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Physical Wellness: The relationship between motor skill, fitness and physical activity in young children

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Abstract

The health benefits of adequate physical activity levels for children are well reported. However, we cannot assume that children will choose to be sufficiently active of their own accord. Motor competence and fitness are increasingly highlighted as key co-determinants of physical activity in young children (Hands, Parker, & Larkin, 2001) and where possible strategies to enhance these factors should be included in early childhood settings. However few studies have adopted an integrated view of the collective effects of these three factors on developing healthy children. This presentation explores interrelationships between measures of motor skill competence, fitness, and weekly physical activity level in 44 children aged between 5 and 10 years. These are derived from parent completed questionnaire and physical assessments. In particular the emphasis was on comparing low active and high active children and drawing implications for parents, caregivers and teachers on ways to facilitate children's physical well being.

Introduction

The importance of physical activity to our physical wellness and overall health and well-being is well documented (Blair et al., 1996; US DHHS, 1996) however worldwide there is increasing concern that children are not sufficiently active on a daily basis to maintain health. Casperson, Powell and Christenson (1985) define physical activity as "any bodily movement produced by skeletal muscles that results in energy expenditure" (p. 126). Physical activity guidelines for children recommend "at least 30-60 minutes of age and developmentally appropriate physical activity from a variety of physical activities on all, or most days of the week" (Corbin & Pangrazi, 1998, p.3). Limited information is available on current levels of physical activity in Australian children as the measurement of physical activity is complex given its diverse nature (recreation, sport, play, physical education) and it is commonly collected via self-report questionnaires. Children under the age of 10, however, find it difficult to accurately and reliable report their physical activity (Baranowski, 1988) and therefore proxy reports by parents, teachers and caregivers are used. Some Australian Bureau of Statistics figures (2001) indicate 59% of Australian children participate in organised sport outside school with more boys (66%) than girls (52%) involved. Participation increased with age from 32% for 5-year-olds to 69% for 11-years-old.

The physical activity level of a child is influenced by a number of physiological factors (Hands et al., 2001). The two of interest to this study are physical fitness and motor competence. Physical fitness is a set of attributes that people have or achieve that relate to their ability to perform physical activity (Casperson, Powell, & Christenson, 1985). A number of measurable components are known to contribute to fitness and have been grouped into health or skill related components. The health related components of interest to this study include cardiorespiratory endurance, muscular strength, muscular endurance, flexibility and body composition. These are important for general health and well being, and in particular for the prevention of diseases associated with a sedentary lifestyle. The impact of relative levels of these attributes on physical activity is only partly understood, particularly in children.

Motor competence is a person's level of proficiency in performing particular motor skills. The relationship between motor competence and physical activity has been established in children as young as 3 years (Saakslahti et al., 1999). Many children cite low motor skill level as a major barrier to participation in sport (Booth et al., 1997; Ulrich, 1987; Wankel & Pabich, 1981). Further evidence comes from studies comparing children with poor motor competence to typically developing children. Children with movement difficulties tend to be vigorously active less often and for a shorter time, play less on large playground equipment and spend less time interacting socially with their peers (Bouffard, Watkinson, Thompson, Dunn, & Romanow, 1996; Butcher & Eaton, 1989; Li & Dunham, 1993; Smyth & Anderson, 2000).

The purpose of this paper was to investigate the relationship between children's motor skill competence and physical fitness and their physical activity level as reported by their parents. Such information is important when planning programs to enhance physical activity in young children and optimising the chances of children choosing to be active rather than inactive.

Method

Participants

Eighty-eight children from Year 1, 3, 5, and 7 classes from three metropolitan primary schools were involved in the study. The parents of a subsample of 44 children (M = 8.9 yrs, SD = 1.55 yrs) comprising 20 girls and 24 boys completed comprehensive surveys asking about their child's physical activity levels, motor skill competence and perceived barriers to physical activity. They also completed a simple 7-day diary recording their child's physical activity. The results for this subsample of children are reported.

Physical measurements

A team of researchers visited each school to gather the skill and fitness measurements. One class at a time participated in the study. Each class of children was divided into small groups and rotated around measurement substations. Two batteries of tests were used. Fitness was evaluated using the Australian Fitness Education Award (ACHPER, 1996). The items included sit and reach (flexibility), sit-ups (muscle endurance), chest pass (muscle strength), Multi Stage Fitness Test (cardiovascular endurance), height and weight (body composition). Weight (kg) is divided by height (m^2) to create the Body Mass Index (BMI), an accepted index of adiposity in children and adolescents (Bellizzi & Dietz, 1999). Motor skill was evaluated using two locomotor and two object control tasks and a balance task. These were 50 metre sprint run, standing broad jump for distance, overhand throw for distance, bounce and catch and one leg balance.

Physical activity levels were established through the parent responses to the survey. The parents were asked to keep a brief 7-day diary on their child's formal and informal physical activities, compare their child's physical activity to their peers and siblings, report the average hours of sitting watching television or using the computer, and identify barriers to additional physical activity.

Results

The sample was categorised according to overall reported physical activity level. Firstly the activities were coded as low, moderate or high active. Examples of low activity were walking or fishing, moderate activities were ballet, board surfing, and table tennis, and high activities are basketball, gymnastics and running. The total of weighted minutes of reported physical activity per week for the children was calculated. The formula for deriving this level ((.75 x light) + moderate + vigorous) has been previously used to interpret physical activity levels (Parker, Anderson, Clarke, Larkin, & Randall, 1997). Participants were then divided into three tertiles based on these calculations. As a result, the low active group comprised 22 children, 11 boys and 11 girls (M = 8.64 yrs, SD = 2.5 yrs), the moderate active group comprised 8 children, 3 girls and 5 boys (8.00 yrs, SD = 2.14yrs), and the high active group comprised 14 children, 6 girls and 8 boys (M = 9.71yrs, SD = 2.2 yrs).

The physical activity, fitness and motor skills for the high active and the low active groups were compared and are reported in Table 1. Significant differences between the high and low active groups were noted for overall minutes of physical activity, minutes spent in moderate and vigorous physical activity, the fitness components for muscle strength and muscle endurance, and the motor skills of standing broad jump, overhand throw and bounce and catch. In all cases, the high activity group recorded superior results.

Pearson product moment correlations were used to investigate the relationships between fitness and motor skills measures for the whole sample and the high and low physical activity groups, and are shown in Table 2. The fitness measure of muscles strength correlated strongly with all motor skills and physical activity. Many of the motor skills significantly correlated with the physical fitness measures, and physical activity significantly correlated with muscle strength, standing broad jump and bounce and catch for the high and low active groups.

Parent Questionnaires

While no differences were statistically significant, the parents of the high active children reported them to be more active when compared to their peers or 12 months ago and paradoxically to watch more television or play more computer games than the low active children. These parents also consistently rated their children as more proficient in motor skills such as run, throw, jump, hop, balance and skip than parents of the low active children. Most parents of both groups (71% high active and 64% low active) felt their child was sufficiently active. Two parents of low active children, and one parent of a high active child reported their child as "not the sporty type".

Discussion

These results confirm the interrelationship between physical activity, physical fitness and motor competence. Significant correlations were reported between 17 of a possible 20 skill-fitness measures relationships and these also related to the physical activity grouping. In general, the children who were more active were also significantly fitter and more proficient in selected movement skills.

Of concern, is the indication that many parents of low active children consider them to be sufficiently active. Physical activity guidelines for children recommend "at least 30-60 minutes of age and developmentally appropriate physical activity from a variety of physical activities on all, or most days of the week" (Corbin & Pangrazi, 1998, p.3). Yet the average number of minutes of physical activity for these low active children was only 88 minutes per week. On the other hand, the high active children were involved with an average of 278 minutes of physical activity per week, which exceeds the minimum recommended level of 210 minutes.

The paradoxical finding that high active children spent more time watching TV and playing computer games than low active children concurs with similar evidence by Lindquist, Reynolds and Goran (1999). These sedentary habits may be independent of physical activity although others have argued that this behaviour reduces opportunities to be physically active (Kohl & Hobbs, 1998; Sallis, Patrick, & Long, 1994)

There are a number of implications that can be drawn from these findings for parents, teachers and caregivers. Firstly, parents and others need information about what constitutes a low level of physical activity for their children and strategies to monitor the amount of activity time (at least 30-60 minutes each day). By identifying children who habitually choose sedentary over active play caregivers can intervene by providing opportunities for physical play. Secondly, it is important to involve the whole family in play. A family "culture" of physical activity enables children to learn the skills and habits of being involved in active play. As reported earlier, neither insufficient time nor "not being sporty" were presented by parents as barriers to the children's level of physical activity. Finally, emphasising developmentally focused skill learning both at home and school for young children provides them with the competence to participate in activities with confidence and greater safety from injury. Children who are more competent in performing a variety of motor skills are more likely to participate in physical play, to develop higher fitness levels and to choose to be active rather than sedentary – thereby enhancing physical wellness.

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Table 1. Descriptive statistics for high (n = 14) and low (n = 22) active children

	High		Low			
	Mean	SD	Mean	SD	F	*p*
Age	9.71	2.2	8.64	2.5	1.32	.20
Physical Activity (minutes p.w.)	278.5	68.1	88.4	31.5	8.80	.001*
Light	52.5	10.6	55.0	31.1	.10	.92
Moderate	251.8	103.2	87.9	29.9	5.68	.001*
Vigorous	175.0	97.5	78.6	31.8	2.48	.001*
Physical Fitness						
Height	142.6	12.3	133.9	13.5	1.94	.06
Weight	36.9	10.6	32.2	10.1	1.35	.18
Body composition (BMI)	17.8	3.0	17.4	2.4	.40	.69
Muscle strength (chest pass –cm)	4.2	1.1	3.4	1.2	2.10	.04*
Muscle endurance (sit ups - no. per min.)	31.1	7.0	24.9	9.2	2.17	.04*
Flexibility (sit and reach – cm)	2.3	9	1.6	7.8	.26	.80
Cardiovascular endurance (MSFT - no. of shuttles)	32.1	15.8	30.6	17.4	.26	.80
Motor Skill						
Run (sec)	9.4	2.1	9.8	1.6	.70	.48
Balance (sec)	82.0	24.7	67.2	24.2	1.77	.08
Throw (cm)	25.6	8.8	19.1	9.9	2.00	.05*
SBJ (cm)	151.8	19.6	134.4	27.8	2.04	.05*
Bounce and catch (count)	17.2	5.0	13.3	4.3	2.48	.02*

Table 2. Correlations between fitness, motor skill and physical activity measures (N = 44)

Fitness	Motor Skill					Physical activity*
	Balance	Run	SBJ	Bounce and Catch	Throw	
BMI	.29	-.32*	.03	.51**	.31*	.04
CV Endurance	.37*	-.61*	.63**	.49**	.71**	.01
Flexibility	.35*	.10	-.23	-.13	-.36*	.04
Muscle strength	.62*	-.65*	.64**	.77**	.75**	.30*
Muscle endurance	.47*	-.48*	.47*	.61**	.57**	.29
Physical Activity*	.28	-.10	.31*	.31*	.28	

* Tertile subgroups