy. The model was first developed by James Prochaska (University of Rhode Island) and Carlo DiClemente (University of Maryland).

Studies in physical activity have assessed precontemplation, contemplation, preparation, action, and maintenance stages. Precontemplation includes people who are not currently physically active (at the level specified) and have no intention of doing so in the near future. Those in the contemplation stage include those not currently physically active but who have an intention to start in the near future. Those in preparation are individuals who are currently doing some activity but not on a regular basis or may be intending to take action in the next month or so. The action stage represents people who are currently active, but have only recently started. The maintenance stage includes those who are currently physically active and have been doing so for some time, usually at least 6 months.

The stages outlined suggest a steady linear progression from one stage to the next. However, change may well be cyclical. In the context of physical activity, several attempts at change are likely before maintenance is reached.

The stages of change refer to the temporal patterning of behaviour change. But why and how might people change? By identifying processes of change TTM researchers have thought that they are able to better understand this temporal shift. Processes of change, therefore, may be important for interventions - for moving people between stages. Processes of change are the strategies and techniques people use as they progress through the different stages of change. Often these are grouped into cognitive (thinking) processes and behavioural (doing) processes. Early thinking suggested early stages were characterised by thinking processes and later stages by

doing processes. However, whether this distinction is important in physical activity is not clear.

One strategy that can assist people to make successful behaviour change is to weigh up the advantages of change ('pros') against the disadvantages or costs ('cons'). This 'decisional balance' exercise is one that has been at the core of the TTM. Research in cross sectional studies shows that at the early stages of behaviour change cons outweigh pros. Those in preparation are likely to have equality between the pros and cons, whereas those who are in maintenance will perceive more pros than cons. This suggests that influencing perceptions of pros and cons may assist in behaviour change and that reaching the stage of action may be dependent on having pros outweigh cons. Finally, evidence has shown that higher self-efficacy is associated with greater exercise readiness – that is, a more 'advanced' stage.

Pender's Health Promotion Model

This model was developed by Nola Pender (University of Michigan) and has been used in many studies in the literature on nursing. It is a broad-based heuristic model similar to others in health research, such as the Health Belief Model. The Health Promotion Model (HPM) is illustrated in Figure A3.

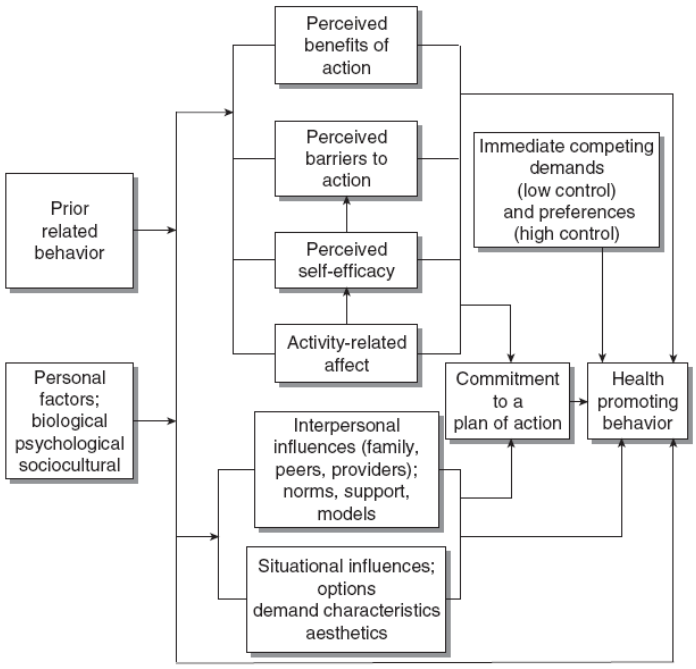

Figure A3. Pender's Health Promotion Model (Srof & Velsor-Friedrich, 2006)**.**

The model proposes that health promoting behaviours are a function individual characteristics and experiences, and behaviour-specific thoughts and feelings (e.g., specific to physical activity) and is derived from SCT. It proposes that health-related behaviour will be associated with psychological beliefs, such as perceived benefits and barriers of the behaviour, and self-efficacy, as well social and environmental influences, such as family support.

Useful websites:

1. Social Cognitive Theory

http://www.tcw.utwente.nl/theorieenoverzicht/Theory%20clusters/Health%20Communication/Social_cognitive_theory.doc/

http://www.learning-theories.com/social-learning-theory-bandura.html

http://www.idea.org/page110.html

http://www.comminit.com/en/node/27153

2. Self-Determination Theory

http://www.psych.rochester.edu/SDT/

3. The Transtheoretical Model

http://www.uri.edu/research/cprc/transtheoretical.htm

4. Pender's Health Promotion Model

http://www.nursing.umich.edu/faculty/pender_nola.html

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Glossary and Abbreviations

Af-Am	African American
BMI	Body mass index
CBA	Controlled before and after
CC	Collaborating Centre
CNRT	Controlled non-randomised trial
Community	Community: A group of people who have common characteristics; communities can be defined by location, race, ethnicity, age, occupation, interest in particular problems or outcomes, or other common bonds (Turnock 2004).
Con	Control group
Core physical skills	A sub-set of physical literacy, this includes key gross and fine motor skills (such as the ability to run, throw, catch a ball, jump, balance or hop) along with specific skills for physical activity such as the ability to swim, or ride a bicycle.
CPHE	Centre for Public Health Excellence
CRCT	Cluster randomised controlled trial
CV	Cardiovascular
d	Cohen's d - a type of effect size (0.2 = small, 0.5 = moderate, 0.8 = large)
ES	Effect size, an indication of the size/meaningfulness of a result. Generally 0.2 = small, 0.5 = moderate, 0.8 = large
Eta^2	Type of effect size (.01=small, .06=moderate, .14 large.
Family	Family primarily refers to nuclear family members, and principal carers of children not living in a traditional family environment, although it may also include extended family members as appropriate.
F&V	Fruit and vegetable
Int	Intervention group
ITT	Intention to treat
MET	Metabolic equivalent (a measure of energy expenditure)
MPA	Moderate physical activity
MVPA	Moderate to vigorous physical activity
NICE	The National Institute for Health and Clinical Excellence
PA	Physical activity
PACE+	Patient-centered Assessment and Counselling for Exercise + Nutrition
PDPAR	Previous Day Physical Activity Recall (self-report instrument)
PHCC	Public Health Collaborating Centre
Physical Literacy	'the motivation, confidence, physical competence, understanding and knowledge to maintain physical activity at an individually appropriate level, throughout life' (Whitehead & Murdoch, 2006).

PDG	Programme Development Group
Power	Power is a terms used in statistics and refers to the ability to detect an effect (e.g., difference between groups in intervention outcome) given that the effect exists. Among other things power is determined by sample size. If too few subjects are used, an intervention may have such low power that there is little chance to detect a significant effect even when it exists.
RCT	Randomised controlled trial
RNCT	Randomised non-controlled trial (ie there are 2 intervention groups and one of them might be considered a comparison group)
SD	Standard deviation
SE	Standard error
UBA	Uncontrolled before and after
VPA	Vigorous physical activity

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