Combating Obesity in K-12 Learners

# The Dynamic Association between Motor Skill Development and Physical Activity

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*Poor motor-skill development, which limits success, may discourage physical activity.*

Given the direct relationships among physical inactivity, obesity, and chronic disease, it is important to understand the underlying mechanisms of the factors that can influence physical inactivity and to determine causal pathways that lead to physical inactivity as they emerge across developmental time. One potential causal pathway that has been largely ignored in the literature is the influence of motor skill development on physical activity levels. Although significant attention has been given to promoting physical activity in children via intervention (McKenzie, Nader, Strikmiller, & Yang, 1996; McKenzie et al., 2003; Sallis et al., 1997), little attention has been given to the developmental process of how children learn to move and to the changing role that emerging motor skill development plays in children's physical activity levels as they grow. We must find ways to mitigate the health risks of inactivity, obesity, and the lack of health-related physical fitness.

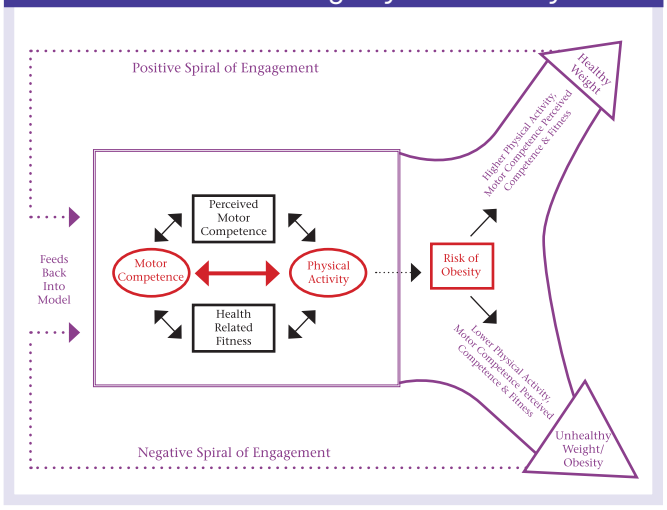
We believe that the lack of an interdisciplinary approach to address this problem has limited our ability as researchers to identify and understand the underlying mechanisms that can lead to either physical activity or physical inactivity. Thus, we have not been able to slow down or diminish these growing problems. Specifically, we believe that the limited advancement in solving the crisis of physical inactivity and obesity is due to a lack of understanding of (1) the relationship between motor skill development and physical activity; (2) the mediating effects of variables, including perceived motor skill competence, obesity, and health-related physical fitness; (3) the dynamic and changing relationships among these variables across developmental time; and (4) the use of appropriate developmental and physical activity measures. With this in mind, we have developed a model (figure 1) representing what we believe are important concepts that have been identified in the literature, but have not been integrated and systematically linked to the understanding of why so many individuals become inactive as they move to adolescence and adulthood.

## The Role of Motor Skill Development

At the heart of our conceptual model is a reciprocal and dynamic relationship between motor skill competence and physical activity. Motor skill competence is defined in terms of common fundamental motor skills (FMS): object control (e.g., throw and kick) and locomotor skills (e.g., run and hop). A common misconception is that children "naturally" attain proficient levels of FMS; however, many children do not (Clark, 2007; Goodway & Branta, 2003; Goodway, Suminski, & Ruiz, 2003; Langendorfer & Roberton, 2002a, b). Many of these children may not attain sufficient competence in FMS to apply these skills to lifelong physical activity in adolescence or adulthood (Goodway & Branta, 2003; Goodway et al., 2003). We suggest that children's physical activity in early childhood may drive their development of motor skill competence in the form of FMS acquisition. Increased physical activity provides more opportunities to promote neuromotor development, which in turn promotes FMS development (Fisher et al., 2005; Okely, Booth, & Patterson, 2001b).

Motor skill competence, as in kicking a ball, likely influences children's motivation for physical activity. However, such skills do not necessarily develop naturally; they must be taught.

Figure 1. Conceptual Model of Developmental Factors Influencing Physical Activity




Differences in the initial levels of FMS development are due to many factors, including the immediate environment, structured physical education, socioeconomic status, parental influences, and climate. Thus, we hypothesize that young children (ages 4-7) will demonstrate various levels of physical activity and motor skill development that are weakly related (i.e., low correlations between levels of physical activity and motor skill development). As children transition into middle childhood and adolescence, we believe the relationship between physical activity and motor skill development becomes more significant and will strengthen. During middle childhood and adolescence, higher levels of motor skill development will offer greater opportunities to engage in various physical activities, sports, and games. We expect that more highly skilled children will self-select higher levels of physical activity, while children who are less skillful will choose to engage in lower levels of physical activity. At this point, we believe the ability to demonstrate skillfulness in many types of sports, games, and activities will influence physical activity levels. As children transition into adolescence and early adulthood, we believe that the relationship between FMS development and physical activity will grow stronger. Thus, we may not fully realize the effect that motor skill development has on habitual physical activity until a person reaches adolescence or adulthood.

## The Role of Mediating Variables

Although the primary focus of our conceptual model is the dynamic and synergistic relationship between motor skill competence and physical activity, we believe that perceived motor skill competence, health-related physical fitness, and obesity represent important mediating variables that will account for some of the heretofore unexplained variability found in physical activity research. Overall, we believe the sum effect of these mediating variables promotes either a negative or positive spiral of engagement in physical activity and also influences the possibility of continued development of FMS.

Perceived motor competence and health-related physical fitness can either worsen this negative spiral of disengagement or improve the positive spiral of engagement. The low-skilled children ultimately perceive themselves as having little motor skill competence, and thus they choose not to engage in physical activity, become less fit, and move further into the negative spiral of disengagement from physical activities, games, and sports (figure 1). This will ultimately result in high levels of physical inactivity and sedentary behavior and will place these individuals at greater risk for being obese during adolescence and adulthood. Research supports this view, suggesting that low-skilled children who have poor perceptions of their motor skill competence are less likely to seek and select physical activity in comparison to their more highly skilled peers (Butcher & Eaton, 1989; Fisher et al., 2005).

We suggest that the positive spiral of engagement will occur among the moderately and highly skilled children. Children who have higher perceived and actual motor skill competence will be more likely to persist in physical activities, especially those that they perceive as fun and intrinsically rewarding (Fisher et al., 2005). A positive spiral of engagement results in greater physical activity and fitness levels for these higher-skilled children because engagement in physical activities (1) provides more opportunities to further develop their motor skill competence, (2) leads to the development of higher and more accurate perceptions of motor skill competence, and (3) enables them to persist in activities for a greater amount of time, resulting in higher fitness levels. As children move from childhood to adolescence, a more substantial physical activity divide will emerge between low-skilled, inactive children who perceive themselves as poorly skilled, and their higher-skilled, more active peers who think physical activity is rewarding and fun.

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and marketing? A lack of scientific-based arguments? Or a lack of confidence to stand for ourselves?

## The Role of Physical Education

Throughout physical education's 120-year history, social demands on body shape have influenced how society views this field and its direct relation to issues of overweight and underweight. But how has physical education responded to these concerns and to the brand new scientific data that proves the benefits of physical activity for life? How has physical education responded to the increasing number of people adopting sedentary behaviors?

The lack of motor skills and ability often causes frustration among participants in physical activities, and repeated frustrated attempts lead to avoidance instead of adherence. The responsibility of physical education is to "educate" the body, giving knowledge about the potential of movement for developing the skills needed to participate with enjoyment in many kinds of physical activity. It is necessary, therefore, that physical education teacher-training programs take responsibility for educating the academy and the broader society of the role that physical education plays in preparing human beings for participation in physical activity.

In order to fix the "house," it is necessary that the professionals and scholars in the field of physical education evoke the past and learn from great leaders such as Luther Halsey Gulick, Jane Adams, Sidney Peixotto, and Thomas Denison Wood, who all believed in the field not as a salvation of the world but as an unquestioned component of the educational mission. History also suggests the need for a better integration of the subdisciplines in the future. Scientific data recently published on obesity, physical activity benefits, and sedentary behavior should be read from the perspective of the five dimensions of human life: historical, biological, anthropological, economical, psychological, and sociological (Strong et a.l., 2005). Furthermore, this knowledge should be transmitted to those served by our profession.

Historically speaking, physical education has not stood up for itself. It is time to do so.

## References


Locke, J. (1693). *Some thoughts concerning education*. London: A. & J. Churchill.

Park, R. J. (2005). Of the greatest possible worth: *The Research Quarterly* in historical contexts. *Research Quarterly for Exercise and Sport*, *76*(Suppl. 2), S5-S26.

Patanjali. (c. 2nd century B.C./1957). *Yoga sutras*. In S. Radhakrishnan & C. A. Moore (Eds.), *A source book in Indian philosophy*. Princeton, New Jersey: Princeton University Press.

Rabelais, F. (1653/1838). *Gargantua and Pantagruel* (Maitland Club Edition). Retrieved July 30, 2007, from http://www.gutenberg.org/etext/1200.

Rousseau, J. J. (1764/1979). *Emile: Or on education*. New York: Basic Books Philosophy.

Strong, W., Malina, R., Blimkie, C., Daniels, S., Dishman, R., Gutin, B., et al. (2005). Evidence-based physical activity for school-age youth. *Journal of Pediatrics, 146*, 732-737.

Toschke, J. A., von Kries, R., Rosenfeld, E., & Toschke, A. M. (2007). Reliability of physical activity measures from accelerometry among preschoolers in free-living conditions. *Clinical Nutrition, 1*, 220-243.

Zieff, S. G., Guedes, C. M., & Wiley J. (2006). Youth knowledge of physical activity health benefits: A Brazilian case study. *The Scientific World Journal*, *6*, 1713-1721.



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### Assessment Issues

In the few studies that have investigated the relationship between motor skill development and physical activity, development has been evaluated by either assessing ability in individual skills or by using a test that purportedly measured the construct of motor skill development (Fisher et al., 2005; McKenzie, Sallis, & Broyles, 2002; Okely et al., 2001a, b). In many of these studies, measures of motor skill development represented either a "product" or result of the child's movement, such as the number of successful catches or a description of the child's way of moving. Studies that used a process-oriented approach to examine motor skill competence did not relate the movement description to a developmental continuum. Rather, they focused on whether the child's movement approximated the movement of an expert or elite performer. In this approach, two children can receive the same "score" for quite different "distances," neither of which represents the children's actual level of motor development.

In short, the developmental validity of many previously used measures of motor skill competence and the types of tasks that have been examined have been questioned, not only by traditional developmental assessment standards, but also by the researchers themselves. Moreover, when the definition of "expert" performance is overly simplistic, the resulting scores tended to have ceiling effects that made it impossible to distinguish between intermediate and advanced motor skill development. In light of these concerns, new research in this area clearly needs to use valid measures of motor skill development.

The increasing trend of physical inactivity and childhood obesity in our society is multifaceted, with many underlying factors. The inclusion of a developmental perspective on this issue is necessary and the factors included in our model will provide a better understanding of why children, adolescents, and adults choose to be either physically active or sedentary.

## References


Butcher, J. E., & Eaton, W. O. (1989). Gross and fine motor proficiency in pre-schoolers: Relationships with free play behavior and activity level. *Journal of Human Movement Studies*, *16*, 27-36.

Clark, J. E. (2007). On the problem of motor skill development. *Journal of Physical Education, Recreation & Dance, 78*(5), 39-44.

Fisher, A., Reilly, J., Kelly, L., Montgomery, C., Williamson, A., & Paton, J. (2005), Fundamental movement skills and habitual physical activity in young children. *Medicine & Science in Sports & Exercise*, *37*, 684-688.

Goodway, J. D, & Branta, C. F. (2003). Influence of a motor skill intervention on fundamental motor skill development of disadvantaged preschool children. *Research Quarterly for Exercise & Sport*, *74*, 36-46.

Goodway, J. D., Suminski, R., & Ruiz, A. (2003). The influence of project SKIP on the motor skill development of young disadvantaged Hispanic children. *Research Quarterly for Exercise & Sport*, *74*(Suppl.), A12.

Langendorfer, S. J., & Roberton, M. A. (2002a). Developmental profiles in overarm throwing: Searching for "attractors," "stages," and "constraints." In J. Clark & J. Humphrey (Eds.), *Motor Development: Research and Reviews* (Vol. 2, pp. 1-25). Reston, VA: National Association for Sport and Physical Education.

Langendorfer, S. J., & Roberton, M. A. (2002b). Individual pathways in the development of throwing. *Research Quarterly for Exercise & Sport*, *73*, 245-256.

McKenzie, T. L., Li, D., Derby, C., Webber, L., Luepker, R. V., & Cribb, P. (2003). Maintenance of effects of the CATCH physical education program: Results from the CATCH-ON study. *Health Education & Behavior*, *30*, 447-462.

McKenzie, T. L., Nader, P. R., Strikmiller, P. K., & Yang, M., (1996). School physical education: Effect of the Child and Adolescent Trial for Cardiovascular Health (CATCH). *Preventive Medicine*, *25*, 423-431.

McKenzie, T. L., Sallis, J. F., & Broyles, S. L., (2002). Childhood movement skills: Predictors of physical activity in Anglo- and Mexican-American adolescents? *Research Quarterly for Exercise & Sport*, *73*, 238-244.

Okely, A., Booth, M. L., & Patterson, J. W. (2001a). Relationship of cardiorespiratory endurance to fundamental movement skill proficiency among adolescents. *Pediatric Exercise Science, 13*, 380-391.

Okely, A. D., Booth, M. L., & Patterson, J. W. (2001b). Relationship of physical activity to fundamental movement skills among adolescents. *Medicine & Science in Sports & Exercise*, *11*, 1899-1904.

Sallis, J. F., McKenzie, T. L., Alcaraz, J. E., Kolody, B., Faucette, N., & Hovell, M. F. (1997). The effects of a 2-year physical education program (SPARK) on physical activity and fitness in elementary school students. *American Journal of Public Health*, *87*, 1328-1334.



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~~McGinnis, J. M., Kanner, L., & DeGraw, C. (1991). Physical education's role in achieving national health objectives. *Research Quarterly for Exercise and Sport, 62*, 128-142.~~

~~Molnar, D. (2004). The prevalence of the metabolic syndrome and type 2 diabetes mellitus in children and adolescents. *International Journal of Obesity, 28*(Suppl. 3), S70-74.~~

~~National Association for Sport and Physical Education & American Heart Association. (2006). *Shape of the nation report: Status of physical education in the USA*. Retrieved August 22, 2007, from http://www.aahperd.org/naspe/ShapeoftheNation/PDF/ShapeoftheNation.pdf.~~

~~Ogden, C. L., Carroll, M. D., Curtin, L. R., McDowell, M. A., Tobak, C. J., & Flegal, K. M. (2006). Prevalence of overweight and obesity in the United States, 1999-2004. *Journal of the American Medical Association, 295*(13), 1539-1548.~~

~~Pate, R. R., Pratt, M., Blair, S. N., Haskel, W. L., Macera, C. A., Bouchard, C., et al. (1995). Physical activity and public health: A recommendation from the Centers for Disease Control and Prevention and the American College of Sports Medicine. *Journal of the American Medical Association, 273*, 402-407.~~

~~U.S. Department of Health and Human Services. (1996). *Physical activity and health: A report of the Surgeon General*. Atlanta, GA: Centers for Disease Control and Prevention.~~

~~U.S. Department of Health and Human Services. (2000). *Healthy People 2010*. Washington, DC: Author.~~

~~U.S. Department of Health and Human Services. (2005). *Health, United States, 2005*. Hyattsville, MD: Author.~~



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