Promotion of Physical Activity in Children Programme Guidance

Review 4:

INTERVENTION REVIEW: UNDER EIGHTS

NICE Public Health Collaborating Centre – Physical Activity
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CONTENTS

Executive Summary

Introduction

This is the fourth review, and the first to deal with the effectiveness of physical activity interventions, in a series of reviews commissioned to provide background evidence for the development of public health guidance for promoting physical activity in children. The descriptive epidemiology review (Review One) made a clear link between physical activity and health outcomes in children. There is evidence suggesting that levels of physical activity among children are insufficient. Thus, there remains an imperative to promote physical activity within this age group.

This report examines the evidence for the effectiveness of interventions to promote physical activity and/or development of core physical skills in children under 8 years of age.

Objectives

This review addressed the following questions:

- What interventions and programmes are effective in increasing levels of physical activity/core physical skills in children under 8 years of age, particularly in those doing less than recommended levels?
- What are the characteristics of the physical activity interventions or programmes which increase physical activity/core physical skills in children under 8 years of age, particularly in those doing less than recommended levels?

Methods

Literature searches were conducted using the terms and databases agreed by the collaborating centre and NICE. 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 (May 2007). The agreed search strategy resulted in 16,461 titles and after initial screening for relevance 1,651 titles remained. The titles and abstracts of these were assessed against the following inclusion/exclusion criteria:

- Is the study an **intervention study** or review of intervention studies?
- Is the age group studied **aged 7 or under**?
- Is an outcome reported on **physical activity behaviour** or **core physical skills?**

In total 169 (including 14 studies identified from other sources, eg reference lists) titles were assessed to be potentially relevant and the full papers retrieved. These were re-checked by one person, against the above inclusion/exclusion criteria. In addition studies were excluded if they had a main focus on treating obesity, were from less economically developed countries, were studies about ethnic groups that do not have large populations in England, reported interventions involving the school curriculum/physical education, or the study involved a change to the built or natural environment or was more appropriate for one of the other four reviews (e.g., active travel).

Results

Six studies were accepted for full data extraction and 163 were rejected. Studies varied in scale from 24 to 545 participants. Only intervention (experimental or quasi-experimental with control groups) study designs were included. No studies were excluded solely because they did not include a control group. Furthermore studies which included some participants under 8 years of age but did not report results by age or where the mean age of participants was ≥8 were excluded.

The six studies comprised one individual RCT, two cluster (group) RCTs, two CBAs and one NRCT. The studies covered 2 settings (preschool/nursery and primary school) and two outcomes (physical activity and core physical skills). Two studies were conducted in the UK, three in the USA and one in Greece.

Evidence statements

1. Preschool: Physical activity interventions evidence statements

There is evidence from two cluster randomised trials, one in the USA [++] and one in the UK [+] that physical activity and education sessions at nursery/preschool do not increase activity levels outside of these sessions when compared to children receiving a health promotion programme that did not focus on physical activity or their normal curriculum

There is evidence from one controlled before and after study in the USA [-] that aerobic exercise classes for children aged three to five do not increase physical activity levels during free-play in the playground when compared to children in a control group participating in playground play.

There is evidence from one controlled before and after study in the USA [-] that directly engaging parents in physical activity and nutrition education classes that include messages designed to increase physical activity and family fitness may increase the frequency of parents reporting active play with their child.

2. **Primary school: Physical activity interventions summary evidence statement**

There is evidence from one randomised controlled trial in the UK [+] that lunch-time clubs in primary schools (5 - 7 yr olds) focused on physical activity, nutrition, or physical activity and nutrition, have no effect on self-reported running during school break times compared to a control group, and no effect on physical activity patterns outside of school hours (as reported by parents).

3. **Pre-school: Core physical skills interventions summary evidence statement**

There is evidence from one cluster randomised control trial in the UK [+], one controlled non-randomised trial in Greece [+] and one controlled before and after trial in the USA [-] that supervised physical activity interventions conducted in the preschool setting can be effective in improving core physical skills such as run, gallop, hop, slide, leap, skip and general motor agility.

Discussion

There is some literature examining physical activity in populations that include those under 8 years of age. However, much of this is not specifically focussed on this age group (ie it includes older children and results are not presented separately for age) or it is not intervention based. This is supported by the findings of two very recent physical activity intervention reviews (Salmon et al., 2007; van Sluijs et al, 2007) which also reported that the evidence base within this age group is preliminary. Evidence from the early primary school years (that does not focus on school curriculum) and for those under 3 is particularly sparse.

There are significant measurement challenges associated with physical activity interventions in this age group. The age of the participants means self-report is not possible, whilst parental proxy reports lack responsivity and therefore may not be sensitive to any changes that occur. Furthermore, they have poor reliability and

validity. In addition, some researchers view objective measures as inappropriate because the small size of the devices represents a choking hazard. Limited reporting of the intervention process (eg participant attendance, compliance of those delivering the intervention with the implementation protocol, quality assurance) makes it difficult, if not impossible, to determine why interventions may or may not have been effective. Most studies did not include a follow up period so maintenance effects could not be assessed.

This review has resulted in some evidence statements that can form the basis of recommendations for practice. However, further evidence for the efficacy and sustainability of interventions promoting physical activity in the under 8s is needed. Until a stronger evidence base becomes available, health professionals, parents and others working with young children should encourage all children to be active and the amount of time they are restrained from being active should be minimised (Strong et al., 2005). The family unit, paediatric health community, nurseries, preschools and primary schools are all likely to be important contributors to encouraging physical activity in this age group. Individuals working in these areas should be encouraged to plan, implement and evaluate physical activity programmes, and to share experiences and best practice with others.

Included studies

Alpert, B., Field, T., Goldstein, S., & Perry, S. (1990). Aerobics enhances cardiovascular fitness and agility in preschoolers. Health Psychol, 9(1), 48-56.

Fitzgibbon, M. L., Stolley, M. R., Schiffer, L., Van Horn, L., KauferChristoffel, K., & Dyer, A. (2005). Two-year follow-up results for Hip-Hop to Health Jr.: a randomized controlled trial for overweight prevention in preschool minority children. J Pediatr, 146(5), 618-625.

McGarvey, E., Keller, A., Forrester, M., Williams, E., Seward, D., & Suttle, D. E. (2004). Feasibility and benefits of a parent-focused preschool child obesity intervention. Am J Public Health, 94(9), 1490-1495.

Reilly, J. J., Kelly, L., Montgomery, C., Williamson, A., Fisher, A., McColl, J. H., et al. (2006). Physical activity to prevent obesity in young children: cluster randomised controlled trial. BMJ, 333(7577), 1041.

Warren, J. M., Henry, C. J., Lightowler, H. J., Bradshaw, S. M., & Perwaiz, S. (2003). Evaluation of a pilot school programme aimed at the prevention of obesity in children. Health Promot Int, 18(4), 287-296.

Zachopoulou, E., Bakle, I., & Deli, E. (2006). Implementing intervention movement programs for kindergarten children. J Early Child Res, 4(1), 5-18.

1.0 Introduction

The National Institute for Health and Clinical Excellence ('NICE' or 'the Institute') has been asked by the Department of Health (DH) to develop guidance on a public health programme aimed at promoting physical activity, play and sport for pre-school and school-age children in family, pre-school, school and community settings. This guidance will provide recommendations for good practice, based on the best available evidence of effectiveness, including cost effectiveness. It is aimed at professionals with public health as part of their remit working within the NHS, local authorities and the wider public, private, voluntary and community sectors. It will also be relevant to parents and professional carers.

The guidance will support implementation of the preventive aspects of national service frameworks (NSFs) and a number of related policy documents (see section 1.4). It has been commissioned in response to growing concerns over low levels of physical activity in children and young people, and the potential impact on current and future health.

1.1 Background to this review

This is the fourth review, and the first to deal with the effectiveness of physical activity interventions, in a series of reviews commissioned to provide background evidence for the development of public health guidance for promoting physical activity in children. These reviews are best seen in the context of the 'behavioural epidemiology' framework (Sallis & Owen, 1999). This framework suggests 5 phases in the research process concerning physical activity and health (Figure 1).

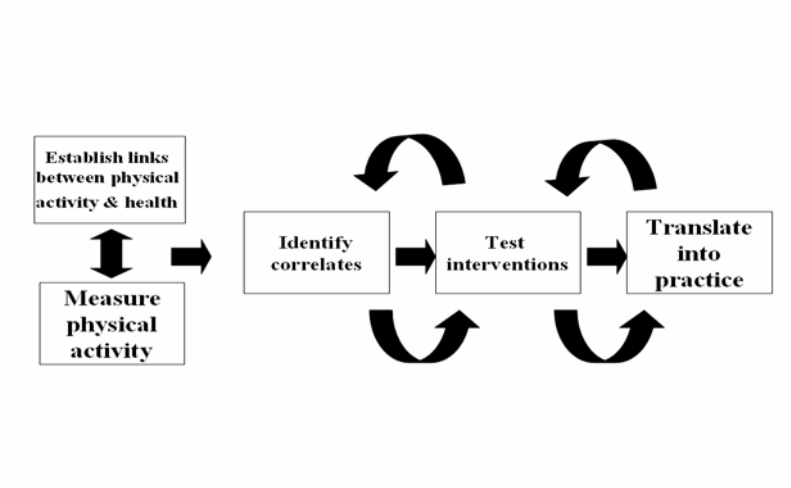


Figure 1: Behavioural epidemiological framework showing the five phases of the research process concerning physical activity and health.

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. Measurement of physical activity is challenging, especially in children. Measurement error plagues this field because without accurate measures of the behaviour it is always difficult to demonstrate strong association with other variables, if they exist, and may struggle to show intervention effects due to lack of measurement sensitivity. The impact of measurement challenges are addressed, where relevant, throughout all the reviews. In the 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 (eg adolescent girls) or become targets that are sought to affect in order to bring about behaviour change (eg increasing parent support). Review Two examined the quantitative correlates of physical activity in young people and Review Three reviewed the qualitative evidence of barriers and facilitators to participation in physical activity by young people.

Referring back to Figure 1, having established the likely correlates of physical activity, 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. The current review is positioned at this level and specifically reviews the evidence for the effectiveness of interventions to increase physical activity and improve core skills in children aged under 8 years. There will be three other effectiveness reviews specifically focussing on, 11-18 year old girls, active transport, and community or family settings.

1.2 The importance of focusing on the under 8's

The descriptive epidemiology review (Review One) made a clear link between physical activity and health outcomes in children. Specifically, it was reported that physical activity has small but significant physical health benefits in children, notably prevention of overweight and obesity and type II diabetes, and improvements in skeletal health. In addition, physical activity has moderate psychological health benefits for children, particularly for self-esteem and depression. Physical activity also has benefits for healthy growth and development and social interaction during childhood by providing "an important vehicle for play and recreation, learning physical and social skills, developing creative intelligence and stimulating growth and fitness" (DH 2004a; p31)

According to current recommendations (DH, 2004a), children and young people 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. Recent estimates suggest that, despite children being the most active segment of the population, 30-40% of children under 8 are not meeting this guideline with 10-25% participating in less than 30 minutes of activity per day (DH, 2003). Although, the limited trend data available suggests that the levels of children doing less than 30 minutes of physical activity per day declined between 1997 and 2002, the proportion active at recommended levels remained unchanged (Review 1). Expert opinion also suggests that physical activity among children is insufficient (van Sluijs et al., 2007). Thus, there remains an imperative to promote physical activity within this age group.

There are important differences in physical activity between young children and older children and adolescents. Firstly, the type and purpose of physical activity participated in varies with age. During the pre-school and early primary school years basic movement patterns are developed which form the foundation for activity at later ages (Strong et al., 2005). With growth, maturation, and experience, these basic movements are coordinated into the more complex movement patterns that characterise the free play, games and sports of older children (Strong et al., 2005). Malina (1991) suggested that up until around 8-10 years of age the main emphasis is on general physical activity and particularly motor skills. After 8-10 years, the

emphasis becomes increasingly focused on prescriptive physical activity, with an emphasis on health, fitness and behavioural outcomes. Secondly, children's physical activity rarely involves sustained activity but is characterised by intermittent short duration (<5 minutes) bursts of all-out activity alternated with periods of rest and recovery (Pangrazi, 2000). This has implications for the nature of the activity recommended (ie it should be age appropriate) and thus the design of interventions to promote it. Thirdly, the correlates of physical activity differ between children and adolescents (Review 2). In pre-adolescent children, activity levels are associated with male gender, intentions and preferences, eating a healthy diet, previous physical activity, access to facilities, time spent outside, and school policies on physical activity. Although it was not possible within Review Two to differentiate the correlates of those under and over 8 years of age, it is probable that even within preadolescents, there will be age related differences (e.g., because of increasing autonomy, maturation etc) in factors influencing participation. All of these differences suggest that it is prudent to review the effectiveness of physical activity interventions separately for different age groups.

1.3 Types of activity in which under 8's participate

Review One described different types of activity younger children are likely to participate in. Active play is an extremely important source of physical activity for children, particularly younger children. The Health Survey for England 2002 (DH 2003) found 'active play' to be the most common type of activity reported by boys and girls on at least five days. Active play included such things as riding a bike, kicking a ball around, running about, playing active games and jumping around. These activities may occur in informal settings (eg gardens, public open spaces) or as part of more formal settings (eg nurseries, play groups, pre-schools, school recess time)

The Young People and Sport in England Survey (Sport England, 2003) showed that almost all young people take part in some form of sporting activity at least once out of school lessons. However, a significant minority (>10%) do not frequently take part in any sport out of lessons. The most popular activities for boys and girls aged 2-10 years are team games, outdoor activities (mainly due to the inclusion of cycling) and swimming. The largest differences between boys and girls are in team games (boys more than girls) and dance (girls more than boys). These sporting activities are more

likely to take place in a structured organised setting such as a sports club, school club, or leisure centre.

Active travel, especially the trip to school, is an important contributor to the overall levels of physical activity in children. The 2005 National Transport Survey (DT, 2006) showed that the proportion of primary school children aged 5-10 walking to school is declining, and levels of cycling to school are extremely low. The effectiveness of interventions to promote active travel will be considered in the second effectiveness review.

Once children start school then physical education and the school curriculum become a further source of physical activity. However, interventions within physical education and the school curriculum are not the focus of these reviews.

Given the variety of ways and locations that children under 8 can gain physical activity it is important that the review search covers a range of activities (eg from learning to swim or cycle through to more structured sport) and sites (eg nurseries, pre-schools, kindergartens, play groups, community sector provision, non-curricular school activities etc).

1.4 Policies and initiatives relevant to the under 8s

Government, commercial organisations and charitable trusts are supporting the promotion and development of sports and physical activity opportunities for under 8's. This section briefly outlines several of the key initiatives/policies.

Choosing Activity: a physical activity action plan (DH, 2005). The aim of this plan is to promote physical activity for all in accordance with the Chief Medical Officers report (DH 2004a). 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. The action plan is linked to **Public Service Agreement** (PSA) targets, of which two have specific relevance to the under 8 age group:

- Halt the year-on-year increase in obesity among children under 11 by 2010, in the context of a broader strategy to tackle obesity in the population as a whole

- Enhance the take-up opportunities by 5 to 16-year-olds so that the percentage of school children in England who spend a minimum of two hours each week on high-quality PE and school sport within and beyond the curriculum increases from 25% in 2002 to 75% by 2006 and 85% by 2008 in England, and to at least 75% in each school sport partnership by 2008.

For children and young people the goals of the action plan are to encourage activity in early years, schools, and further and higher education, and to extend further the use of education facilities as a community resource for sport and physical activity, including out-of-hours use. Within the action plan there is reference to: travel to school, the healthy schools programme, school sport, the Physical Education, School Sport, and Club Links (PESSCL) strategy, building community capacity for clubs, coaches and volunteers in community sport, and outdoor play. Government departments and other organisations with a role within the action plan include: DfES, DCMS, DH, DT, Youth Sport trust, Sport England.

A number of other policy documents/initiatives are also relevant or have been subsumed within the physical activity action plan:

- '**Choosing health**' (DH 2004b) where increasing exercise is one of 6 over-arching priorities. For young people the components of good health are to be a core part of children's experience in schools through a coordinated 'whole school' approach to health (National healthy schools programme, school travel, support for cycling, PESSCL). The next steps for Choosing Health are outlined in **Health Challenge England** (DH 2006).
- **Every Child Matters: Change for Children** (DfES 2004) focuses on the well-being of children and young people from birth to age 19. The aim is for every child to have the support they need to be healthy, stay safe, enjoy and achieve, make a positive contribution, and achieve economic well-being. **Time for Play** (DCMS, 2006) builds on this and **Getting serious about play** (DCMS 2004) and highlights the importance of play and demonstrates: the extent of current activity across government departments, work to develop a regional infrastructure for play, and local service delivery.
- **Gameplan** (DCMS, 2002), a publication from the Strategy Unit in support of the policy *A Sporting Future for All* (DCMS, 2001). 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.

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 including the *Healthy Schools Physical Activity Toolkit* which is linked to the National Healthy Schools Scheme; *Get Moving, Get Active Participation award*, a Foundation Key Stage 1 participation award developed in partnership with the Youth Sport Trust which rewards children for participating in PE, school sport and other types of physical activity; and 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.

While these examples are by no means exhaustive they are indicative of a great deal of activity in terms of developing policy, initiatives and resources to promote and provide physical activity opportunities to children. However much of this work, has focused on 'sport' & 'sporting opportunities' and only a minority appears to promote lifetime physical activity or focus on lifestyle and unstructured activities (Cale & Harris, 2005). There is also a need for more systematic evaluation of the effectiveness of policies and initiatives.

1.5 Purpose of this review

The purpose of this review is to assess the evidence for the effectiveness of interventions to promote physical activity/core physical skills in children under 8 years of age. This review will contribute to the guidance concerning children and physical activity by identifying effective strategies and settings for helping young children (under 8s) become physically active or improve core physical skills.

Specifically the following research questions are addressed:

- What interventions and programmes are effective in increasing levels of physical activity/core physical skills in children under 8 years of age, particularly in those doing less than recommended levels?
- What are the characteristics of the physical activity interventions or programmes which increase physical activity/core physical skills in children under 8 years of age, particularly in those doing less than recommended levels?

1.6 Scope of the review

This review focuses on children under 8 years of age. Children and young people who have a medical condition requiring clinical assessment or monitoring immediately prior to and/or during, physical activity were not included in this review. This review does not cover interventions that involve the school curriculum (lessons delivered by teachers as part of the core school day, such as physical education (PE), personal health and social education (PSHE) and science). This review also does not cover interventions that have been dealt with in previous NICE guidance (or guidance in development) aimed at pre-school and school-age children (See for example NICE guidance for obesity (www.nice.org.uk/guidance/CG43), depression in children and young people (www.nice.org.uk/guidance/CG28), four commonly used methods to increase physical activity (www.nice.org.uk/page.aspx?o=PHI002), and forthcoming guidance for promoting and creating built or natural environments that encourage and support physical activity (www.nice.org.uk/page.aspx/o=338047), promoting the mental wellbeing of children in primary schools (www.nice.org.uk/page.aspx?o=350205)).

1.7 Outcomes

Studies were included if they reported outcomes of physical activity and/or core physical skills. Measurements of physical activity could include changes in the proportion of children achieving a pre-determined level of physical activity, number of minutes, frequency and intensity of physical activity, and/or numbers participating or using physical activity facilities.

Studies were also included if they reported changes in core physical skills. These are a sub-set of physical literacy, and include 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. Core physical skills were included as a primary outcome in this review as it was felt that these were legitimate outcomes to be expected from many interventions aimed at in this age group; that the acquisition of these skills were fundamental to increasing physical activity in many domains; and that it would be too limiting to restrict outcomes to physical activity only. Psycho-social outcomes such as self-esteem - while part of the original definition of physical literacy (Whitehead & Murdoch, 2006) - were not included as primary outcomes of this review as changes in such variables are not necessarily associated with increases in physical activity. The types of measures of core physical skills included fundamental motor skills (e.g., run, gallop, hop, horizontal jump, slide, leap, skip) or motor agility (touching toes in sitting position, touching toes in standing position, walking backward, walking forward on a balance beam, etc).

1.8 Review team

This review has been carried out by a team from the Public Health Collaborating Centre (CC) for Physical Activity. 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).

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 and de-duplicated resulting in 16461 references. 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. One lead author was contacted for clarification of study procedure and analysis and they identified another 4 recently published studies for consideration. One further review on promoting physical activity among children and adolescents that was published after our search was brought to our attention by the authors. The reference lists of all included studies and all identified review papers were also checked resulting in a further 9 references.

2.1.1 Search terms

All search strategies were designed by the CC and NICE. Tailored search terms were used appropriate to a particular database. Search terms followed the same order (1) physical activity terms, (2) child terms and (3) location terms. Typical search terms included:

> Physical activity, physical fitness, physical endurance, exercise, promotion, motor skills, physical literacy, physical inactivity, swimming, walking, running, biking, sport, football, rugby, netball, cricket, hockey, rounders, rollerblading, rollerskating, skating, skateboard, jumping, skipping, hopping, playing, games, physical education, dancing, recreation, child, kid, infant, youth, toddler, girl, boy, young, under 8, under 5, baby, babies, preschool, school, nursery, crèche, play group, play centre, playground, reception class, leisure centre, fitness centre, parks, parent groups, kindergarten, family, community, neighbourhood, garden, pitch, youth club, open space, swimming pool, Child Day Care Centre

A full search for MEDLINE is presented in Appendix A.

All searches were performed from January 1990 to the most recently published version of the database (May 2007).

2.1.2 Databases searched

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

2.2 Selection of studies for inclusion

The agreed search strategy resulted in 16461 titles, which were initially screened for potential relevance by one person. After the initial screening 1651 titles and abstracts were assessed for relevance against the following inclusion/exclusion criteria:

- Is the study an **intervention study** or review of intervention studies?
- Is the age group studied **aged under 8**?
- Is an outcome reported on **physical activity behaviour** or **core physical skills?**

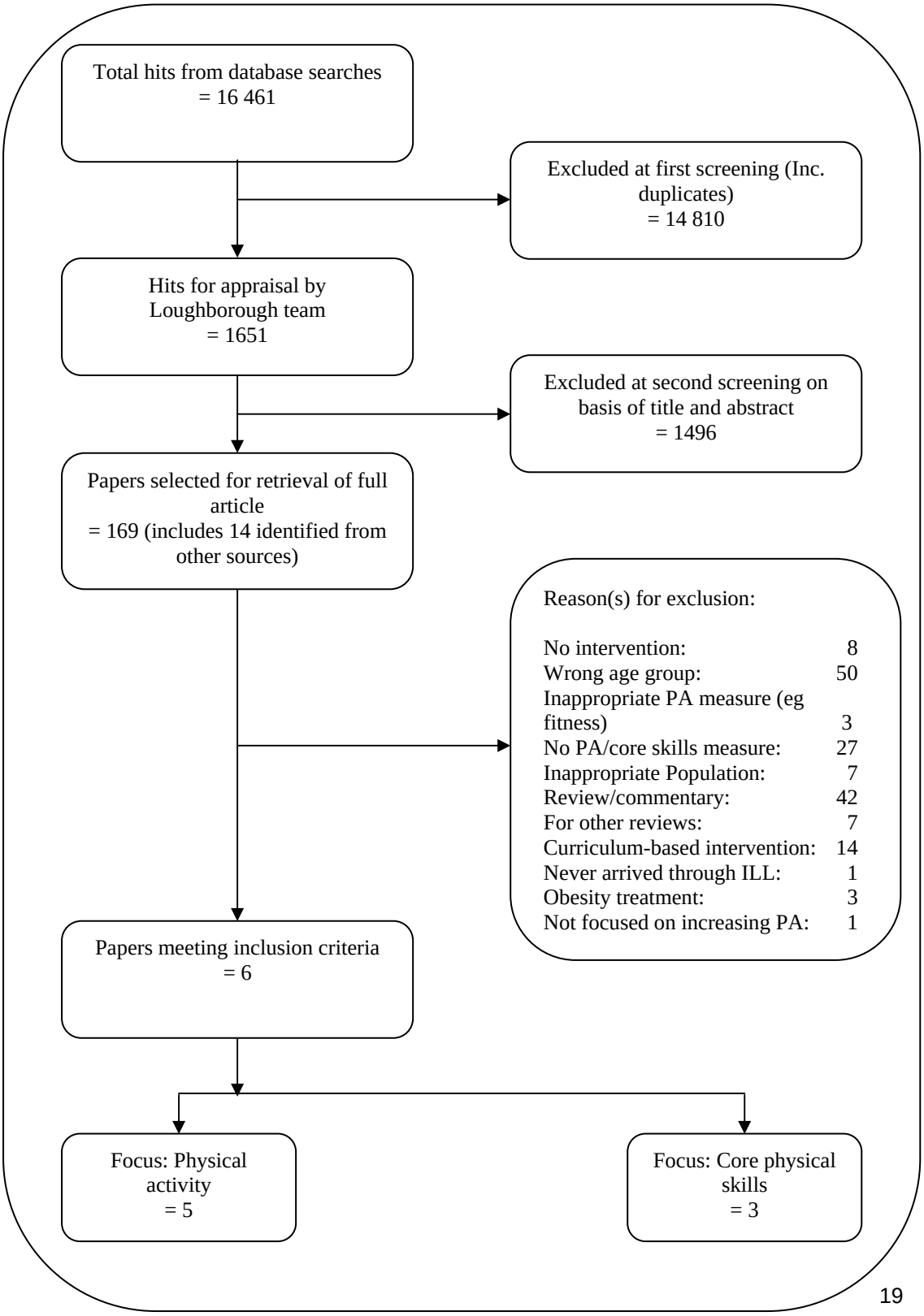
Consistency of screening was assessed by another researcher checking relevance on a 10% sample with no discrepancies found. In total 169 (including 14 studies identified from other sources) titles were assessed to be potentially relevant and the full papers retrieved. These were checked by one person, against the above inclusion/exclusion criteria. In addition studies were excluded 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 involved the school curriculum/physical education
- 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 was more appropriate for one of the other four reviews in this series (e.g., active travel).

Another researcher checked 10% of the titles against the inclusion/exclusion criteria. In addition, this researcher independently assessed any full papers where there was

uncertainty. Any discrepancies were resolved by a third reviewer (7 studies). Six studies were accepted for full data extraction (see Appendix B) and 163 were rejected (see Appendix C). See Figure 2 for flow diagram of the study selection procedure.

Figure 2. Flow diagram of study selection. (Note: some included studies provided results for both physical activity and core physical skills)



The review is a systematic review of intervention studies. Reviews of intervention studies would have been included in this review if they had satisfied all inclusion criteria. However, no review papers were included as they either did not focus specifically on the under 8 age group, or make comments specific to this age group. As already stated, the reference lists of all reviews were examined to identify potentially relevant primary studies. Primary experimental or quasi-experimental studies were included if they assessed the effect of an intervention to change physical activity or core physical skills in children under 8 years of age. No studies were excluded solely because they did not include a control group (ie they failed to meet another inclusion criteria such as age). Furthermore studies which included some participants under 8 years of age but did not report results by age or where the mean age of participants was $\geq$8 were excluded.
The main reasons for exclusion of studies were (a) wrong age group (b) not an intervention study or (c) no physical activity or core physical skills data presented (Appendix C).

2.3 Study Type and Quality Appraisal

Each study was categorised by research design (Randomised Control Trial [RCT], Cluster Randomised Control Trial [CRCT], Controlled Before and After [CBA] etc) and graded using a code '++', '+' or '-', based on the extent to which the potential sources of bias had been minimised (NICE, 2006). The included studies were quality assessed independently by 2 reviewers using the design specific quality assessment tools in Appendix A of the NICE manual (NICE 2006). Any discrepancies were resolved through discussion.

++ **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

For interventions with physical activity as an outcome three studies were categorised as RCTs with the remaining two studies categorised as CBAs. Table 1 shows that one study was assessed as [+], two as [+] and two as [-]. The main reason for studies being assessed as [-] quality was the use of a measure of physical activity of

unknown reliability and validity (e.g., parent reports of frequency of active play with child, 10 minute observation of gross motor activity on a playground).

Table 1. Study type and quality – physical activity interventions

Study Type and Quality	Authors
CRCT ++	Fitzgibbon et al., 2005
CRCT +	Reilly et al., 2006*
RCT +	Warren et al., 2003
CBA -	Alpert et al., 1990; McGarvey et al., 2004

* Outcome measures taken at the end of the intervention

For interventions with core physical skills as an outcome one study was classified as CRCT, one study as CBA and one study as CNRT. Table 2 shows that 2 studies were assessed as [+] and one as [-]. The reason for the study being assessed as [-] quality was the use of an unvalidated test of agility and the high risk of contamination between groups.

Table 2. Study type and quality – core physical skills interventions

Study Type and Quality	Authors
CRCT +	Reilly et al., 2006*
CBA -	Alpert et al., 1990
CNRT +	Zachopoulou et al., 2006

* Outcome measures taken at the end of the intervention

2.4 Study categorisation – Description of studies

2.4.1 Physical activity interventions

The five physical activity studies are described in Sections 3 and 4 and presented in Evidence Table 1. They included:

- 2 CRCT (Fitzgibbon et al., 2005, Reilly et al., 2006)
- 1 RCT (Warren et al., 2003)
- 2 CBAs (Alpert et al., 1990; McGarvey et al., 2004)

The studies are grouped by age of participants. Four of these studies were with preschool participants with three based in nursery/preschool settings (Alpert et al., 1990; Fitzgibbon et al., 2005; Reilly et al., 2006), and one in a health clinic

(McGarvey et al., 2004). One study was with primary school aged participants and was based within a primary school (Warren et al., 2003). The studies provided different interventions: one intervention in the nursery/preschool setting provided only physical activity sessions (Alpert et al., 1990), one provided physical activity sessions alongside a home element (Reilly et al., 2006) and one provided physical activity sessions alongside an education element and a home element (Fitzgibbon et al., 2005). The intervention in the health clinic (McGarvey et al., 2004) and the primary school intervention (Warren et al., 2003) provided an educational component (ie they did not include a physical activity component).

2.4.2 Core physical skills interventions

The three core physical skills studies are described in Section 5 and presented in Evidence Table 2. They included:

- 1 CRCT (Reilly et al., 2006)
- 1 CBA (Alpert et al., 1990).
- 1 CNRT (Zachopoulou et al., 2006)

All of these studies were based in a nursery/preschool setting. All studies provided a physical activity session. One study also included a home element (Reilly et al., 2006) and one study compared two different movement development programmes (Zachopoulou et al., 2006).

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 and core physical skills studies were examined by setting of the

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

3. Preschool: Physical activity interventions - Summary of findings

3.1 Overall summary of studies identified

This category termed 'preschool physical activity interventions' groups a set of interventions focused on increasing physical activity among nursery or preschool aged children. Intervention examples include physical activity sessions, with or without an education element and/or a home element. Four studies, one CRCT [++], one CRCT [+] and two CBA [-], reported evidence on the effectiveness of physical activity interventions in preschools. One was conducted in the UK and three were conducted in the USA.

Fitzgibbon et al. (2005) (CRCT++) assessed the effectiveness of a 14-week healthy eating and exercise intervention to increase weekly frequency and intensity of physical activity. The intervention was based on a combination of principles of social cognitive theory (specifically the importance of modelling by peers and parents) and self-determination theory (specifically by focussing on the children's sense of control, intrinsic motivation and avoiding coercion). The intervention consisted of 3 20-minute educational sessions followed by 20 minutes of physical activity per week plus a home element involving key messages and parent homework and newsletters. The 20 minutes of physical activity consisted of a 5-minute warm-up, 10-minutes of

aerobic activity, and a 5-minute cool-down. Teachers used multiple games and approaches, such as aerobic "trips to the zoo" where children pretended to be different animals. The home newsletters contained information that mirrored the children's curriculum and the parent homework reinforced concepts presented in the weekly newsletter. Parents received a $5 grocery store coupon for every completed homework assignment returned. The target populations were ethnic minority groups in Chicago and the sample was predominantly black. Intensive training was given to the early childhood educators who then served as interventionists. The study was conducted in the USA, and had follow-up at 1 and 2 years.

Reilly et al. (2006) (CRCT+) examined the effectiveness of a 24-week intervention which aimed to increase physical activity through play and reducing sedentary behaviour. The intervention comprised 3 x 30 min sessions of physical activity each week. The intervention was intended to increase levels of physical activity and fundamental motor skills. A home-element which sought to link preschool content to activities in the home, and provide educational materials for parents, was also used. For six weeks during the intervention, nurseries displayed posters focused on increasing physical activity. Control group nurseries continued with their usual curriculum and head teachers agreed not to enhance their physical development and movement curriculum. No theoretical basis for the intervention was reported and there was no follow-up period. The study was conducted in the UK.

Alpert et al. (1990) (CBA -) assessed the effect of an 8-week programme comprising daily activity sessions of 30 minute duration. Sessions consisted of a short warm-up followed by 20 minutes of continuous aerobic exercise, accompanied with music, and ended with a cool down period. No theoretical basis for the intervention was reported and there was no follow-up period. This study was conducted in the USA

McGarvey et al. (2004) (CBA-) assessed the effectiveness of a 12-month intervention involving parent education classes covering nutrition and physical activity as part of the Women, Infants and Children Programme (a US Department of Agriculture initiative through state health departments with low income families). Parents of both the intervention and control group attended educational groups once every 2 months and an individual session with a nutritionist every 6 months. The intervention was based on social cognitive theory (specifically through encouraging parents and other adults involved in the programme to model health behaviours) and self-efficacy theory (specifically through strategies to raise confidence for behaviour change

among parents, eg goal setting, discussing expectations). For the intervention group the educational material was modified to introduce 6 key messages: (1) increase physical activity, (2) monitor mealtime behaviour, (3) limit household television viewing, (4) drink water instead of sweetened beverages, (5) consume 5 fruits and vegetables daily, and (6) increase family activities to promote fitness. In addition, intervention parents were encouraged to serve as role models for their children. Staff at the clinic parents attended were encouraged to model healthy lifestyle habits that parents might witness when waiting in the clinic. The same healthy lifestyle messages were reinforced by members of the local coalition of community services (eg recreation centres, Department of Parks and Recreation facilities, public libraries, a food bank, parenting classes and a multicultural centre). There was no follow-up period. The study was conducted in the USA.

3.2 Evidence of efficacy

One [++] quality study, one [+] quality study and one [-] quality study, one in the UK and two in the USA, reported no significant difference between intervention and control groups in physical activity at post-intervention (Alpert et al., 1990; Fitzgibbon et al., 2005; Reilly et al., 2006) or at 1- or 2-year follow-up (Fitzgibbon et al., 2005). One [-] quality study (McGarvey et al., 2004), based in the USA, reported a significant increase in parent reported frequency of active play with child (not defined further by authors but assessed on a 5-point scale 1= none, 5 – always) at post-intervention. These results are summarised in Table 3.

Table 3. Summary of studies by quality and outcome

Quality		++	+	-
Outcome	+ve			McGarvey et al., (2004) (CBA)
	0	Fitzgibbon et al., (2005) (CRCT) Reilly et al., (2006) (CRCT)		Alpert et al., (1990) (CBA)
	-ve			

There is evidence from four studies (two CRCT [++]* and two CBA(–)) that interventions to increase physical activity through physical activity and education sessions at nursery/preschool result in no change in physical activity outside of these sessions.**

***** Fitzgibbon et al., (2005); Reilly et al., (2006)

****** McGarvey et al., (2004); Alpert et al., (1990)

Outcome of study	Quality of study		
	++	+	-
positive effect			McGarvey et al., (2004) (CBA)
no effect	Fitzgibbon et al., (2005) (CRCT)	Reilly et al., (2006) (CRCT)	Alpert et al., (1990) (CBA)
negative			

Key questions

Three studies (1 CRCT++, 1 CRCT+, 1 CBA-) reported on interventions that provided physical activity sessions with or without an educational element and with or without a home component. Fitzgibbon et al. (2005) (CRCT++) assessed the effectiveness of three 20-minute educational sessions followed by 20 minutes of physical activity per week for 14 weeks plus a home element involving key messages and parent homework. Reilly et al. (2006) (CRCT+) assessed the effectiveness of a 24-week intervention involving 3 30-minute sessions per week plus a home resource pack for parents. Alpert et al. (1990) (CBA-) assessed the effectiveness of a 8 week intervention involving daily 30-minute activity sessions. All of these studies reported no changes in physical activity outside the sessions.

One study (McGarvey et al., 2004, CBA-) reported on an intervention that provided nutrition and physical activity education sessions to low income mothers of 2-4 year old children served through the women, infants and children programme. The authors reported a significant increase in parent reported frequency of active play with child at post-intervention.

One CBA[-] reported data on self-esteem and health habits (Alpert et al., 1990). Self-esteem increased in the intervention group but not in the control and there were no significant differences in health habits. One CBA[-] (McGarvey et al., 2004) reported increased self-efficacy, outcome expectancy and client satisfaction in both the intervention and the control group.

Applicability

One CBA[-] (McGarvey et al., 2004) demonstrated a positive effect on parents active play with their children. This study was conducted in the USA. The intervention provided nutrition and physical activity education sessions to low income mothers of 2-4 year old children served through the Women, Infants and Children programme with the goal of obesity prevention. It is possible that this study could be transferred to the UK with appropriate adaptation. The other studies, one from the UK (Reilly et al., 2006 CRCT[+]) and two from the USA (Fitzgibbon et al., 2005 CRCT[++]; Alpert et al., 1990 CBA[-]) could, with adaptation, be appropriate within the UK but the evidence for their effectiveness remains unknown.

Preschool: Physical activity interventions evidence statements

There is evidence from two cluster randomised trials, one in the USA and one in the UK (Fitzgibbon et al., 2005 [++]; Reilly et al 2006., [+]) that physical activity and education sessions at nursery/preschool do not increase activity levels outside of these sessions when compared to children receiving a health promotion programme that did not focus on physical activity (Fitzgibbon et al., 2005) or their normal curriculum (Reilly et al., 2006).

There is evidence from one controlled before and after study in the USA (Alpert et al 1990 [-]) that aerobic exercise classes for children aged three to five do not increase physical activity levels during free-play in the playground when compared to children in a control group participating in playground play.

There is evidence from one controlled before and after study in the USA (McGarvey et al 2004 [-]) that directly engaging parents in physical activity and nutrition education classes that include messages designed to increase physical activity and family fitness may increase the frequency of parents reporting active play with their child.

4. Primary school: Physical activity interventions - Summary of findings

4.1 Overall summary of studies identified

This category termed 'primary school physical activity interventions' reports on a single intervention (Warren et al., 2003, RCT[+]) to increase physical activity within a primary school setting.

Warren et al. (2003) assessed a 32 week intervention, conducted across 4 school terms (8 weeks per term). Three schools were involved, and within a school participants were randomly assigned to one of four groups (see below). The intervention consisted of lunchtime sessions which lasted approximately 25 minutes and were held weekly in term 1 and fortnightly in terms 2-4. Each intervention group lesson had an interactive approach and was behaviourally focussed. Interventions focused on introducing participants to key concepts in nutrition (Eat Smart group), physical activity (Play Smart group) or both (Eat Smart Play Smart group; note children in this group received half of the nutrition and half of the physical activity programme each term). Homework assignments were set to reinforce messages from school sessions and parents received one newsletter per term. The control group (Be Smart group) were provided with an educational programme about food, presented in a non-nutrition sense (eg food traditions, food in different countries, food processing). On alternate weeks control group children learnt about the human body. Control group children had an activity book with related homework, but did not receive the weekly messages. The intervention was based on social learning theory and incorporated the following elements: (1) raising the value of the desired behaviour, including short-term benefits, which are most likely to appeal to children, (2) providing the opportunity to taste healthy foods and undertake non-competitive physical activity, (3) providing incentives to reinforce messages (eg verbal praise and small prizes), (4) developing practical skills and thus self-confidence in the desired behaviour, and (5) working with parents (as far as possible) to overcome barriers to the desired health behaviour. There was a 1-month follow-up. The study was conducted in the UK.

4.2 Evidence of efficacy

One [+] quality study, based in the UK, reported an increase in percentage of participants self-reporting going running during morning break at post-testing for all

four groups. The increase was greater in the intervention groups (Eat Smart +20%, Play Smart +19%, Eat/Play Smart +15%) than that seen in the control group (Be Smart +10%). The Play Smart (+12%) and Eat/Play Smart (+8%) groups also showed an increase in the percentage of participants self-reporting going running during lunchtimes. The authors reported that there was a small increase in the number of children walking to / from school in all four groups, although no data were presented. No intervention effects were observed for physical activity outside of school (based on parent reports of weekday habitual attendance of after-school clubs, outdoor play, television viewing and computer usage, and activity during weekends) again no data were presented. No tests of statistical significance were reported.

Key questions

Based on one RCT[+] study it is not possible to identify any features potentially related to effectiveness in terms of intervention content, delivery, setting or intensity, nor can any statements be made about any potential differential impact for baseline activity status, specific socio-demographic groups or cultural factors.

Applicability

As the RCT[+] was conducted in the UK primary schools it is applicable to other primary schools within the UK. However, the intervention is likely to need adaptation to enhance its effectiveness.

Primary school: Physical activity interventions summary evidence statement

There is evidence from one randomised controlled trial in the UK (Warren et al., 2003 [+]) that lunch-time clubs in primary schools (5 - 7 yr olds) focused on physical activity, nutrition, or physical activity and nutrition, have no effect on self-reported running during school break times compared to a control group, and no effect on physical activity patterns outside of school hours (as reported by parents).

5. Preschool: Core physical skills interventions – summary of findings

5.1 Overall summary of studies identified

Under this heading are interventions that aimed to improve the core physical skills of children attending preschool. All studies utilised supervised group physical activity sessions, with or without musical accompaniment, with one intervention also employing a home element providing educational resources for parents. Three papers, one CRCT[+], one CBA[-] and one CNRT[+] reported effectiveness of interventions to improve core physical skills in the preschool setting, of which one was conducted in the UK, one in the USA and one in Greece.

Reilly et al. (2006) (CRCT+) examined the effectiveness of a 24-week intervention which aimed to increase physical activity through play and reducing sedentary behaviour. The intervention comprised 3 x 30 min sessions of physical activity each week. The intervention was intended to increase levels of physical activity and fundamental motor skills. A home-element which sought to link preschool content to activities in the home, and provide educational materials for parents, was also used. For six weeks during the intervention, nurseries displayed posters focused on increasing physical activity. Control group nurseries continued with their usual curriculum and head teachers agreed not to enhance their physical development and movement curriculum. No theoretical basis for the intervention was reported and there was no follow-up period. The study was conducted in the UK.

Zachopoulou et al. (2006) (CNRT +) compared the effect of a movement programme with or without musical accompaniment in 5-year-old kindergarten children. The main difference between the 2 intervention groups was the absence of any rhythmic accompaniment in one programme. This means the children practiced the same movement elements and fundamental locomotor skills in both intervention groups. An exploratory teaching style was used and children were encouraged to execute a skill or activity using their creativity. The movement programme was comprised of 4 phases. During the first phase (two weeks) and the second phase (two weeks) children developed body awareness (eg body parts, body shapes) and space awareness (eg space areas, levels directions, sharing space with others). In phase 3 (3 weeks) and phase 4 (3 weeks) children were asked to execute locomotor skills (eg running, jumping, hopping). As they demonstrated increasingly developed patterns of these skills more complex locomotor skills were introduced (eg galloping, skipping, sliding, leaping) and to also perform these skills in combination. Sessions were 35 minutes in duration and conducted twice a week for 10 weeks. The two programmes were implemented by a physical educator specialised in teaching young children and rhythmic instruction. Control group children participated in free-play activities. No

theoretical basis for the intervention was reported and there was no follow-up period. This study was conducted in Greece.

Alpert et al. (1990) (CBA -) assessed the effect of an 8-week programme comprising daily activity sessions of 30 minute duration. Sessions consisted of a short warm-up followed by 20 minutes of continuous aerobic exercise, accompanied with music, and ended with a cool down period. No theoretical basis for the intervention was reported and there was no follow-up period. This study was conducted in the USA

5.2 Evidence of efficacy

Two [+] quality studies (Reilly et al., 2006; Zachopoulou et al., 2006) reported significant improvements in fundamental motor skills (e.g., run, gallop, hop, horizontal jump, slide, leap, skip) scores post intervention for intervention participants compared with controls. One [-] quality study (Alpert et al., 1990) found significant improvements in motor agility at post-testing for participants in the experimental group. Findings are summarised in Table 4.

Table 4. Summary of studies by quality and outcome

Outcome of study	Quality of study		
	++	+	-
positive effect		Reilly et al., (2006) (CRCT) Zachopoulou et al., (2006) (CNRT)	Alpert et al., (1990) (CBA)
no effect			
negative			

Key questions

There is some evidence to suggest that the presence or absence of musical accompaniment does not influence the effectiveness of interventions as both intervention groups in Zachopoulou et al. (2006) improved their core motor skills. One CRCT[+] (Reilly et al., 2006) reported that the intervention was more effective in

girls. There is insufficient evidence to identify any features potentially related to effectiveness in terms of intervention delivery or intensity, nor can any statements be made about any potential differential impact for specific cultural factors.

One CBA[-] reported data on self-esteem and health habits (Alpert et al., 1990). Self-esteem increased in the intervention group but not in the control and there were no significant differences in health habits.

Applicability

The three studies that reported a positive effect on core physical skills, would to a greater or lesser extent be applicable to the UK. Reilly et al. (2006) was delivered by nursery staff within a UK nursery and should be broadly applicable across this setting. Zachopoulou et al. (2006) was conducted in Greece by a specialist physical educator external to the nursery. The extent to which this professional group would be routinely available in the UK is uncertain. It is not stated who lead the Alpert et al. (1990) intervention which was based in the USA. However a large number of external support staff (university students) were present in the aerobics classes to take heart rates and encourage those not reaching heart rate targets. The importance of their presence to the success of the intervention is unclear, and resourcing to this the extent in the UK is unlikely.

Pre-school: Core physical skills interventions summary evidence statement

There is evidence from one cluster randomised control trial in the UK (Reilly et al., 2006 [+]), one controlled non-randomised trial in Greece (Zachopoulou et al., 2006 [+]) and one controlled before and after trial in the USA (Alpert et al., 1990 [-]) that supervised physical activity interventions conducted in the preschool setting can be effective in improving core physical skills such as run, gallop, hop, slide, leap, skip and general motor agility.

6. Discussion

There is some literature examining physical activity in populations that include those under 8 years of age. However, much of this is not specifically focussed on this age group (ie it includes older children and results are not presented separately for age) or it is not intervention based. This is supported by the findings of two very recent reviews (Salmon et al., 2007; van Sluijs et al., 2007) which also reported that the

evidence base with this age group is preliminary. Evidence from the early primary school years (that does not focus on school curriculum) and for those under 3 is particularly sparse. There are a number of potential reasons for this. The lack of studies may reflect that research on physical activity and learning physical activity skills largely does not take place outside of the curriculum for this age group. Alternatively, it may reflect a paradigm issue. For example, it was anticipated that there might have been relevant studies investigating the effectiveness of methods to teach children to swim or to ride a bike. The lack of these studies may in part demonstrate that those involved in swimming or cycling training do not come from a research paradigm where conducting intervention studies are a normal part of their mode of working. Additionally, Cale and Harris (2006) have suggested that because interventions outside of the school environment involve a wide range of individuals and organisations and use a variety of methods that they are difficult to plan, implement and evaluate. Finally, the scarcity of evidence may also be due to the difficulty in measuring physical activity as well delivering interventions within this age group (Cale & Harris, 2006).

It is worth expanding on the significant measurement challenges associated with physical activity interventions in this age group. The age of the participants means self-report is not possible, whilst parental proxy reports lack responsivity and therefore may not be sensitive to any changes that occur. Furthermore, they have poor reliability and validity. In addition, some researchers view objective measures as inappropriate because the small size of the devices represents a choking hazard (McGarvey et al., 2004). Using objective measures also requires the assistance of a parent or other adult to ensure compliance with the wear protocol. The impact of measurement should not be under-estimated. In a recent review of physical activity interventions in children and adolescents it was reported that 64% of studies using an objective measure of physical activity reported significant effects compared to only 38% of studies that used survey measures (Salmon et al., 2007).

Measurement challenges are further reflected in the poor assessment of overall activity levels in the majority of studies reviewed. This is especially important in interventions that provide activity sessions, as previous research has suggested that children may compensate for higher levels of physical activity during classes by decreasing their physical activity at other times (Mallam et al., 2003). If this compensation effect does happen, then a net increase in physical activity may not occur (van Sluijs et al., 2007).

Other limitations within the studies review include:

- Limited reporting of the intervention process (eg participant attendance, compliance of those delivering the intervention with the implementation protocol, quality assurance) makes it difficult, if not impossible, to determine why interventions may have been effective or ineffective (van Sluijs et al., 2007);
- Most studies did not include a follow up period. It is recommended that there is at least a 1-2 year follow-up to determine maintenance effects as evidence in other age groups and settings has shown that long term effects of programmes are weak (Shephard & Trudeau, 2000). Reilly and McDowell (2003) suggest that "…almost all interventions in this area are grounded in lifestyle changes and the behavioural change literature shows consistently that short-term lifestyle changes can be made relatively easily, but are difficult to sustain. Short-term studies in this area are therefore prone to bias." (p.613).

Several limitations to this review need to be acknowledged. The review was limited to studies published in the English language. The measurement tools employed within many of the studies had unknown psychometric properties and it is possible that the study findings reflect substantial measurement error. The number of studies included in the review is small. The age boundary used in the review (under 8) did not reflect a natural break point in childhood development (eg preschool vs primary school). It is therefore possible that some studies that included participants under 8 were excluded because results were reported for all children in a school group (e.g., primary school).

Conclusion

This review has resulted in some evidence statements that can form the basis of recommendations for practice. However, further evidence for the efficacy and sustainability of interventions promoting physical activity in the under 8s is needed. Until a stronger evidence base becomes available, health professionals, parents and others working with young children should encourage all children to be active and the

amount of time they are restrained from being active should be minimised (Strong et al., 2005). The challenge is to find ways to allocate break periods throughout the day at nursery, and particularly early primary school, and then to implement activity changes during these sessions (Jago & Baranowski, 2004). The family unit, pediatric health community, nurseries, preschools and primary schools are all likely to be important contributors to encouraging physical activity in this age group. Individuals working in these areas should be encouraged to plan, implement and evaluate physical activity programmes, and to share experiences and best practice with others.

6. Evidence tables

Evidence Table 1: Physical activity interventions

First author & date	Study design & research type/ 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
FitzGibbon et al (2005)	Cluster RCT [++]	Nursery/ pre-school	To assess the impact of a culturally proficient / physical activity intervention on changes in BMI	Minority pre-school children , USA. Mean age int = 4 years Cont = 4.1years Total N= 409 (Int: n=197; Cont: n=212)	Based on SCT, SDT Pre-school element – 14 weeks (40 mins 3x/week). 1 = 20 minute educational session on a topic relating to healthy eating or exercise, 2. 20 mins PA, including 5 min warm-up / cooldown, 10mins continuous aerobic activity. Home element – weekly newsletters sent home with content that mirrored children's sessions, newsletters contained a homework assignment for parents (approx. 15 mins). Parents received $5 for each completed and returned assignment. Control group received a 14 week generic health and safety intervention with no discussion of PA or diet	1 & 2 years	Parent report of frequency and intensity of previous 7 day PA	Exercise frequency was similar among treatment and control children post intervention (.59% (-12.60 to 13.79) and at both 1 (-10.55% (-27.05 to 5.95) and 2 year (.79% (-15.97 to 17.55) follow-up. Exercise intensity was similar among treatment and control children post intervention (.14 (-.26 to .54) and at both 1 (-.29 (-1.32 to .75) and 2 year (-.62 (-1.77 to .53) follow-up. (INT - CONT difference (95% confidence intervals)	INT had sig smaller increases in BMI and BMI z-scores compared with control children at 1 (BMI -.53 (-.91 to -.14; BMIz -.23 (-.38 to -.09) and 2 year (BMI -.54 (-.98 to -.10; BMIz -.18 (-.31 to -.04) follow-up after adjustment for baseline BMI and age. Hours of TV viewing per day were similar among treatment and control children post intervention (-.17 (-.64 to .30) and at both 1 (-.17 (-.75 to .42) and 2 year (-.11 (-.60 to .38) follow-up. (INT - CONT difference (95% confidence intervals)	Use of unvalidated PA measure ITT analysis in terms of groups randomised to, but not reported how dealt with missing data at follow-up	Somewhat applicable to low income minority pre-school children

First author & date	Study design & research type/ 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
Reilly et al (2006)	CRCT [+]	Nursery/ pre-school	To assess whether a physical activity intervention reduces BMI in young children	Nursery children, Scotland. Mean age int = 4.2 years Cont = 4.1years Total N=545 (int: n= 268, con: n=277)	24 weeks. Int group: 2 elements Nursery element – PA programme 3 x 30 min sessions per week for 24 weeks to increase PA and improve FMS. Home element – families received a resource pack with materials on linking physical play at nursery and at home, two simple health education leaflets. Control group: continued with their usual curriculum and headteachers agreed not to enhance there physical development and movement curriculum	none	6 day accelerometry summarised as accelerometer counts per minute and proportion of waking hours in MVPA and in sedentary behaviour.	NS diff in time in log accelerometer counts per minute (p=.18) or percentage of time sedentary (p=.08). Marginally sig change in log percentage time in MVPA (p=.05) with mean change being greater in the control nurseries by 0.1 (0.0 to 0.2). (multi-level modelling coefficients not presented)	See table 2 for FMS results BMI – no sig effect (p=.87 @ 6 months, p=.90 @12 months) (multi-level modelling coefficients not presented)		Applicable to population and settings included in the study (Broader application is uncertain)

First author & date	Study design & research type/ 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
Warren et al (2003)	RCT [+]	Primary school lunchtime clubs	To evaluate a school- and family-based intervention to prevent obesity in children aged 5-7 years (mean 6.1 years @ baseline)	Primary school children, Oxford UK. Mean age 6.1years Total N= 213 (Int: Nut: n=56 PA: n=54 Nut & PA: n=54 Cont: n=54)	Based on social learning theory Conducted over 4 terms (8 weeks per term; weekly in term 1, fortnightly in terms 2-4). 25 minute 'lunchtime clubs': 4 groups Eat Smart: explored concepts of health, link between food and health, tasting sessions, positive messages about foods, tooth friendly foods. Play Smart: promoted activity in daily life, concepts of energy and activity, playground activity, TV reduction, activity recommendations Eat Smart, Play Smart: half of nutrition and half of PA programme All int groups had an activity book for home use – homework and weekly messages for children and parents. Termly newsletter to parents Control: learnt about food in non-nutrition sense, and the human body	1 month	Child report: Mode of transport to school, break-time activity Parent report: weekday attendance at after-school clubs, outdoor play, TV viewing, computer use. Habitual weekend activity	Small increases in number of children walking to/from school in all groups An increase in activity in the playground (% going running) at morning break in all groups but was higher in all intervention groups compared with the control groups. An increase in activity in the playground (% going running) at lunchtime in the Play Smart and Eat Smart, Play Smart groups at lunchtime. From the parental questionnaires, no intervention effect was observed on physical activity patterns out of school. **No stats reported**		Self-report/ parent report of PA. No information on reliability and validity of PA measures ITT analysis in terms of groups randomised to, but not reported how dealt with missing data at follow-up.	Applicable only to setting and population included in the study (UK primary schools)

irst author & date	Study design & research type/ 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
Alpert et al (1990)	CBA [-]	Nursery/ pre-school	To improve motor agility, CV fitness, and a range of secondary outcomes (including gross motor activity) in preschool children through an aerobics programme.	Children aged 3-5 attending all day pre-school, USA Total N=24 (int: n=12; cont: n=12)	30 min sessions daily for 8 weeks. Sessions book ended by 5 min warm-up/ cool down. 20 mins aerobic exercise programme designed to raise participants heart rates to 60-80% of predicted max. Session accompanied with music, used imagery to enhance participation (e.g., jump like a kangaroo). University students monitored heart rates and offered encouragement to those not reaching training pulse rate. Control group participated in normal outdoor play (part of their regular schedule).	none	Observation of gross motor activity on the playground (3 10 min periods in week before and after int) (Agility – see table 2)	Increase in gross motor activity in both groups (22% to 44.4% of total time in INTgroup, 27.5% to 44.8% in CONT group). No significant group x time interactions ($p > .05$). No other stats presented	See Table 2 for agility results Self-esteem increased in int group ($p = .01$) but not cont. (9.6 to 12.6 in INT group, 9.2 to 8.1 in CONT group) No sig differences between groups or group x time interactions in health habits ($p>.05$)	High risk of contamination between groups as both groups were from 1 nursery site. No information on validity of PA measure	Applicable to population and settings included in the study (Broader application is uncertain)
McGarvey et al., (2004)	CBA [-]	Nursery/ pre-school	To test the feasibility and benefits of a programme to promote 6 targeted parent behaviours to prevent obesity in children served by the Women, Infants and Children (WIC) programme	Low income mothers with children aged 2-4 years, USA Total N=336 (int: n=185; cont: n=151)	Based on SCT and SET 12 months Both groups received: Nutrition education classes every 2 months. Individual session with nutritionist every 6 months. Int group was enhanced with 6 key messages: increase PA, monitor mealtime behaviour, limit household TV viewing, drink water instead of sweetened beverages, consume 5 fruit and vege daily, increase family activities to promote fitness. In both Spanish and English. Encouraged to act as role models. Messages reinforced by Staff and collaborating community organisations.	none	Parent reports of frequency of active play* with child, modelling family activity on a 5-point scale (1=none/very inactive; 5=always/ very active) *active play not defined further	Int group increased frequency of active play (.47 (.14, .8)* with child, cont group decreased (.22 (-.7, .26)*. These between group differences were significant ($F(1, 161) = 7.03$; $p = .01$). NS change in family modelling within or between groups ($F(1, 161) = .33$; $p>.05$) *mean change in outcome variable within a group	Increased self-efficacy, outcome expectancy, client satisfaction in both groups.	Validity and reliability of PA measure is unclear Non-equivalent comparison group (Hispanics over-represented in int group) Differential rates of follow-up at int and cont sites	Applicable to population and settings included in the study (Broader application is uncertain)

Evidence Table 2: Core physical skills interventions

First author & date	Study design & research type/ quality	Setting	Research question	Study population, country, sample size	Description of intervention	Length of follow-up	Core physical skill outcome variables (inc measures)	Main results	Non core physical skills outcomes	Confounders / potential sources of bias	Applicability to the UK
Reilly et al (2006)	CRCT [+]	Nursery/ pre-school	To assess whether a physical activity intervention reduces BMI in young children	Nursery children, Scotland. Mean age int = 4.2 years Cont = 4.1years Total N=545 (int: n= 268, con: n=277)	24 weeks. Int group: 2 elements Nursery element – PA programme 3 x 30 min sessions per week for 24 weeks to increase PA and improve FMS. Home element – families received a resource pack with materials on linking physical play at nursery and at home, two simple health education leaflets. Control group: continued with their usual curriculum and headteachers agreed not to enhance there physical development and movement curriculum	none	Movement Assessment Battery (Okley et al, 2004)	Girls improved more than boys (p=.001). Int group improved FMS sig more than control (p<.05) (multi-level modelling coefficients not presented)	See table 1 for PA results BMI – no sig effect (p=.87 @ 6 months, p=.90 @12 months)		Applicable to population and settings included in the study (Broader application is uncertain)

First author & date	Study design & research type/ quality	Setting	Research question	Study population, country, sample size	Description of intervention	Length of follow-up	Core physical skill outcome variables (inc measures)	Main results	Non core physical skills outcomes	Confounders / potential sources of bias	Applicability to the UK
Zachopoulou et al (2006)	CNRT [+]	Nursery/ pre-school	To identify the effects of two different 10 week movement programmes (with or without the element of music) on fundamental locomotor skill performance in kindergarten children	Kindergarten children, Greece Approx 5 years old at baseline Total N = 83 (int A n=28; int B n=28; contn = 27)	Group A : 10 week movement programme to develop fundamental locomotor skills. Group B: 10 week music and movement programme. Same as for group A but with the addition of rhythmic accompaniment Both programmes were applied twice a week for 35 mins. Cont – participated in freeplay sessions	none	Test of Gross Motor Development (Ulrich, 1985) – qualitative assessment of 7 fundamental locomotor skills	Significant group x time interaction for running ($p<.05$), hopping ($p<.05$), leaping ($p<.01$), horizontal jump ($p<.01$; and skipping ($p<.01$) - in all cases the result was in favour of the two int groups compared to the controls. No group x time interaction for galloping. Sliding results not reported as non-equivalent at baseline ($p<.05$) Effect sizes (Eta^2) for within group changes : running (ES = .24 group A, ES = .43 group B), hopping (ES = .43 group A, ES = .45 group B), leaping (ES = .21 group A, ES = .45 group B). horizontal jump (ES = .50 group A, ES = .48 group B) and skipping (ES = .43 group A, ES = .43 group B). No effect sizes were reported for the control group	None reported	Risk of contamination between groups	Applicable to population and settings included in the study (Broader application is uncertain)

First author & date	Study design & research type/ quality	Setting	Research question	Study population, country, sample size	Description of intervention	Length of follow-up	Core physical skill outcome variables (inc measures)	Main results	Non core physical skills outcomes	Confounders / potential sources of bias	Applicability to the UK
Alpert et al (1990)	CBA [-]	Nursery/ pre-school	To improve motor agility, CV fitness, and a range of secondary outcomes (including gross motor activity) in preschool children through an aerobics programme.	Children aged 3-5 attending all day pre-school, USA Total N=24 (int: n=12; cont: n=12)	30 min sessions daily for 8 weeks. Sessions bookended by 5 min warm-up/ cool down. 20 mins aerobic exercise programme designed to raise participants heart rates to 60-80% of predicted max. Session accompanied with music, used imagery to enhance participation (e.g., jump like a kangaroo) Control group participated in normal outdoor play.	none	Agility test – designed for this study and assessed 10 aspects of motor agility	Children in the int group showed higher scores on the agility test during post-test sessions than during the pre-test sessions (6.0 pre-test vs 9.6 post-test). Control group remained the same (5.8 pre-test, 6.1 post-test). Significant group x time interaction ($p < .05$) No other stats presented	See Table 1 for gross motor play results Self-esteem increased in int group ($p = .01$) but not cont. No sig differences in health habits ($p>.05$)	High risk of contamination between groups as both groups were from 1 nursery site. No information on reliability and validity of agility measure	Applicable to population and settings included in the study (Broader application is uncertain)

Appendix A – Example search strategy

OVID Medline

Physical activity in the under 8s search

Physical activity terms
1. (physical adj5 (fit$4 or activ$3 or endur$4)).tw.
2. (exercis$3 adj5 (fit$4 or activ$3 or endur$4)).tw.
3. ((promot$ or uptak$ or encourag$ or increas$ or start$ or adher$) adj5 physical activit$).tw.
4. ((promot$ or uptak$ or encourag$ or increas$ or start$ or adher$) adj5 exercis$).tw.
5. ((decreas$ or reduc$ or discourag$) adj5 sedentary).tw.
6. motor skill$.tw.
7. (physical adj5 inactiv$3).tw.
8. physical$ litera$.tw.
9. (swim$ or walk$ or running or biking or bicycl$ or bike$).tw.
10. sport$.tw.
11. (football or rugby or netball or cricket or hockey or rounders).tw.
12. (rollerblading or rollerskating or skating or skateboard$).tw.
13. (jump$1 or jumping or skip$1 or skipping or hopping).tw.
14. (play$1 or playing).tw.
15. games.tw.
16. physical education.tw.
17. exp "Physical Education and Training"/
18. exp Dancing/
19. exp Sports/
20. Recreation/
21. "Play and Playthings"/
22. Exercise/
23. 1 or 2 or 3 or 4 or 5 or 6 or 7 or 8 or 9 or 10 or 11 or 12 or 13 or 14 or 15 or 16 or 17 or 18 or 19 or 20 or 21 or 22

Child terms
24. child$.tw.
25. kid$1.tw.
26. infant$1.tw.
27. youth$1.tw.
28. toddler$1.tw.
29. girl$1.tw.
30. boy$1.tw.
31. young$.tw.
32. (under 7 or under 7s).tw.
33. (under 5 or under 5s).tw.
34. (baby or babies).tw.
35. child/ or child, preschool/ or infant/
36. 24 or 25 or 26 or 27 or 28 or 29 or 30 or 31 or 32 or 33 or 34 or 35

Location terms

37. (school or schools).tw.
38. (preschool$ or pre-school$).tw.
39. nurser$.tw.
40. creche$.tw.
41. (play group$ or play centre$ or play center$ or playground$).tw.
42. reception class$.tw.
43. (leisure adj5 (centre$1 or center$1 or facilit$)).tw.
44. (fitness adj5 (centre$1 or center$1 or facilit$)).tw.
45. parks.tw.
46. parent groups.tw.
47. kindergarten.tw.
48. (family or families).tw.
49. communit$.tw.
50. (neighbourhood$ or neighborhood$).tw.
51. garden$.tw.
52. (pitch or pitches).tw.
53. youth club$.tw.
54. open space$.tw.
55. (swim$ adj3 pool$).tw.
56. Schools/
57. Nurseries/
58. Child Day Care Centers/
59. Fitness Centers/
60. public facilities/ or swimming pools/
61. 37 or 38 or 39 or 40 or 41 or 42 or 43 or 44 or 45 or 46 or 47 or 48 or 49 or 50 or 51 or 52 or 53 or 54 or 55 or 56 or 57 or 58 or 59 or 60
62. 23 and 36 and 61

Combine physical activity, child and location terms with AND

Appendix B: Included studies

Alpert, B., Field, T., Goldstein, S., & Perry, S. (1990). Aerobics enhances cardiovascular fitness and agility in preschoolers. Health Psychology, 9(1), 48-56.

Fitzgibbon, M. L., Stolley, M. R., Schiffer, L., Van Horn, L., KauferChristoffel, K., & Dyer, A. (2005). Two-year follow-up results for Hip-Hop to Health Jr.: a randomized controlled trial for overweight prevention in preschool minority children. J Pediatrics, 146(5), 618-625.

McGarvey, E., Keller, A., Forrester, M., Williams, E., Seward, D., & Suttle, D. E. (2004). Feasibility and benefits of a parent-focused preschool child obesity intervention. Am J Public Health, 94(9), 1490-1495.

Reilly, J. J., Kelly, L., Montgomery, C., Williamson, A., Fisher, A., McColl, J. H., et al. (2006). Physical activity to prevent obesity in young children: cluster randomised controlled trial. BMJ, 333(7577), 1041.

Warren, J. M., Henry, C. J., Lightowler, H. J., Bradshaw, S. M., & Perwaiz, S. (2003). Evaluation of a pilot school programme aimed at the prevention of obesity in children. Health Promot Int, 18(4), 287-296.

Zachopoulou, E., Bakle, I., & Deli, E. (2006). Implementing intervention movement programs for kindergarten children. J Early Child Res, 4(1), 5-18.

Appendix C: Excluded studies

Study	Reason for exclusion
Kids get active through traditional Arabic games. (2005). Sportshorts: NSW Sport Rec, 5(1).	No PA data
Afonso, B., & Bothelo, G. (2003). Promoting informal physical activity at school recess: a pilot study with girls and boys from 2nd and 4th grades of elementary school. Revista Portuguesa de Ciencias do Desporto, 3(2), 143-145.	Wrong age group
Allensworth, D. (1997). Improving the health of youth through a coordinated school health programme. Promot Educ, 4(4), 42-47.	No intervention
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 counsellors (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.	Fitness assessed not PA
Badruddin, S. H., Molla, A., Khursheed, M., & Vaz, S. (1993). The impact of nutritional counselling on serum lipids, dietary and physical activity patterns of school children. J Pak Med Assoc, 43(11), 235-237.	Inappropriate population
Baker, I. R., Dennison, B. A., Boyer, P. S., Sellers, K. F., Russo, T. J., & Sherwood, N. A. (2007). An asset-based community initiative to reduce television viewing in New York state. Prev Med, 44(5), 437-441.	Wrong age group
Barrett, B. J. (2001). Play Now, Play Later: Lifetime Fitmess Implications. J PE Rec Dance, 72(8), 35-39.	Wrong age group
Belansky, E. S., Romaniello, C., Morin, C., Uyeki, T., Sawyer, R. L., Scarbro, S., et al. (2006). Adapting and implementing a long-term nutrition and physical activity curriculum to a rural, low-income, biethnic community. J Nutr Educ Behav, 38(2), 106-113.	No PA data
Boarnet, M. G., Day, K., Anderson, C., McMillan, T., & Alfonzo, M. (2005). California's safe routes to school program - Impacts on walking, bicycling and pedestrian safety. J Am Plan Assoc, 71(3), 301-317.	Wrong age group
Caballero, B., Clay, T., Davis, S.M., Ethelbah, B., Holy Rock, B., Lohman, T., Norman, J., Story, M., Stone, E.J., Stephenson, L., & Stevens, J. (2003). Pathways: A school-based, randomised controlled trial for the prevention of obesity in American Indian schoolchildren. Am J Clin Nutr, 78, 1030-1038.	Inappropriate population
Cale, L., & Harris, J. (2006). Interventions to promote young people's physical activity - issues, implications and recommendations for practice. Health Educ J, 65(4), 348-365.	Review – not specific to under 8's
Cole, K., Waldrop, J., D'Auria, J., & Garner, H. (2006). An integrative research review: effective school-based childhood overweight interventions. J Spec Pediatr Nurs, 11(3), 166-177.	Review – not specific to under 8's
Connor-Kuntz, F. J., & Dummer, G. M. (1996). Teaching across the curriculum: Language enriched physical education for preschool children. Adapt Phys Activity Q, 13(3), 302-315.	Not focused on increasing PA
Damon, S., Dietrich, S., & Widhalm, K. (2005). PRESTO--Prevention Study of Obesity: a project to prevent obesity during childhood and adolescence. Acta Paediatr Suppl, 94(448), 47-48.	Wrong age group
Davis, R. G. (2003). Running for Life: An elementary fitness program. J PE Rec Dance, 74(4), 11-13.	No PA data
Davis, S. M., Clay, T., Smyth, M., Gittelson, J., Arviso, V., Flint-Wagner, H., Rock, B.H., Bruce, R.A., Metcalfe, L., Stewart, D., Vu, M., & Stone, E.J. (2003). Pathways curriculum and family interventions to promote	Wrong age group

healthful eating and physical activity in American Indian schoolchildren. Prev Med, 37(6).	
Davis, S. M., Lambert, L. C., Gomez, Y., & Skipper, B. (1995). Southwest cardiovascular curriculum project: study findings for American Indian elementary students. J Health Educ, 26(2), S72-S81.	Wrong age group
Deal, T. B. (1993). Physical activity patterns of preschoolers during a developmental movement program. Child Study J, 23(2), 115-134.	No intervention
DeMattia, L., Lemont, L., & Meurer, L. (2007). Do interventions to limit sedentary behaviours change behaviour and reduce childhood obesity? A critical review of the literature. Obes Rev, 8(1), 69-81.	Review – not specific to under 8's
Dennison, B.A., Russo, T.J., Burdick, P.A., & Jenkins, P.L. (2004). An intervention to reduce television viewing by preschool children. Arch Pediatr Adolesc Med, 158, 170-176.	No PA data
Doak, C. M., Visscher, T. L., Renders, C. M., & Seidell, J. C. (2006). The prevention of overweight and obesity in children and adolescents: a review of interventions and programmes. Obes Rev, 7(1), 111-136.	Review – not specific to under 8's
Donato, K. A. (2006). National health education programs to promote healthy eating and physical activity. Nutr Rev, 64(2 Pt 2), S65-70.	No PA data
Dreimane, D., Safani, D., MacKenzie, M., Halvorson, M., Braun, S., Conrad, B., et al. (2007). Feasibility of a hospital-based, family-centred intervention to reduce weight gain in overweight children and adolescents. Diabetes Res Clin Pract, 75(2), 159-168.	Wrong age group
Eastman, W. (2000). The Active Living Approach: A Canadian perspective for physically active young children. Paper presented at the European Conference on Quality in Early Childhood Education.	No PA data
Edwards, B. (2005). Childhood obesity: a school-based approach to increase nutritional knowledge and activity levels. Nurs Clin North Am, 40(4), 661-669, viii-ix.	Wrong age group
Epstein, L. H., Valoski, A., Wing, R. R., & McCurley, J. (1990). Ten-year follow-up of behavioural, family-based treatment for obese children. JAMA, 264(19), 2519-2523.	Obesity treatment study
Evans, W. D., Necheles, J., Longjohn, M., & Christoffel, K. K. (2007). The 5-4-3-2-1 go! Intervention: social marketing strategies for nutrition. J Nutr Educ Behav, 39(2 Suppl), S55-59.	No intervention
Fitzgibbon, M. L., Stolley, M. R., Dyer, A. R., VanHorn, L., & KauferChristoffel, K. (2002). A community-based obesity prevention program for minority children: rationale and study design for Hip-Hop to Health Jr. Prev Med, 34(2), 289-297.	No PA data
Fitzgibbon, M. L., Stolley, M. R., Schiffer, L., Van Horn, L., Kaufer-Christoffel, K., & Dyer, A. (2006). Hip-Hop to Health Jr. for Latino preschool children. Obesity (Silver Spring), 14(9), 1616-1625.	Inappropriate population
Flodmark, C. E., Marcus, C., & Britton, M. (2006). Interventions to prevent obesity in children and adolescents: a systematic literature review. Int J Obes (Lond), 30(4), 579-589.	Review – not specific to under 8's
Flynn, M. A., McNeil, D. A., Maloff, B., Mutasingwa, D., Wu, M., Ford, C., et al. (2006). Reducing obesity and related chronic disease risk in children and youth: a synthesis of evidence with 'best practice' recommendations. Obes Rev, 7 Suppl 1, 7-66.	Review – not specific to under 8's
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.	Wrong age group
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.	Wrong age group

Fulton, J. E., McGuire, M. T., Casperson, C. J., & Dietz, W. H. (2001). Interventions for weight loss and weight gain prevention among youth: current issues. Sport Med, 31(3), 153-165.	Review – not specific to under 8's
Glenny, A. M., O'Meara, S., Melville, A., Sheldon, T. A., & Wilson, C. (1997). The treatment and prevention of obesity: a systematic review of the literature. Int J Obes Relat Metab Disord, 21(9), 715-737.	Review – not specific to under 8's
Going, S., Thompson, J., Cano, S., Stewart, D., Stone, E., Harnack, L., et al. (2003). The effects of the Pathways Obesity Prevention Program on physical activity in American Indian children. Prev Med, 37(6 Pt 2), S62-69.	Curriculum-based intervention
Goran, M. I., Reynolds, K. D., & Lindquist, C. H. (1999). Role of physical activity in the prevention of obesity in children. Int J Obes Relat Metab Disord, 23 Suppl 3, S18-33.	Review – not specific to under 8's
Guinhouya, C. B., Hubert, H., Dupont, G., & Durocher, A. (2005). The recess period: A key moment of prepubescent children's daily physical activity? Int Electronic J Health Educ, 1(8), 1-9.	Wrong age group
Gunner, K. B., Atkinson, P. M., Nichols, J., & Eissa, M. A. (2005). Health promotion strategies to encourage physical activity in infants, toddlers, and preschoolers. J Pediatr Health Care, 19(4), 253-258.	No intervention
Halle, J. W., Gabler-Halle, D., & Chung, Y. B. (1999). Effects of a peer-mediated aerobic conditioning program on fitness levels of youth with mental retardation: two systematic replications. Ment Retard, 37(6), 435-448.	Inappropriate population
Hamlin, M., Hong, S. W., & Ross, J. (2002). The effect of 16 weeks of regular short duration physical activity on fitness levels of primary school children. J PE NZ, 35(1), 45-54.	Fitness assessed not PA
Hardeman, W., Griffin, S., Johnston, M., Kinmonth, A. L., & Wareham, N. J. (2000). Interventions to prevent weight gain: a systematic review of psychological models and behaviour change methods. Int J Obes Relat Metab Disord, 24(2), 131-143.	Review – not specific to under 8's
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.	Wrong age group
Harris, J., & Cale, L. (1997). How healthy is school PE? A review of the effectiveness of health-related physical education programmes in schools. Health Educ J, 56(1), 84-104.	Review – not specific to under 8's
Harris, K. J., Paine-Andrews, A., & Richter, K. P. (1997). Reducing elementary school children's risks for chronic diseases through school lunch modifications, nutrition education, and physical activity interventions. J Nutr Educ 29(4), 196-202.	Wrong age group
Harvey-Berino, J., & Rourke, J. (2003). Obesity prevention in preschool Native-American children: a pilot study using home visiting. Obes Res, 11(5), 606-611.	Inappropriate population
Harwell, R., Wright, P., Allen, L. (1998). Project STRIDE: a unique summer intervention program for youth-at-risk. J Park Rec Admin, 16(1), 97-113.	Wrong age group
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.	Wrong age group
Hopper, C. A., Gruber, M.B., Munoz, K.D., & MacConnie, S.E. (1996). School-based cardiovascular exercise and nutrition programs with parent	Wrong age group

participation. J Health Educ, 27(5), S32-S39.	
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.	Wrong age group
Hopper, C. A., Munoz, K. D., Gruber, M. B., MacConnie, S., Schonfeldt, B., & Shunk, T. (1996). A school-based cardiovascular exercise and nutrition program with parent participation: An evaluation study. Child Health Care, 25(3), 221-235.	Wrong age group
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 behaviours of third-grade children. Res Q Exerc Sport, 76(2), 130-139.	Wrong age group
Hughes, A. R., McLaughlin, R., McKay, J., Lafferty, K., McKay, T., & Mutrie, N. (2007). The B'Active programme for overweight primary school children in Glasgow: determining the prevalence of overweight and obesity and piloting an activity intervention. Br J Nutr, 97(1), 204-209.	No PA data
Hunter, S. M., Johnson, C. C., Little-Christian, S., & Nicklas, T. A. (1990). Heart Smart: A multifaceted cardiovascular risk reduction program for grade school students. Am J Health Promot, 4(5), 352-360.	Wrong age group
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.	Wrong age group
Ignico, A. A., & Mahon, A. D. (1995). The effect of a physical fitness program on low-fit children. Res Q Exerc Sport, 66(1), 85-90.	Wrong age group
Ignico, A. A., Richhart, C., & Wayda, V. K. (1999). The effects of a physical activity program on children's activity level, health related fitness, and self esteem. Early Child Dev Care, 154, 31-39.	Wrong age group
Jago, R., & Baranowski, T. (2004). Non-curricular approaches for increasing physical activity in youth: a review. Prev Med, 39(1), 157-163.	Review – not specific to under 8's
Johnson, C. C., & Nicklas, T. A. (1995). Health-ahead - the Heart Smart Family approach to prevention of cardiovascular disease. Am J Med Sci, 310(Supp 1), S127-S132.	Wrong age group
Jurak, G., Kovac, M., & Strel, J. (2006). Impact of the additional physical education lessons programme on the physical and motor development of 7 - 10 year-old children. Kinesiology, 38(2), 105-115.	Curriculum based intervention
Jurg, M. E., Kremers, S. P., Candel, M. J., Van der Wal, M. F., & De Meij, J. S. (2006). A controlled trial of a school-based environmental intervention to improve physical activity in Dutch children: JUMP-in, kids in motion. Health Promot Int, 21(4), 320-330.	Wrong age group
Kahn, E.B., Ramsey, L.T., Brownson, R.C., Heath, G.W., Howze, E.H., Powell, K.E., Stone, E.J., Rajab, M.W., & Corso, P (2002). The effectiveness of interventions to increase physical activity: A systematic review. Am J Prev Med, 22(4S), 73-107.	Review – not specific to under 8's
Kain, J., Uauy, R., Albala, C., Vio, F., Cerda, R., & Leyton, B. (2004). School-based obesity prevention program in Chilean school children: primary outcomes. Child Obes, 209-216.	Wrong age group
Kelder, S., Hoelscher, D. M., Barroso, C. S., Walker, J. L., Cribb, P., & Hu, S. (2005). The CATCH Kids Club: a pilot after-school study for improving elementary students' nutrition and physical activity. Public Health Nutr, 8(2), 133-140.	Wrong age group
Klepp, K. I., Oygard, L., Tell, G.S., Veller, O.D., (1994). Twelve year follow-up of a school-based health education programme: the Oslo Youth Study. Eur J Public Health, 4(3), 195-200.	Wrong age group
Kolbe, L. J., Kann, L., Collins, J. L., Small, M. L., Pateman, B. C., & Warren, C. W. (1995). The School Health Policies and Programs Study	No PA data

(SHPPS): context, methods, general findings, and future efforts. J Sch Health, 65(8), 339-343.	
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.	Curriculum based intervention
Levin, S., & Martin, M. (2002). Catch the Catawba SPARK: physical actvity for head start youths. J PE Rec Dance, 73(3), 39-42.	No PA data
Licence, K. (2004). Promoting and protecting the health of children and young people. Child Care Health Dev, 30(6), 623-635.	Review – not specific to under 8's
Lissau, I. (2007). Prevention of overweight in the school arena. Acta Paediatr Suppl, 96(454), 12-18.	Review – not specific to under 8's
Lister-Sharp, D., Chapman, S., Stewart-Brown, S., & Sowden, A. (1999). Health promoting schools and health promotion in schools: two systematic reviews. Health Technol Assess, 3(22), 1-207.	Review – not specific to under 8's
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
Lytle, L. A., Jacobs, D. R., Jr., Perry, C. L., & Klepp, K. I. (2002). Achieving physiological change in school-based intervention trials: what makes a preventive intervention successful? Br J Nutr, 88(3), 219-221.	Research commentary
Manios, Y., & Kafatos, A. (1999). Health and nutrition education in elementary schools: changes in health knowledge, nutrient intakes and physical activity over a six year period. Public Health Nutr, 2(3A), 445-448.	Curriculum based intervention
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., Kafatos, I., & Kafatos, A. (2006). Ten-year follow-up of the Cretan Health and Nutrition Education Program on children's physical activity levels. Prev Med, 43(6), 442-446.	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
Manios, Y., Moschandreas, J., Hatzis, C., & Kafatos, A. (2002). Health and nutrition education in primary schools of Crete: changes in chronic disease risk factors following a 6 year intervention programme. Br J Nutr, 88, 315-324.	Curriculum-based intervention
Marcoux, M. F., Sallis, J. F., McKenzie, T. L., Marshall, S. J., Armstrong, C. A., & Goggin, K. (1999). Process evaluation of a physical activity self-management program for children: SPARK. Psy Health, 14(4), 659-677.	No PA data
McBride, N., & Midford, R. (1999). Encouraging schools to promote health: impact of the Western Australian School Health Project (1992-1995). J Sch Health, 69(6), 220-226.	No PA data
McCallum, Z., Wake, M., Gerner, B., Baur, L. A., Gibbons, K., Gold, L., et al. (2007). Outcome data from the LEAP (Live, Eat and Play) trial: a randomized controlled trial of a primary care intervention for childhood overweight/mild obesity. Int J Obes (Lond), 31(4), 630-636.	Obesity treatment study
McCallum, Z., Wake, M., Gerner, B., Harris, C., Gibbons, K., Gunn, J., et al. (2005). Can Australian general practitioners tackle childhood overweight/obesity? Methods and processes from the LEAP (Live, Eat and Play) randomized controlled trial. J Paediatr Child Health, 41(9-10), 488-494.	Obesity treatment study
McKenzie, T. L. (1999). School health-related physical activity programs:	Research commentary

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Appendix D: Glossary

BMI	Body mass index
CBA	Controlled before and after
CC	Collaborating Centre
CNRT	Controlled non-randomised trial
CPHE	Centre for Public Health Excellence
CRCT	Cluster randomised controlled trial
CV fitness	Cardiovascular fitness
DCMS	Department of Culture Media and Sport
DfES	Department for Education and Skills
DH	Department of Health
DT	Department of Transport
FMS	Fundamental motor skill
MVPA	Moderate to vigorous physical activity
NHS	National Health Service
NICE	The National Institute for Health and Clinical Excellence
NS	Non-significant
NSF	National service frameworks
PHCC	Public Health Collaborating Centre
PDG	Programme Development Group
RCT	Randomised controlled trial
SCT	Social cognitive theory
SDT	Self-determination theory
SET	Self-efficacy theory
Physical Literacy	'the motivation, confidence, physical competence, understanding and knowledge to maintain physical activity at an individually appropriate level, throughout life' (Whitehead & Murdoch, 2006).
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.

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