Evidence Briefing



Physical activity for the early years

BHF National Centre
physical activity+health

Making physical activity a priority



Contents

Summary	1
Introduction	1
Physical and psychological health outcomes of physical activity	2
Factors influencing physical activity	4
Current levels of physical activity	5
Increasing levels of physical activity	7
Measuring physical activity	8
Public health guidelines for physical activity	8
Implications for practice	9

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Summary

The evidence reviewed in this document indicates that during the early years:

- Physical activity may be beneficially associated with cardiovascular disease risk factors, weight status, musculoskeletal health and psychological, social and emotional development and well-being.
- Structured physical activity sessions delivered in early years settings can be effective in improving motor skills.
- Physical activity patterns persist at a moderate level over a period of up to three years.
- Boys are generally more active than girls.
- Children are more active if their parents / carers are active and if they participate in physical activity with their child.
- Children who spend longer periods outside are more active than those who do not.
- Additional shorter breaks (rather than extending the duration of a single break) and more time between breaks results in greater activity.
- Additional playground equipment results in more physical activity.
- Training which examines ways to integrate physical activity into the curriculum can be effective in increasing activity levels.
- Additional research is required to build the evidence base.



Introduction

Historically, little research was conducted to examine the role of physical activity in promoting optimal well-being in the early years. However, there is now increasing interest in this age group, driven in part by a growing awareness that early life experiences impact upon future health outcomes and the rising prevalence of overweight and obesity in this population [1].

In this Evidence Briefing we focus specifically on children less than 5 years of age, hereafter referred to as 'under 5s' or 'the early years' [2;3]. This important population group has previously been excluded from public health guidelines for physical activity, which typically focussed upon children aged 5 years and above. However, in recognition of the emerging evidence supporting the promotion of physical activity in the early years, the 2011 joint Chief Medical Officers' report "Start Active, Stay Active" for the first time provides UK-wide guidelines for under 5s [4].

In broad terms, physical activity is defined as "any body movement produced by the skeletal muscles that results in a substantial increase over resting energy expenditure" [5]. Accordingly, we focus here upon gross motor physical activity involving the large muscle groups. In the early years, physical activity occurs in numerous forms, such as active transportation (e.g. walking to the shops) and adult-facilitated activities (e.g. dance / swimming lessons) but the predominant source is likely to be physically active play.

Key term – Physically active play

The term 'physically active play' refers to activities that tend to be spontaneous, unstructured and intrinsically motivated, consistent with a conventional definition of play [3], but is distinguished from passive activities, such as playing table-top games or drawing, which may be accurately defined as play but typically involve minimal movement or physical exertion.

In this Evidence Briefing we examine the role of physical activity in the health and well-being of children under 5. Sedentary behaviour is not considered here, but will be addressed in a subsequent Evidence Briefing. We attempt to summarise succinctly the available evidence and, where necessary, direct the interested reader to existing articles which have dealt with specific issues in greater detail.

Physical and psychological health outcomes of physical activity

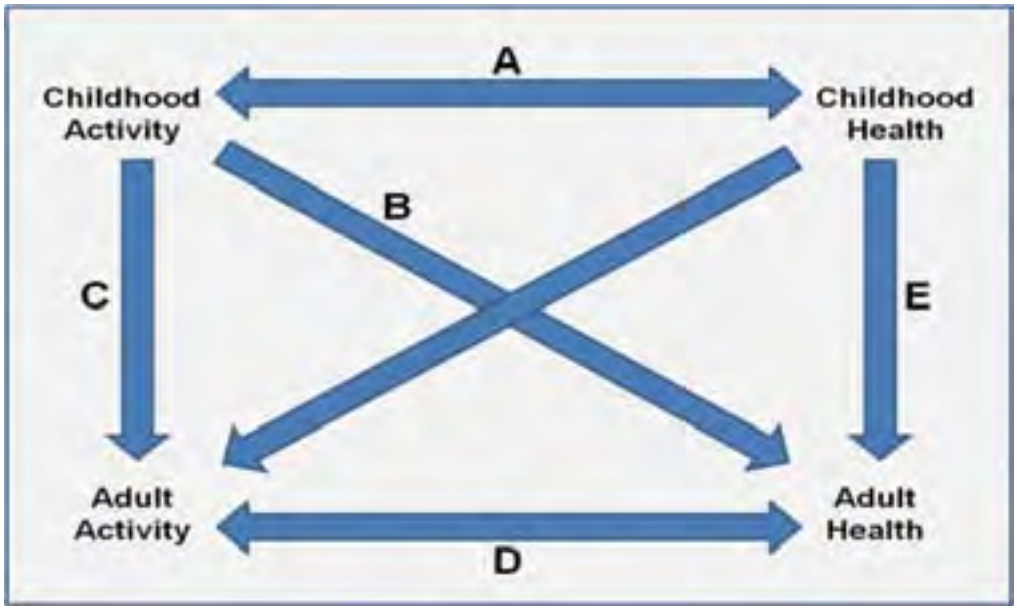
In this age group, there are numerous pathways through which physical activity may impact upon current and future behaviours and health outcomes, as illustrated in Figure 1 [6]. This model provides a strong basis on which to justify the promotion of physical activity in the under 5s.

The impact of physical activity on health during adulthood (pathway D) has been considered in detail elsewhere so is not considered here [7]. Currently, with the exception of bone mineral density, there is a lack of evidence which links childhood activity patterns with adult health status (pathway B). With respect to pathway E, research has shown that some physical activity related cardiovascular risk factors, overweight, and bone mineral density persist to some degree from young age into adulthood [8;9]. This briefing, however, will focus on the role of physical activity in providing immediate health benefits (Pathway A) and the extent to which physical activity patterns during the early years may persist over time (Pathway C). The discussion below summarises findings from recent systematic literature reviews [3;10].

Immediate Health Benefits (Pathway A)

Compared with older children or adults, relatively little research has been conducted in this age group and what research is available often has methodological limitations [3;10]. For example, much of the evidence is obtained from cross-sectional or 'snapshot' studies, which assess both physical activity and health outcome (e.g. weight) at a single point in time. An important limitation of this type of study is that it is not possible to ascertain whether the outcome, for example high cholesterol or obesity, is a cause or consequence of low physical activity levels.

Figure 1. Conceptual model for the benefits of childhood physical activity.



There is evidence that physical activity during the early years may be beneficially associated with:

- **Cardiovascular disease risk factors:** Risk factors such as blood pressure and cholesterol have been examined for their association with physical activity in the early years, but the evidence is limited to only a small number of observational studies. The research generally suggests that physical activity is beneficially associated with blood cholesterol levels in this age group, but evidence for an association with blood pressure, both systolic and diastolic, is mixed.
- **Weight status:** The role of physical activity in preventing or treating excessive weight gain in the early years is currently unclear. Experimental studies have generally found no differences in weight status between experimental and control groups at follow-up. By contrast, the majority of observational studies have found greater physical activity is associated with reduced weight gain or lower risk of being overweight / obese in under 5s. Currently, it is not possible to draw firm conclusions on this issue and further research is required to clarify the situation.
- **Musculoskeletal health:** The role of physical activity in promoting bone health has been studied in a small number of experimental studies, all of which indicate that, under certain conditions, physical activity may be beneficial for musculoskeletal health. It should be acknowledged, however, that most of this research focused upon low birth-weight, pre-term infants, and it is not clear whether similar findings would be observed in normal-term babies of healthy weight.
- **Motor skill development:** Physical activity is positively associated with motor development in this age group, however, studies have assessed both physical activity and motor development at a single point in time, so it is not possible to establish whether improved motor development is a cause or consequence of physical activity participation. A recent review of the literature [11] indicated that experimental studies that employed physical activity programmes to improve motor development generally have been successful.
- **Psychological, social and emotional health:** Physical activity likely plays a key role in brain development during early childhood [12] and the importance of play for the cognitive, social and emotional well-being of children and adolescents is well acknowledged [13]. These benefits most likely accrue through a variety of mechanisms, including the formation of neural structures necessary for future activities; practice of physical and social skills, and as a means of expressing emotions [14]. It is likely that many of the opportunities for development that exist for play in general are also available during physically active play [15]. Research from a small number of studies indicates that physical activity during the early years may be beneficially associated with self-concept, self-esteem and social and emotional competence [3;10].

Persistence of Physical Activity Over Time (Pathway C)

Physical activity may benefit health through the persistence of activity patterns from the early years into childhood and adulthood (tracking), where the benefits of a physically active lifestyle are well established [7].

Key term – Tracking

The degree to which activity patterns persist over time is known as tracking. High levels of tracking indicate that physical activity patterns are consistent over time, strengthening the case for the promotion of activity early in life. An example of 'good' or 'high' levels of tracking would be a child that is highly active at age 3 years continuing to be highly active up to the age of 5 years and beyond.

To examine whether physical activity 'tracks' over time, it is necessary to measure physical activity at 2 points in time and calculate the extent to which physical activity patterns between these 2 points are associated ('correlated'). In studies that first



assessed physical activity in participants less than 5 years of age, the second round of measurements have been conducted up to 3 years later. The evidence indicates that physical activity patterns in the early years persist at a 'moderate' level into the primary school years. Currently, there are no studies that have assessed tracking of physical activity from the early years into adolescence or adulthood, however, reviews of the literature indicate that tracking typically weakens as the period of follow up increases [16].

Physical and Psychological Health Outcomes – Summary

In summary, the available evidence indicates that physical activity may be beneficial for the physical and psychological well-being of children under 5 years of age and that patterns of physical activity persist at a moderate level over a period of up to 3 years. However, the evidence base for physical activity in the early years is currently quite limited, both in its quantity and in some cases the underlying quality of the research. It is important to acknowledge that, appropriately enough, research into the early years is still in its infancy and it is a lack of research that limits our ability to draw firm conclusions in many cases. As more studies are conducted on this topic, we will gain better insight into the benefits of physical activity in this age group.

Factors influencing physical activity

Physical activity is a complex, multi-dimensional behaviour influenced by a wide range of factors (typically referred to as correlates) operating at individual, social and environmental levels. Young children have relatively little control over their behaviours, therefore social and environmental characteristics that facilitate or impair physical activity may be particularly important.

Understanding the correlates of physical activity helps to identify population groups that should be targeted for intervention and indicates how we may go about changing behaviour. Below we summarise the influence of various factors on physical activity patterns in the early years, drawing from recent reviews of the literature [2;10].

Biological/demographic factors

- **Gender:** Differences in the activity patterns of boys and girls during the early years have been observed consistently, with boys generally being more active than girls.
- **Age:** Findings are inconsistent regarding changes in physical activity up to 5 years of age; it is currently unclear whether levels of activity decrease, remain stable or increase during the early years.
- **Demographic factors:** The influence of demographic factors, such as ethnicity or socio-economic status, on physical activity in this age group is unclear.

Psychological factors

Psychological correlates of physical activity in children under 5 have been little studied; reflecting the inherent difficulty of assessing these constructs in young children.

Behavioural factors

- **TV viewing:** A number of studies have examined the association between physical activity and TV viewing in under 5s. Findings are generally mixed with some studies reporting that TV viewing may be associated with lower levels of activity but others reporting no association.

Social / cultural factors

- **Parental behaviours and practices:** Whilst findings are not wholly conclusive, there is some evidence that parental physical activity or parent-child interactions during activity are associated with higher levels of activity. Parental encouragement does not appear to be associated with physical activity at this age.

Environmental factors

- **Time spent outdoors:** A number of studies have shown that time spent outdoors is associated with higher levels of physical activity during the early years.
- **Childcare settings:** There is emerging evidence that activity levels may vary markedly between childcare settings, and that policy and environmental characteristics appear to be influential. A recent study by Cardon et al [17], for example, reported that having smaller numbers of children attending a childcare centre, shorter break times and more time between breaks was associated with higher levels of activity.

Influencing Factors – Summary

To date, relatively few factors have been found to be consistently associated with physical activity in children under 5 years, primarily due to a lack of research. However, based upon the summary provided above, it is possible to conclude that in this age group boys are more active than girls, children of physically active parents are more likely to be active than those with inactive parents, and children who spend longer periods outdoors are more active than those who spend less time outdoors.

Current levels of physical activity

In this section we describe current levels of physical activity in under 5s using data from nationally-representative studies. The surveillance data summarised below was produced prior to the release of physical activity guidelines for the early years age group [4]. Much of this data was presented to provide estimates against the guidelines for older children and adolescents at the time of publication (at least 60 minutes of at least moderate to vigorous physical activity every day) [18].

Overall Physical Activity Levels

England: The 2008 Health Survey for England included physical activity assessments for children by parental report and accelerometry [1]. Parent-reported data are presented only as proportions of children exceeding 60 minutes of moderate to vigorous activity per day.

- Parent-report data indicate that 43% of boys and 35% of girls aged 2 years exceeded 60 minutes per day of moderate to vigorous physical activity. At age 4 years, this figure had fallen to 28% in both sexes (Figure 2 over page).
- Total accelerometer assessed physical activity (light, moderate and vigorous intensity combined) in boys aged 4-7 years was 397 minutes (6.6 hours) per day. Approximately 70% of this activity was of light intensity.
- Total accelerometer assessed physical activity in girls aged 4-7 years was 375 minutes (6.3 hours) per day. Approximately 70% of this activity was of light intensity.

Scotland: The Scottish Health Survey 2008/09 [19] included parental report of physical activity in children aged 2-4 and 5-7 years.

- As illustrated in Figure 3, the proportion of children aged 2-4 years exceeding 60 minutes per day of moderate to vigorous physical activity was 72% for boys and 67% for girls. At age 5-7 years these figures increased slightly to 77% and 75% respectively.

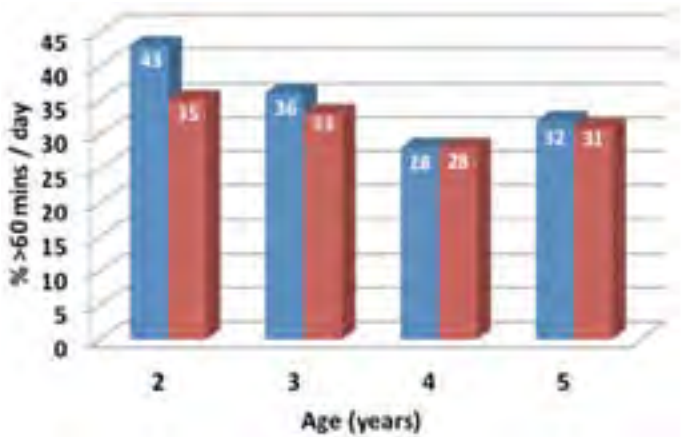


Figure 2. Proportion of children exceeding 60 minutes / day of moderate to vigorous physical activity (parent-reported)

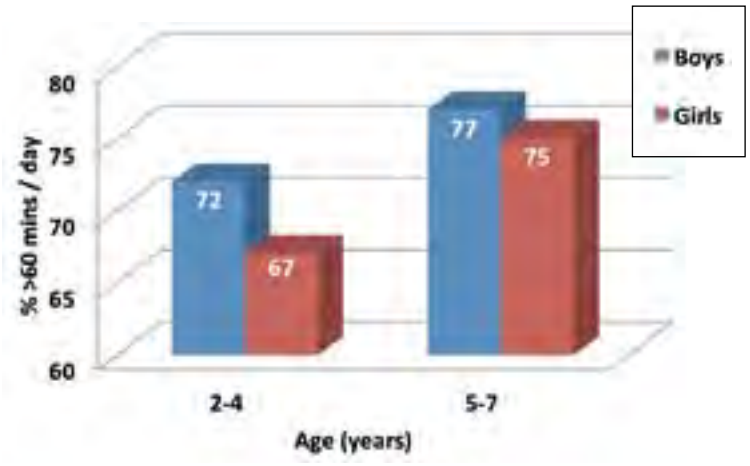


Figure 3. Proportion of children exceeding 60 minutes / day of moderate to vigorous physical activity (parent-reported)

The Welsh Health Survey includes self-report questions on physical activity for children aged 4-15 years but presents only pooled results for children of all ages. Currently, nationally representative surveys of physical activity in children are not undertaken in Northern Ireland.

As physical activity levels in children under 5 years are not assessed comprehensively at the national level in the UK, it is valuable to examine other sources of information on activity levels in this age group. Tucker (20) recently performed a systematic literature review of physical activity levels in children aged 2-6 years and found that children spent 2-4% of their day in moderate or vigorous intensity physical activity, which translates to 20-30 minutes per day. Of the 9 studies conducted in the UK, only 2 reported that greater than 50% of participants exceeded 60 minutes of moderate or vigorous physical activity every day.

Physical Activity in the Childcare Setting

A large proportion of children under 5 are enrolled in childcare, thus it is a potentially valuable setting for the promotion of physical activity in this age group. With this in mind, it is interesting to examine how active under 5s are whilst attending childcare.

A recent review of the literature indicates that physical activity levels in childcare appear generally to be very low; the majority of studies suggest that children accumulate less than 60 minutes of moderate or vigorous physical activity over an 8-hour day [21].

For example, Reilly et al [22] assessed activity levels by accelerometer in 424 Scottish children aged 3-4 years. Average time spent in moderate to vigorous activity per day whilst attending childcare was less than 25 minutes.

Increasing levels of physical activity

To attain sufficient levels of physical activity, under 5s should be encouraged to be physically active throughout the day and in all settings. Interventions to increase physical activity in the early years have been located in family, community or childcare settings, most frequently the latter. Family- and community-based interventions in this age group are few in number and have been largely ineffective or methodologically weak. Accordingly, they are not considered further in this discussion.

Motor-skill development

Ward et al [23] recently reviewed the literature for the effectiveness of childcare-based interventions to increase physical activity and motor-skill development in the early years. The authors report consistent evidence that structured activity sessions delivered in childcare are effective in improving motor skills. Whilst such findings are encouraging, the authors suggest the need for "cautious optimism" in the interpretation of these studies because of limitations in research design. Successful interventions focused upon fundamental movement skills, body management, physical fitness or dance, delivered in discrete units of 30-45 minutes, 2-3 days per week for up to 20 weeks.

Physical Activity – Curriculum-based Approaches

Interventions which assessed physical activity were examined separately according to whether the intervention focussed upon the curriculum or the environment / policies of the childcare setting. The effectiveness of curriculum-based approaches to increase physical activity in the early years is unclear, though examples of successful intervention programmes were identified [23]. There was some indication that higher dosage interventions, either in terms of more sessions per week or longer duration, were required to bring about changes in physical activity compared to what was required to improve motor-skills. Effective interventions comprised structured activity programmes delivered for 30-45 minutes 5-6 days per week for up to 12 months.

Physical Activity – Environment / Policy Approaches

A small number of studies have examined the influence of changes to the childcare environment or policy upon physical activity levels. Provision of additional playground equipment and teacher training in ways to integrate physical activity into the curriculum were found to be effective in increasing physical activity. From the limited available evidence it appears that modifications to childcare break times are more likely to result in greater activity if additional shorter breaks are offered rather than extending the duration of a single break time [2;23].

Increasing Levels of Physical Activity – Summary

In summary, there is relatively strong evidence that childcare-based interventions to improve motor-skill can be effective. For the promotion of physical activity, however, the evidence for what works in the childcare setting remains somewhat unclear. It appears that curriculum-, environment- and policy-based strategies have the potential to bring about changes in activity patterns in childcare, but more research is required. It is interesting to note that different 'dosages' of intervention (i.e. frequency and duration of intervention sessions) are required to bring about changes in physical activity or motor-skill in the childcare setting.



Measuring physical activity

Accurate measurement is essential to establishing the role of physical activity in promoting optimal health, to monitor compliance with public health guidelines and to assess the impact of interventions. Researchers and practitioners concerned with programme evaluation face a number of unique challenges when attempting to assess physical activity in the early years. For example, activity patterns at this age are sporadic; therefore measurement tools must be sensitive enough to record short bouts of activity.

Numerous methods of assessing physical activity exist. Self-report questionnaires are the most frequently used method but their use in the early years is not appropriate because children of this age are unable to recall their activities accurately. Alternative methods that could be considered include:

- **Proxy-reports of children's physical activity:** Typically completed by parents or school teachers, these are a viable alternative to self-report [24]. Proxy measures can be used to collect data from large numbers of participants at relatively low cost, however, they may lack validity in comparison to other methods and information obtained by this method should be interpreted with caution.
- **Direct observation:** In this method a trained observer records participants' physical activity behaviour for a predetermined period of time. A key strength of this method is that information on the type of physical activity being performed and the social and environmental context in which it takes place can also be recorded. Disadvantages include the need to train observers, which is time consuming; the need for regular assessment of consistency between observers; and potentially high staff costs, due to the method being somewhat labour intensive.
- **Pedometers:** These are small devices worn on the hip which measure total steps per day. Pedometers are an objective measure of physical activity, therefore avoiding some of the biases associated with teacher or parent report. This method is also inexpensive and suitable to use with large numbers of children. However, pedometers provide no information on the type or context of physical activity and are not suitable for measuring some activities e.g. swimming and cycling.

No single physical activity measure is optimal for all situations and the choice of method requires careful consideration. Key issues that must be considered include the specific question being addressed, availability of personal and financial resources and the measurement properties of the particular method. A more comprehensive discussion of the various methods of assessing physical activity and the unique challenges for measurement in the early years can be found elsewhere [25;26]

Public Health Guidelines

Previously, public health guidelines for physical activity in children were aimed at those aged 5 years and over and were therefore not applicable to the early years. However, new guidelines, released in July 2011 with endorsement from the Chief Medical Officer of each of the home countries, include recommendations specifically for the early years [4]. These guidelines state:

1. Physical activity should be encouraged from birth, particularly through floor-based play and water-based activities in safe environments.
2. Children of pre-school age who are capable of walking unaided should be physically active daily for at least 180 minutes (3 hours), spread throughout the day.
3. All under fives should minimise the amount of time spent being sedentary (being restrained or sitting) for extended periods (except time spent sleeping).

The new guidelines were informed by the growing body of evidence on the benefits of physical activity in this age group and expert opinion. The influence of sedentary behaviour on health has not been considered here, but will be addressed in a subsequent Evidence Briefing. These guidelines differ in two important ways from those developed for older children and adolescents. Firstly, recommendations for the early years refer to all levels of activity without specific reference to intensity (i.e moderate

or vigorous). This is because recommendations specifying a particular intensity of activity are not developmentally appropriate for this age group. Secondly, 180 minutes of activity is recommended for under 5s in contrast to the 60 minutes of activity recommended for older children. In part this reflects the fact that early years guidelines refer to all activity (not just moderate and vigorous activity) but also it is widely observed that activity levels decline as children age (particularly during adolescence), therefore it is valuable to establish high levels of activity during the early years in order that activity levels later in childhood are sufficient to benefit health.

Implications for practice

The evidence summarised in this document has important implications for policy-makers and practitioners working with the early years and for parents / carers of children this age. Potential action areas for each of these groups are highlighted below. In this article we have focussed solely upon physical activity, however, the actions listed below should be considered alongside measures to limit sedentary behaviour. The evidence linking sedentary behaviour with health, and implications of this evidence for practice, will be considered in a separate Evidence Briefing.

Potential actions for policy

- Policy-makers from various disciplines, including education, welfare, health and social development, should be aware of the importance of and take action to promote physical activity in the early years through policy measures.
- Planners of curriculum programmes should incorporate some structured physical activity sessions into early years curriculum programmes.
- When developing these programmes consideration should be given to the many competing demands for time and priority within the curriculum.
- The knowledge and expertise of early years staff to deliver these sessions should be considered and appropriate training and support made available to enable successful delivery of these programmes.
- Appropriate safe play areas should be provided in local communities for all families to access.
- More research is needed to inform early years practice as well as raising the profile of this important area in the minds of policy makers, health professionals, practitioners and parents / carers.

Potential actions for practitioners

- Provide children in their care with enabling environments to facilitate the learning and practice of new movement patterns and skills (e.g. organised games or guided discovery sessions).
- Provide lots of small play equipment, everyday objects and props. Plan the use of this equipment to ensure all children have equal access to all equipment on a regular basis.
- Ensure that all play opportunities are available to girls and boys alike.
- Modify break times to encourage shorter more focused sessions of outdoor active play.
- Review and improve knowledge and understanding of early years physical development through appropriate training courses, resources and community networks.
- Facilitate and support parents' understanding of the importance of early movement experiences to the physical and psychological well-being of their child.

Potential actions for parents and carers

- Support their child by providing lots of opportunities for them to be active and practise physical activities on a daily basis, especially in a variety of outside environments.
- Work with their child's early years settings to:
  1. be informed of the physical activity experiences their child is having and support with similar and new movement opportunities at home.
  2. send their child suitably dressed to participate in physical activities both indoors and outdoors according to the seasonal weather.
- Be an active role model by participating in physical activity and seek opportunities to be active together.
- Ensure that boys and girls are given equal access to a variety of active play experiences.

References

(1) Health Survey for England 2008. Volume 1: Physical activity and fitness. Leeds: The NHS Information Centre for health and social care.; 2009.

(2) Hinkley T, Crawford D, Salmon J, Okely AD, Hesketh K. Preschool children and physical activity: a review of correlates. Am J Prev Med 2008 May;34(5):435-41.

(3) Timmons BW, Naylor PJ, Pfeiffer KA. Physical activity for preschool children--how much and how? Can J Public Health 2007;98 Suppl 2:S122-S134.

(4) The Department of Health. Start Active, Stay Active. A report on physical activity for health from the four home countries' Chief Medical Officers. The Department of Health; 2011.

(5) Bouchard C, Shephard RJ. Physical activity, fitness, and health: the model and key concepts. In: Bouchard C, Shephard RJ, Stephens T, editors. Physical Activity, Fitness and Health: international proceedings and consensus statement.Champaign, Ill: Human Kinetics; 1994. p. 77-88.

(6) Blair SN, Clark D, Cureton K, Powell KE. Exercise and fitness in childhood: Implications for a lifetime of health. In: Gisolfi C, Lamb D, editors. Perspectives in Exercise Science and Sports Medicine.Indianapolis: Benchmark Press; 1989. p. 401-30.

(7) Warburton DE, Charlesworth S, Ivey A, Nettlefold L, Bredin SS. A systematic review of the evidence for Canada's Physical Activity Guidelines for Adults. Int J Behav Nutr Phys Act 2010;7:39.

(8) Berenson GS. Childhood risk factors predict adult risk associated with subclinical cardiovascular disease. The Bogalusa Heart Study. Am J Cardiol 2002 Nov 21;90(10C):3L-7L.

(9) Whitaker RC, Wright JA, Pepe MS, Seidel KD, Dietz WH. Predicting obesity in young adulthood from childhood and parental obesity. N Engl J Med 1997 Sep 25;337(13):869-73.

(10) Okely AD, Salmon J, Trost SG, Hinkley T. Discussion paper for the development of physical activity recommendations for children under five years. Canberra, ACT, Australia: Australian Department of Health and Ageing, Government of Australia.; 2008.

(11) Riethmuller AM, Jones R, Okely AD. Efficacy of interventions to improve motor development in young children: a systematic review. Pediatrics 2009 Oct;124(4):e782-e792.

(12) Maude P. Physical literacy and the young child. In: Whitehead M, editor. Physical literacy throughout the lifecourse. Oxon: Routledge; 2010. p. 100-16.

(13) Ginsburg KR. The importance of play in promoting healthy child development and maintaining strong parent-child bonds. Pediatrics 2007 Jan;119(1):182-91.

(14) Eaton WO, Mckeen NA, Campbell DW. The waxing and waning of movement: Implications for psychological development. Developmental Review 2001 Jun;21(2):205-23.

(15) Pellegrini AD, Smith PK. Physical activity play: the nature and function of a neglected aspect of playing. Child Dev 1998 Jun;69(3):577-98.

(16) Telama R. Tracking of physical activity from childhood to adulthood: a review. Obes Facts 2009;2(3):187-95.

(17) Cardon G, Van CE, Labarque V, Haerens L, De B, I. The contribution of preschool playground factors in explaining children's physical activity during recess. Int J Behav Nutr Phys Act 2008;5:11.

(18) Department of Health. At least five a week: Evidence on the impact of physical activity and its relation to health. A report from the Chief Medical Officer. 2004.

(19) The Scottish Health Survey 2009. Volume 1: Main report. Edinburgh: The Scottish Government; 2010.

(20) Tucker P. The physical activity levels of preschool-aged children: A systematic review. Early Chidhood Res Q 2008;23:547-58.

(21) Reilly JJ. Low Levels of Objectively Measured Physical Activity in Preschoolers in Child Care. Med Sci Sports Exerc 2010 Mar;42(3):502-7.

(22) Reilly JJ, Kelly L, Montgomery C, Williamson A, Fisher A, Mccoll JH, et al. Physical activity to prevent obesity in young children: cluster randomised controlled trial. BMJ 2006 Nov 18;333(7577):1041-3.

(23) Ward DS, Vaughn A, McWilliams C, Hales D. Interventions for increasing physical activity at child care. Med Sci Sports Exerc 2010 Mar;42(3):526-34.

(24) Chinapaw MJ, Mokkink LB, van Poppel MN, Van MW, Terwee CB. Physical activity questionnaires for youth: a systematic review of measurement properties. Sports Med 2010 Jul 1;40(7):539-63.

(25) Oliver M, Schofield GM, Kolt GS. Physical activity in preschoolers: understanding prevalence and measurement issues. Sports Med 2007;37(12):1045-70.

(26) Pate RR, O'Neill JR, Mitchell J. Measurement of physical activity in preschool children. Med Sci Sports Exerc 2010 Mar;42(3):508-12.

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