

2002

What do we really know about the constraints and enablers of physical activity levels in young children?

Beth P. Hands

University of Notre Dame Australia, bhands@nd.edu.au

Helen Parker

University of Notre Dame Australia, hparker@nd.edu.au

Dawne Larkin

University of Western Australia, dlarkin@cyllene.uwa.edu.au

Follow this and additional works at: https://researchonline.nd.edu.au/health_conference



Part of the [Medicine and Health Sciences Commons](#)

This conference paper was originally published as:

Hands, B. P., Parker, H., & Larkin, D. (2002). What do we really know about the constraints and enablers of physical activity levels in young children?. *23rd Biennial National/International Conference*.

This conference paper is posted on ResearchOnline@ND at https://researchonline.nd.edu.au/health_conference/4. For more information, please contact researchonline@nd.edu.au.



Running Head: Constraints and enablers of physical activity in children

What do we **really** know about the constraints and enablers of physical activity levels
in young children?

Beth Hands^a, Helen Parker^a, Dawne Larkin^b
University of Notre Dame Australia^a
University of Western Australia^b

Send correspondence to:

Dr Beth Hands
School of Health and Physical Education
College of Health
University of Notre Dame
PO Box 1225
FREMANTLE WA 6959
Ph: (618) 9239 5792
Fax: (618) 9239 5790
Email: bhands@nd.edu.au

Word Count: 4794

Abstract

Ample evidence exists to support the benefits of habitual physical activity levels on long term health and well-being for adults, youth and, more recently, children. However information about factors that impact on young children's choices to be active or inactive is limited because the accurate measurement of physical activity in young children is difficult. Consequently, many statements found in the literature about young children's physical activity levels are not founded on empirically validated information. Some conclusions are extrapolated to younger children from findings in studies of older children.

This paper is based on an extensive review of literature and the outcomes of a National Summit held in Fremantle, WA in November 2001. It seeks to identify those key early life experiences and context factors that research has confirmed create the child who is attracted to physically active play rather than sedentary play. The implications of these findings for future research and intervention programs are presented.

Introduction

Ample evidence exists to support the benefits of habitual physical activity levels on long term health and well-being for adults and youth however the implications for early childhood are still unclear. We are reading more and more frequently that young children are less physically active than years ago. Why is this happening? What factors are impacting on young children's choices to be active or inactive? What do we know? The answer is very little.

Information about physical activity levels in young children is limited for a number of reasons. Firstly, there are no valid and reliable baseline data by which we can compare activity levels. Secondly, studies investigating physical activity in young children have used a range of different measurement tools and protocols. The lack of consistency of agreed, valid methods makes results difficult to compare. Thirdly, one cannot use self-report, recall methods that are common in physical activity research with youth and adults with young children because of their inability to accurately recall their own activity levels. Fourthly, the nature of children's physical activity is different to that of adults. Young children engage in many forms of movement patterns in play (run, walk, clamber, sit, skip, hop, jump, etc.), these are performed in short bouts, and with varied amounts of repetition.

These qualities of children's physical play limit the choices of measurement methods available to researchers. Consequently, many statements found in the literature about young children's physical activity levels are not founded on empirically validated information. Often conclusions are extrapolated to younger children from findings in studies of older children. Recent papers identifying key predictors of physical activity in children have been based on studies involving children aged 12 years (Sallis, Prochaska, & Taylor, 2000) and beyond (Kohl & Hobbs, 1998) and do not focus on the unique early years. Physical and cognitive development, movement skill patterns, and social and physical environments differ significantly between pre-school, upper primary school children and adolescents. The key factors, the potential "influencers" of physical activity, for these age groups, therefore, must also differ.

In early childhood, a large number of factors have been proposed or hypothesised as impacting on children's activity levels in both the short and long term. Some factors
Hands, Parker & Larkin, 2002

are thought to constrain the rate and direction of behaviour change in the developing child while others optimise activity levels and lead to a physically active lifestyle in future years. However, very few of these factors have been confirmed.

A framework is important to tease out precursor or foundation factors that enable a child to build an active future, a framework that is capable of incorporating developmental change and multiple influences. One framework proposed by Lindquist, Reynolds and Goran in 1999 considers “determinants” at four levels: **physiological** factors such as maturation and growth, **psychological** factors such as motivation and self-efficacy, **sociocultural** factors such as family characteristics and sociodemographics, and **ecological** factors such as the physical environment. An extension of this typological model is to consider these not as “determinants” at different levels of influence but as sources of “interacting constraints” on developing behaviour. Such a framework has been applied to understanding motor and cognition development by Esther Thelen and Linda Smith, respectively, from a dynamic systems approach (Thelen & Smith, 1994). For physical activity behaviour, the dynamic approach encompasses the changing interaction between key sources of constraint – the child itself, the socio-cultural context and the physical environment.

Some of these factors support and enhance physical activity (for example, parent support, encouragement, playgym experiences, etc.) whilst some constrain or limit physical activity engagement (for example, lack of physical maturity, gross motor incoordination, level of cognitive reasoning, motivation etc.). Whilst the interacting factors are called constraints we can just as easily view them as “enablers”. The “dynamic systems” model challenges us to think of behaviour as “emergent” from complex interactions of factors and not merely as being “pre-designed” through maturation processes.

To guide health promotion initiatives engendering physical activity in young children we need to identify the interacting factors, constraints and enablers. What is the collective effect of interactions at certain periods in development? This paper is based on an extensive review of literature and seeks to identify those key early life experiences and context factors that research has confirmed creates the child who is attracted to physically active play rather than sedentary play by targeting only those

studies who have focused on children aged 8 years or under. It attempts to discriminate between the predictors or factors that have been shown to impact on physical activity in young children and those that are simply hypothesised and yet to be investigated. This review formed the background reading to a National Summit, *Building an Active Future*, held in Fremantle, WA in November 2001 (Hands, Parker, & Larkin, 2001). The implications of these findings and the recommendations arising from the Summit for future research and intervention programs are presented and summarised in Table 1.

Constraints and Enablers

Physiological Factors

Age

Activity levels of young children appear to peak around the ages of 6 and 7 years with a gradual, yet significant drop in activity with age (Armstrong, Balding, Gentle, & Kirby, 1990; Eaton, Keen, & Campbell, 2001; Goran, Gower, Nagy, & Johnson, 1998; Welsman & Armstrong, 1997). This decrease also coincides with the introduction of formal schooling.

Developmental Maturity

Young children of similar ages differ in growth rates for weight, height, proportion of body segments, distribution of fat and muscle tissue, postural characteristics and somatotype. The impact these factors have on each child's potential to move skilfully and to interact vigorously with the environment is suspected yet largely unknown.

Gender

Participation in physical activities, particularly the more vigorous, is generally lower in females than in males (Cratty, Ikeda, Martin, Jennett, & Morris, 1970; Goran et al., 1998; Janz, Paulos, Burns, & Levy, 1999; Lindquist et al., 1999; Poest, Williams, Witt, & Atwood, 1989; Welsman & Armstrong, 1998). Kohl and Hobbs (1998) suggest these differences are related to the development of motor skills, body composition during growth, maturation levels and socialisation toward sport and physical activity.

Motor Competence

Australian children cite low motor skill level as a major barrier to participation in sport (Booth et al., 1997). Wankel and Pabich (1981) also reported that many children indicated they dropped out of organised sport because they could not perform the skills sufficiently well to play the game successfully. Comparisons of children with high and low motor competence consistently found significant differences in engagement of moderate to vigorous activities (Li & Dunham, 1993; Smyth & Anderson, 2000, Ulrich, 1987). Bouffard and others (1996) found that children with low competence vigorously active 15.1% of recess time compared to 23.7% for children with high competence,

Fitness

Few studies have investigated the relationship between fitness components such as flexibility, muscle endurance and strength and cardiovascular endurance and physical activity with this age group. Body composition, on the other hand, has been investigated. While numerous studies have reported that obese children generally engage in less physical activity than their leaner counterparts, for young children this has not been consistently demonstrated. For example a study of obese and non-obese Chilean preschoolers found no significant differences in physical activity levels between the two groups (Kain & Andrade, 1999). Similar amounts of time were spent watching TV, sleeping and engaged in sedentary, moderate and intense activities by both groups. Similarly, an investigation of the relationship between TV watching, physical activity and body composition in 5- and 6-year-old children showed that children who watched more television were less active, however this lower activity level did not result in increased adiposity (DuRant, Thompson, Johnson, & Baranowski, 1996).

Psychological Factors

Perceived Motor Competence

Studies of adolescents and adults have found that those who had positive and enjoyable experiences when young were more likely to continue to exercise when adult (Godin & Shephard, 1986; Shephard & Godin, 1986; Taylor, Blair, Cummings, Wun, & Malina, 1999). It follows that children who develop confidence about their Hands, Parker & Larkin, 2002

motor skill and have positive expectations about their participation in games and sports, consequently actively seek out movement experiences in an assured manner (Kalverboer, 1990). Harter (1978) formalised this in her interactive model of Effectance Motivation which linked a child's previous success at task mastery to their motivation to participate in other activities within that context or domain.

Studies involving older children, aged 8- to 12-years, found that those who experienced difficulty in acquiring the level of motor skill expected of them developed poor perceptions of their athletic competence and physical appearance (Rose, Larkin, & Berger, 1997). These children are less motivated to participate in challenging activities and have lower physical activity levels.

Motivation to be Active

Sedentary behaviours such as TV watching, computer games or reading can be very reinforcing for children. For some children, physical activity is also reinforcing (Epstein, Kilanowski, Consalvi, & Paluch, 1999). Such children seek out physical rather than sedentary past times.

Knowledge, Attitude, Interests and Strengths

Knowledge about importance of physical activity, attitude towards physical activity, personal interests and strengths are psychological factors that have been hypothesised as constraints or enablers however no research with young children has been reported.

Sociocultural Factors

Parents

Many studies have investigated the links between children's physical activity and different aspects of their family life, particularly the influence of the parents. As children model many behaviours from their parents, then parental physical activity is likely to be a powerful influence on their children's activity (Freedson & Evenson, 1991; Moore et al., 1991; Poest et al., 1989; Sallis, Patterson, McKenzie, & Nader, 1988; Steinbeck, 2001). In addition, parental attitudes towards activity may impact on the child's activity level and attitude towards activity (Klesges et al., 1984; Pellegrini & Smith, 1998) although some studies have found no relationship Hands, Parker & Larkin, 2002

(McMurray et al., 1993; Mota & Queiros, 1996). Studies of infants and toddlers have shown that the play environment in the home, parental role modelling, and activity choices offered by the parents shape young children's play behaviours (reviewed in Barnett & Chick, 1986). Even the presence of the parent in the room or outdoor play environment can increase a child's activity level (Klesges, Haddock, & Eck, 1990; Routh, Walton, & Padan-Belkin, 1978)

Child-rearing Practices

While Erbaugh and Clifton (1884) suggested child-rearing practices may impact on children's physical activity levels, no studies have been identified.

Structure of Family

Lindquist and colleagues (1999) found that children from single parent homes were more active during the week than children living with both parents.

Siblings

Position in the family significantly influences the motor development of young children (Erbaugh & Clifton, 1984). The older child usually initiated physical activity while the younger siblings observed. The younger child, especially if male, then often replicated the activity their older siblings had performed. Barnett and Chick (1986) found that more physically playful boys had male siblings, whereas for more physically playful girls the gender of older siblings was not important.

Peers

Although, found to be powerful influence amongst older children, peers do not appear to be influential at this age (McKenzie et al., 1997).

Teacher or Caregiver

As young children are spending more time in formal day care or pre-primary settings, the teacher or caregiver's attitude towards physical activity may be important (Benham-Deal, 1993). As children get older they rely less on prompts and influence from their teachers to be physically active (McKenzie et al., 1997).

Ethnicity

Race/ethnicity has been shown to be predictive of physical activity in youth and adolescents, however findings may be confounded by other factors such as socio-economic status (McKenzie et al., 1997; Sallis, 1994; Sallis et al., 1992). No comparable data were found for indigenous or ethnic young Australian children.

Nutrition

Physical activity is thought to be a key indicator of mild to moderate malnutrition (Malina, 1984). Differences in physical activity levels were evident between two groups of 4-month-old Mexican infants, one group receiving nutritional supplements. At 2 years of age the group receiving supplements were 6 times as active as the other group (Cahvez & Martinez, 1984; Malina, 1984).

Socio-Economic Status

Higher levels of SES have been hypothesised to be a determinant, as middle class children are thought to have a more supportive home environment and parents with more leisure time (Barnett & Chick, 1986; Strauss & Knight, 1999).

Other Factors

Additional socio-cultural factors that may impact on young children's activity levels include safety concerns, fear of litigation, community interests, location and sporting facilities.

Ecological Factors

Design of Outdoors

Given the variation in children's physical development at any one age, the size and design of playground equipment should be considered. Play spaces need to accommodate all shapes and sizes and be developmentally appropriate (Herkowitz, 1979). Herkowitz suggests that novelty and complexity in playground design stimulates interest and physical activity. Periodically adding or changing equipment increases the interest and activity level of young children. When children are exposed to the same non-complex play environment over time, the level of physical activity decreases, while the level of social activity increases (Scholtz & Ellis, 1975).

Time Spent Outdoors

Time spent outdoors is an important determinant of physical activity (Klesges, Eck, Hanson, Haddock, & Klesges, 1990). A strong positive relationship as high as $r = .74$ between time outdoors and physical activity level has been reported (Sallis, 1994).

Availability of Sedentary Activities

Sedentary activities, such as playing computer games, watching TV videos reduce the opportunities for children to be playing sport and being physically active (DuRant et al., 1996; Kohl & Hobbs, 1998; Sallis, 1994), although Lindquist, Reynolds and Goran (1999) found television watching was a behaviour independent of physical activity. Children who watched more television were not necessarily less active (Lindquist et al., 1999).

Loss of Child's Independence

Children are increasingly being forced into car-dependent and formally supervised play activities as parents respond to concerns about their children's safety in unsupervised settings. Children now have less freedom to travel around their neighbourhood or to simply play "in the street". These restrictions limit their opportunities to play in novel, yet close, play environments that also facilitate social interaction. In the early 1970's, 80% of British 7 and 8-year-olds children travelled to school alone, however this number reduced to less than 10% in 1990 (Hillman, Adams, & Whitelegg, 1990).

Time of Week

Young children were less likely to be sedentary on weekends than weekdays (Janz et al., 1999; Shephard, Jequier, Lavallee, LaBarre, & Rajic, 1980; Trost, Pate, Freedson, Sallis, & Taylor, 1999).

Time of Day

The most active time of the day for young children is between midday and 4pm (Freedson, 1989)

Season

Children tend to be more active outdoors, and some seasonal variations have been reported in colder climates (Crocker, Bailey, Faulkner, Kowalski, & McGrath, 1997; Kohl & Hobbs, 1998). Kohl and Hobbs (1998) found that children are more physically active during summer and least active in winter.

Implications and Recommendations

As a result of the comprehensive review of literature and intensive discussions held during the Building an Active Future Summit, a number of recommendations were made for future research, policy development, program development and implementation (Hands, Parker, Larkin, & Martin, 2002). Overall more questions were asked than answers given. The Summit agreed that extensive systematic and well-coordinated research is necessary in order to best meet the needs of this population. At present, information about physical activity in young children is contradictory and incomplete. Simple associations are impossible to draw because of the complex interaction between factors that are often unique to this age group. These were highlighted earlier in the paper. In order to further our understandings we need to progress systematically through a number of steps. The following recommendations would be finetuned after an initial stock take which is necessary to gather existing information about children's current levels of physical activity, existing guidelines for appropriate levels of physical activity, policies that are in operation and existing programs.

Future Research

1. *Physical activity measurement.* This is a critical first step. We need to identify the most appropriate method to validly and reliably measure physical activity levels in young children. It is difficult to accurately measure the physical activity of young children given the variable nature of their movement patterns. Multidimensional research methods might provide different information that would contribute to the holistic picture.

2. *Current levels of Physical Activity.* Establish base line information about young children's physical activity levels. Current data are disjointed and inconsistent. It is difficult to collate it in a way that provides cohesive information.
3. *Constraints and enablers of physical activity.* Identify the factors that facilitate and impede children's physical activity. In particular, identify those factors which are unmodifiable, resistant to modification or more easily modifiable. When doing this we need to question our assumptions about physical activity and systematically look at the activity levels of the young children to explore what they do and why. There are many ways to be physically active and young children may choose to be active in different ways to older age groups. We also need to think of the child within the context of their family, community and society.
4. *Long term benefits of physical activity.* Identify the benefits of early intervention on long term health and well-being.
5. *Optimal periods for physical activity intervention.* Identify when, why and how we might best intervene to enhance children's physical development and promote healthy levels of physical activity.

Policy Development

1. *Physically active environments.* Identify and support developmentally appropriate environments that are conducive to physical activity in young children. At the same time, actively seek solutions that alleviate barriers to physical activity such as safety concerns, and the attractiveness of many sedentary activities (TV, computer games).
2. *Networking of key stakeholders.* Involve stakeholders in multifocal decision making, coordinating research, developing criteria for policy making and initiating new programs. Join together with health, community and education services to actively promote physical activity in early childhood.

Program Development

1. *Successful physical activity programs.* Develop programs that incorporate factors conducive to changes in behaviour and enhance the formation of habits in young children. Intervention programs will need to trial ways to make positive changes in physical activity levels that are transferable, generalisable and sustainable beyond the time the child is involved in the program.
2. *Inclusive physical activity programs.* Gather information about children's involvement in physical activity programs, the qualities of programs that are inclusive and the best ways to include all children.

Conclusion

While a number of recommendations were made, the identification of enablers and constraints to physical activity in young children is of principal interest to this paper. Given the list of factors already investigated, which ones are easily modifiable? Are those that have been confirmed through research as enablers modifiable? Interestingly, 4 of the factors that received ++ (repeated evidence, positive association) in Table 1 are also potentially modifiable. These factors are motor competence, perceived motor competence, design of outdoors and the time of the week suggesting that early childhood intervention and prevention programs should target these factors.

References

- Armstrong, N., Balding, J., Gentle, P., & Kirby, B. (1990). Patterns of physical activity among 11 to 16 year old British children. *British Medical Journal*, *301*, 203-205.
- Barnett, L. A., & Chick, G. E. (1986). Chips off the ol' block: parents' leisure and their children's play. *Journal of Leisure Research*, *18*(4), 266-283.
- Benham-Deal, T. (1993). Physical activity patterns of preschoolers during a developmental movement program. *Child Study Journal*, *23*(2), 115-133.

- Booth, M. L., Macaskill, P., McLellan, L., Phongsavan, P., Okely, T., Patterson, J., Wright, J., Bauman, A., & Baur, L. (1997). *NSW schools fitness and physical activity survey*. Sydney: NSW Department of Education and Training.
- Bouffard, M., Watkinson, E. J., Thompson, L. P., Dunn, J. L. C., & Romanow, S. K. E. (1996). A test of the activity deficit hypothesis with children with movement difficulties. *Adapted Physical Activity Quarterly*, *13*, 61-73.
- Chavez, A., & Martinez, C. (1984). Behavioural measurements of activity in children and their relation to food intake in a poor community. In E. Pollitt & P. Amante (Eds.), *Energy: Intake and Activity* (pp. 331-353). New York, PH: Alan R Liss.
- Cratty, B. J., Ikeda, N., Martin, M. M. M., Jennett, C., & Morris, M. (1970). *Game choices of children with movement problems*. Springfield IL: C C Thomas.
- Crocker, P. R. E., Bailey, D. A., Faulkner, R. A., Kowalski, K. C., & McGrath, R. (1997). Measuring general levels of physical activity: Preliminary evidence for the physical activity questionnaire for older children. *Medicine and Science in Sports and Exercise*, *29*(10), 1344-1349.
- DuRant, R. H., Thompson, W. O., Johnson, M., & Baranowski, T. (1996). The relationship among television watching, physical activity and body composition of 5- or 6-year-old children. *Pediatric Exercise Science*, *8*, 15-26.
- Eaton, W. O., Keen, N. A. M., & Campbell, D. W. (2001). The waxing and waning of movement: Implications for psychological development. *Developmental Review*, *21*, 205-223.
- Epstein, L. H., Kilanowski, C. K., Consalvi, A. R., & Paluch, R. A. (1999). Reinforcing value of physical activity as a determinant of child activity level. *Health Psychology*, *18*(6), 599-603.
- Erbaugh, S. J., & Clifton, M. A. (1984). Sibling relationships of preschool-aged children in gross motor environments. *Research Quarterly for Exercise and Sport*, *55*(4), 323-331.
- Freedson, P. S. (1989). Field monitoring of physical activity in children. *Pediatric Exercise Science*, *1*, 8-18.
- Freedson, P. S., & Evenson, S. (1991). Familial aggregation in physical activity. *Research Quarterly for Exercise and Sport*, *62*(4), 384-389.

- Godin, G., & Shephard, R. J. (1986). Psychosocial factors influencing intentions to exercise of young students from grades 7 to 9. *Research Quarterly for Exercise and Sport*, 57(1), 41-52.
- Goran, M. I., Gower, B. A., Nagy, T. R., & Johnson, R. K. (1998). Developmental changes in energy expenditure and physical activity in children: Evidence for a decline in physical activity in girls before puberty. *Pediatrics*, 101(5), 887-891.
- Hands, B., Parker, H. E., & Larkin, D. (2001). *Building an Active Future Summit: Background Paper*. Perth, WA: University of Notre Dame.
- Hands, B., Parker, H. E., Larkin, D., & Martin, M. (2002). *Planning for Action: Report of the Building an Active Future Summit*. Perth, WA: University of Notre Dame.
- Harter, S. (1978). Effectance motivation reconsidered. *Human Development*, 21, 34-64.
- Herkowitz, J. (1979). Developmentally engineered equipment and playspaces for motor development and learning. In C. H. Nadeau & W. R. Halliwell & K. M. Newell & G. C. Roberts (Eds.), *Psychology of Motor Behaviour and Sport - 1979*. Champaign, IL: Human Kinetics.
- Hillman, M., Adams, J., & Whitelegg, J. (1990). *One false move: A study of children's independent mobility*. London: Policy Studies Institute.
- Janz, K. F., Paulos, R., Burns, T. L., & Levy, S. M. (1999). *Measuring physical activity in pre-school children: The Iowa Bone Growth Study*. Paper presented at the Measurement of Physical Activity Conference, Dallas TX.
- Kain, J., & Andrade, M. (1999). Characteristics of the diet and patterns of physical activity in obese Chilean preschoolers. *Nutrition Research*, 19(2), 203-215.
- Kalverboer, A. F. (1990). *Introduction: Developmental biopsychology and the study of behavioural deviance in childhood*. Ann-Arbor MI: Michigan University Press.
- Klesges, R. C., Coates, T. J., Moldenhauer-Klesges, L. M., Holzer, B., Gustavson, J., & Barnes, J. (1984). The FATS: An observational system for assessing physical activity in children and associated parent behaviour. *Behavioural Assessment*, 6, 333-345.

- Klesges, R. C., Eck, L. H., Hanson, C. L., Haddock, C. K., & Klesges, L. M. (1990). Effects of obesity, social interactions, and physical environment on physical activity in preschoolers. *Health Psychology, 9*, 435-449.
- Klesges, R. C., Haddock, C. K., & Eck, L. H. (1990). A multimethod approach to the measurement of childhood physical activity and its relationship to blood pressure and body weight. *Journal of Pediatrics, 116*, 888-893.
- Kohl, H. W., & Hobbs, K. E. (1998). Development of physical activity behaviours among children and adolescents. *Pediatrics, 101*(3), 549-554.
- Li, X. J., & Dunham, P. (1993). Fitness load and exercise time in secondary physical education classes. *Journal of Teaching Physical Education, 12*, 180-187.
- Lindquist, C. H., Reynolds, K. D., & Goran, M. I. (1999). Sociocultural determinants of physical activity among children. *Preventive Medicine, 29*, 305-312.
- Malina, R. M. (1984). Physical activity and motor development/performance in populations nutritionally at risk. In E. Pollitt & P. Amante (Eds.), *Energy: Intake and Activity* (pp. 285-302). New York, PH: Alan R Liss.
- McKenzie, T. L., Sallis, J. F., Elder, J. P., Berry, C. C., Hoy, P. L., Nader, P. R., Zive, M. M., & Broyles, S. L. (1997). Physical activity levels and prompts in young children at recess: A two-year study of a bi-ethnic sample. *Research Quarterly for Exercise and Sport, 68*(3), 195-202.
- McMurray, R. G., Bradley, C. B., Harrell, J. S., Bernthal, P. R., Frauman, A. C., & Bangdiwala, S. I. (1993). Parental influence on childhood fitness and activity patterns. *Research Quarterly for Exercise and Sport, 64*(3), 249-255.
- Moore, L. L., Lombardi, D. A., White, M. J., Campbell, J. L., Oliveria, S. A., & Ellison, R. C. (1991). Influence of parent's physical activity levels on activity levels of young children. *The Journal of Pediatrics, 118*(2), 215-219.
- Mota, J., & Queiros, P. (1996). Children's behaviour: Physical activity regarding parent's perception vs. children's activity. *International Review for the Society of Sport, 31*(2), 173-183.
- Pellegrini, A. D., & Smith, P. K. (1998). Physical activity play: The nature and function of a neglected aspect of play. *Child Development, 69*(3), 577-598.
- Poest, C. A., Williams, J. R., Witt, D. D., & Atwood, M. E. (1989). Physical activity patterns of preschool children. *Early Childhood Research Quarterly, 4*, 367-376.

- Rose, B., Larkin, D., & Berger, B. (1997). Coordination and gender influences on the perceived competence of children. *Adapted Physical Activity Quarterly*, *14*, 210-221.
- Routh, D. K., Walton, M. D., & Padan-Belkin, E. (1978). Development of activity level in children revisited: effects of mother presence. *Developmental Psychology*, *14*, 571-581.
- Sallis, J. F. (1994). *Determinants of physical activity behaviour in children*. Champaign IL: Human Kinetics.
- Sallis, J. F., Patterson, T. L., McKenzie, T. L., & Nader, P. R. (1988). Family variables and physical activity in preschool children. *Developmental and Behavioural Pediatrics*, *9*(2), 57-61.
- Sallis, J. F., Prochaska, J. J., & Taylor, W. C. (2000). A review of correlates of physical activity of children and adolescents. *Medicine and Science in Sports and Exercise*, *32*(5), 963-975.
- Sallis, J. F., Simons-Morton, B. G., Stone, E. J., Corbin, C. B., Epstein, L. H., Faucette, N., Iannotti, R. J., Killen, J. D., Klesges, R. C., Petray, C. K., Rowland, T. W., & Taylor, W. C. (1992). Determinants of physical activity and interventions in youth. *Medicine and Science in Sports and Exercise*, *24*(6), s248-s257.
- Scholtz, G. J., & Ellis, M. J. (1975). Repeated exposure to objects and peers in a play setting. *Journal of Experimental Child Psychology*, *19*, 488-455.
- Shephard, R. J., & Godin, G. (1986). *Behavioural intentions and activity of children*. Champaign IL: Human Kinetics.
- Shephard, R. J., Jequier, J. C., Lavallee, H., LaBarre, R., & Rajic, M. (1980). Habitual physical activity: effects of sex, milieu, season, and required activity. *Journal of Sports Medicine and Physical Fitness*, *20*, 55-66.
- Smyth, M. M., & Anderson, H. (2000). Coping with clumsiness in the school playground: Social and physical play in children with coordination impairments. *British Journal of Developmental Psychology*, *18*, 389-413.
- Steinbeck, K. S. (2001). The importance of physical activity in the prevention of overweight and obesity in childhood: A review and an opinion. *The International Association for the Study of Obesity*, *2*, 117-130.

- Strauss, R. S., & Knight, J. (1999). Influence of the home environment in the development of obesity in children. *Pediatrics*, *103*(6), 1-12.
- Taylor, W. C., Blair, S. N., Cummings, S. S., Wun, C. C., & Malina, R. M. (1999). Childhood and adolescent physical activity patterns and adult physical activity. *Medicine and Science in Sports and Exercise*, *31*(1), 118-123.
- Thelen, E., & Smith, L. B. (1994). *A dynamic systems approach to the development of cognition and action*. Cambridge, MA: MIT Press.
- Trost, S. G., Pate, R. R., Freedson, P. S., Sallis, J. F., & Taylor, W. C. (1999). *Using objective physical activity measures with youth: How many days of monitoring are needed?* Paper presented at the Measurement of Physical Activity, Dallas TX.
- Ulrich, B. D. (1987). Perceptions of physical competence, motor competence, and participation in organised sport. Their interrelationships in young children. *Research Quarterly for Exercise and Sport*, *58*, 57-67.
- Wankel, L., & Pabich, P. (1981). The minor sport experience: factors contributing to or detracting from enjoyment. In T. Orlick & J. T. Partington & J. H. Samela (Eds.), *Mental training for coaches and athletes* (pp. 70-71). Ottawa, Ontario: Coaching Association of Canada.
- Welsman, J., & Armstrong, N. (1998). Physical activity patterns of 5 to 7-year-old children and their mothers. *European Journal of Physical Education*, *3*, 145-155.
- Welsman, J. R., & Armstrong, N. (1997). Physical activity patterns of 5 to 11-year-old children. In N. Armstrong & B. Kirby & J. Welsman (Eds.), *Children and Exercise XIX* (pp. 139-144). London: E & FN Spon.

Table 1.
Enablers and Constraints of Physical Activity in Children Aged 8 Years and Under

Physiological Factors	
Age	++
Developmental maturity	?
Gender (male)	++
Motor competence	++
Body composition	-
Other fitness factors- muscle strength, flexibility, muscle endurance	?
Hereditary factors	?
Psychological Factors	
Perceived motor competence	++
Motivation to be active	+
Knowledge about importance of PA	?
Attitude towards PA	?
Interests/strengths	
Sociocultural Factors	
Parents	
◆ Attitude	↔
◆ Activity	+
◆ Personality	+
Child-rearing practices	?
Structure of family	+
Siblings	+
Peers	-
Teacher or Caregiver	+
Ethnicity	↔
Nutrition	+
Socio Economic Status	↔
Safety concerns, fear of litigation	?
Community interests/location	?
Sporting facilities	?
Ecological Factors	
Design of outdoors	++
Time spent outdoors	+
Availability of sedentary activities	-
Loss of child's independence	+
Time of week (weekend)	++
Time of day (afternoon)	+
Season	+

Note.

++ Repeated evidence, positive association

+ Limited evidence, positive association

↔ Mixed evidence

-- Repeated evidence, negative association

- Limited evidence, negative association

? Hypothesised, no data available