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Review Article

The Role of Motor Competence in the Promotion of Physical Activity and a Healthy Body Weight in Youth

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Abstract

Despite considerable efforts, obesity rates in youth have been rising or plateaued at a high level throughout the world. Global data indicate that 1 in 10 school-aged children are overweight or obese. Due to the increased risks for physical and psychological problems along with an estimated 10% of total health care costs attributed to weight-related health problems, a high prevalence of overweight and obesity has been identified as a major threat to future public health. Current intervention strategies addressing this problem, however, have been of limited success and alternative strategies are warranted. Given the importance of physical activity (PA) along with healthy nutrition in long term weight management, a stronger emphasis on the development of motor competence may be a valuable strategy in the promotion of an active lifestyle and healthy body weight in youth. Even though available data indicates a reciprocal, synergistic relationship between motor competence, PA and body weight, there appears to be a shift in strength and directionality over time. Particularly during late childhood and adolescence motor competence appears to be a crucial determinant of subsequent PA and healthy body weight, while diverse movement experiences form the foundation for motor competence during early childhood. By discussing the empirical evidence on the longitudinal associations of motor competence, PA and body weight along with major theoretical models this narrative review emphasizes the potential contribution of a focus on motor competence in the promotion of an active lifestyle and healthy body weight in youth.

INTRODUCTION

Excess body weight is considered a major health problem due to the well-documented association with metabolic and cardiovascular disease, as well as poor pulmonary function, orthopedic problems, depressive symptoms and overall quality of life [1-3]. In addition to individual health problems, overweight and obesity also puts a significant burden on the health care system. An estimated 10% of all health care spending have been attributed to weight-related health problems [4]. Obesity has also been associated with an increase in costs for both inpatient and outpatient treatment by 36% and an increase in costs for medication by 77% [5]. In addition to these direct costs there is also evidence for a decrease in work-related productivity, which further affects the social system [6,7].

The high prevalence of overweight and obesity in youth is of particular concern [8,9] as it increases the risk for metabolic diseases during childhood [10], and adult obesity with the associated health problems [11]. Further, excess body weight during childhood has been associated with an increased chronic disease risk and premature death even in the absence of adult obesity [12]. In light of these health risks there have been considerable efforts to tackle excess body weight at young ages. Obesity rates in youth, however, have continued to increase or plateau at high levels, indicating limited success of current weight loss and weight management strategies [13]. US data, for example, showed an increase in average body weight of children by 5 kg in the last 3 decades [14], which resulted in 30% of school-aged children being overweight or obese. In Europe the prevalence of overweight and obesity is around 20% and globally 1 in 10 school-aged children are either overweight or obese [15]. The World Health Organisation, therefore, declared the prevention of childhood overweight and obesity as one of the biggest health challenges in the 21st century [16].

Various environmental and genetic correlates of overweight and obesity have been studied but the lack of success in addressing the obesity epidemic suggests that our understanding of the regulation of body weight remains limited. In fact, it has been suggested that the rate of energy expenditure and energy intake rather than body weight is a regulated entity [17]. In this case physical activity (PA) plays a crucial role in weight management. The large increase in population weight over the last several decades also indicates that behaviors, including PA and dietary intake, are of particular importance [18,19]. Further, sedentary choices during leisure time, such as high media utilization, have become increasingly popular [20], which may also have contributed to a majority of youth not meeting current PA guidelines [21-23]. Along with beneficial effects on body

weight, PA has been associated with metabolic, cardiovascular and skeletal health as well as psychological well-being [24-26]. As has been shown for interventions targeting body weight in youth, efforts to achieve a sustainable increase in PA have also been of limited success [27].

Alternative strategies in addition to environmental facilitation or specific PA programs, therefore, should be considered in the promotion of an active lifestyle that facilitates maintenance of a healthy body weight or weight loss in youth. Several studies suggested that low motor competence contributed to the high obesity prevalence in youth [28-30]. Accordingly, the promotion of motor competence may be a viable strategy in the promotion of PA and healthy body weight in youth. Higher motor competence is also associated with children's physical, psychological and mental health and is a critical contributor to general development [31-37]. The purpose of this narrative review is to discuss 2 major theoretical models along with empirical evidence on the longitudinal associations of motor competence, PA and body in order to highlight the potential contribution of a focus on motor competence in addressing low PA levels and excess body weight in youth.

DEFINITION OF MOTOR COMPETENCE AND TRENDS IN YOUTH

Motor competence has been recently suggested as global term that incorporates previously used terminologies such as motor coordination, motor abilities, motor performance, motor proficiency, motor skills or fundamental movement skills [34]. It is defined as a person's ability to execute different motor tasks that rely on the coordination of fine and gross motor skills in order to perform everyday tasks [38,39]. Motor competence, therefore, provides the foundation for various specific locomotor and object control skills that are required for successful participation in active leisure choices and/or sports [40,41]. Locomotor skills are characterized by movements that propel the body through space (e.g., running, jumping, skipping, hopping) while object control skills are needed to manipulate objects (e.g., throwing, kicking, catching) [42]. Even though rudimentary movements (e.g. walking, running) develop naturally, the development of efficient movement patterns and more advanced motor abilities requires deliberate efforts [43].

As has been shown for PA in youth, motor competence has declined over the last several decades [44,45] resulting in a large amount of children and adolescents with poor motor competence [46,47]. Australian data, for example, indicates that two thirds of children entering elementary school are not proficient in locomotor skills [43]. Further, low object control skills were observed in more than 60% of girls and 25% of boys [43]. Poor motor competence, however, influences motivation to participate in PA and the limited success of interventions targeting PA and body weight has, at least in part, been attributed to the lack of attention towards the development of motor competence [48]. Higher motor competence has been associated with greater enjoyment of PA and increased motivation to engage in PA [49-51]. Accordingly it has been shown that children with higher motor competence displayed a less pronounced decline in PA as they progressed into adolescence compared to their peers with lower motor competence [49,52]. Higher motor competence also resulted in higher levels of moderate-to-vigorous PA during adulthood even in the absence of participation in organized sports [53]. Particularly in children with excess body weight it has, therefore, been suggested to focus on deficiencies in motor competence that could hinder participation in health-enhancing PA at the early stages of intervention programs in order to facilitate participation in PA that would last beyond the intervention period [50,54].

Despite the fact that rudimentary movement patterns develop naturally, the development of motor competencies is influenced by a complex interaction of biological, psychological, social, cognitive and motivational factors [43]. Accordingly, the optimal development of motor competence needs to be nurtured and requires appropriate instruction, encouragement, practice and feedback [41,55,56]. Children, therefore, need to be provided with opportunities for engagement in a variety of movements including free play and supervised exercise [57,58]. Free play has been shown to facilitate the development of various movement skills in different contexts particularly in younger children [59], as it is commonly associated with movements in moderate-to-vigorous PA [52]. Structured activities with appropriate instruction and feedback that emphasize various object control and locomotor skills, however, need to be implemented as well to provide additional stimuli for motor development. Several studies showed that school and community programs that implement developmentally appropriate movement experiences resulted in improved motor competence in children and adolescents [56,60-62]. As motor competence is considered a sustainable outcome, it may further be argued that high motor competence contributes to sustainable improvements in an individual's behavioral capability and induces changes in behavioral preferences, including participation in PA [49,63,64].

THEORETICAL MODELS FOR THE DEVELOPMENT OF MOTOR COMPETENCE AND LONGITUDINAL ASSOCIATIONS WITH PHYSICAL ACTIVITY AND BODY WEIGHT

If motor competence is to be considered a viable option in weight management the directionality of the association between motor competence and PA, however, needs to be clarified [65]. Available data indicates a reciprocal, synergistic relationship between body weight, PA and motor competence [66-69]. The strength and directionality of this relationship, however, appears to change over time [69]. Middle childhood seems to be a particularly critical period, where positive trajectories with high motor competence, high PA and lower body weight or negative trajectories of low motor competence, low PA and higher body weight start to diverge [34], (Figure 1). There are two commonly used theoretical models that address the longitudinal relationship between motor development and PA – the dynamic association model [69], and the hierarchical model [70].

The dynamic association model focuses on variations in directionality and strength of the association between motor competence and PA from early childhood into adolescence [69]. It posits that the association between motor competence and PA is limited during early childhood due to the stronger

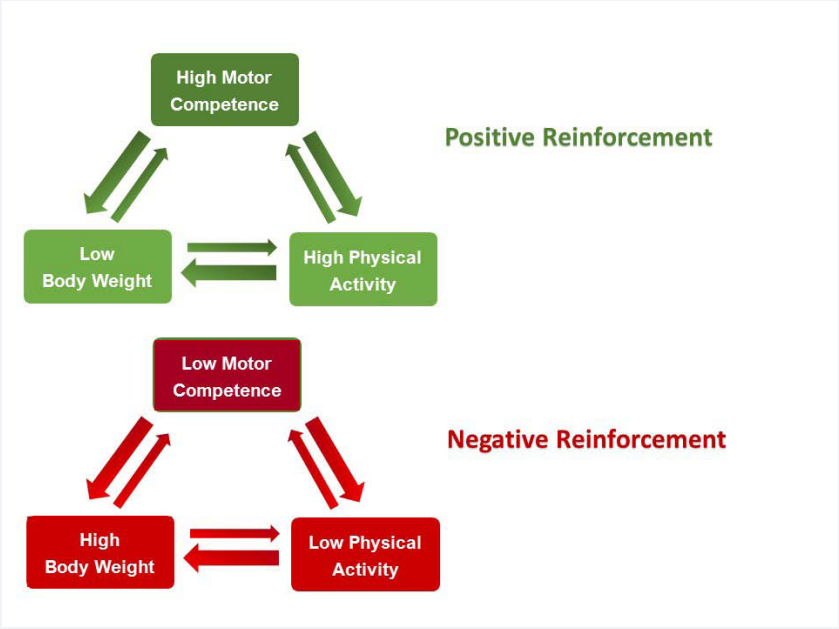

Figure 1 Positive and negative trajectories of motor competence, physical activity and body weight.

environmental and parental influences as well as limited prior experience with structured movement programs. Nevertheless, participation in diverse forms of PA at young ages appears to be necessary for the development of various unspecific motor skills, which may also be referred to as motor milestones [71,72]. An infant's drive to move may also indicate the importance of PA for the development of rudimentary motor skills. Over time the association between PA and motor competence strengthens as more active children will display greater improvements in motor competence than their less active peers. During the transition into middle and late childhood the directionality (i.e. PA as a precursor for motor development) starts to shift. This may at least partially be attributed to changes in social interactions. As children start to compare their motor competence to others their actual and/or perceived motor competence may become a precursor for participation in PA. Accordingly, higher motor competence may become a precursor for further participation in PA.

This shift in directionality continues and increases in strength during the transition into adolescence as adolescents with higher actual and/or perceived motor competence are more motivated to engage in various forms of PA. Higher PA further enhances motor competence [71,72]. It has, therefore, been suggested that motor competence is a major determinant for PA and particularly activities of higher intensities as well as sports during adolescence and into adulthood [57,69,73]. The competence motivation theory [74], provides additional support for this argument as it suggests that competence and enjoyment influence the motivation for engagement in various activities, including PA [74]. Low motor competence, on the other hand, would result in less pleasant experiences and thus increases the risk for withdrawal from exercise and PA. This has also been shown by a recent longitudinal study that showed an increased likelihood for dropping out from sports in adolescents with low motor competence [75]. Low motor competence has further been shown to reduce the motivation towards engaging in more challenging activities [71,76], which limits motor development and contributes to a vicious cycle of low motor competence and low PA.

While the dynamic association model acknowledges a bi-directional association between motor competence and PA that shifts in directionality over time, the hierarchical model suggests that motor competence is a prerequisite for engagement in PA even at young ages. Seefeldt argues that children progress through four levels of motor competence (reflexes, fundamental motor skills, transitional motor skills, sport specific skills) as a result of growth and maturation as well as experience [70]. Critical components of this theory are so-called proficiency barriers, which reflect key motor milestones. Breaking through a proficiency barrier allows children to engage in more complex movements and increases the likelihood for further engagement in PA. Not overcoming a proficiency barrier, on the other hand, hinders the engagement in subsequent PA and increases the risk for withdrawal from sports and PA. Accordingly, already in elementary school children there has been a more pronounced decline in PA with low motor competence, while high motor competence attenuated the age-related decline in PA [52]. Particularly object control skills have been shown to affect PA more strongly compared to locomotor skills [49,77], which may be attributed to their greater complexity and importance in many popular sports.

The combination of PA and motor competence also affects weight status over time. Several longitudinal studies have shown that low motor competence is associated with increased risk for overweight and obesity while high motor competence has been associated with a healthy body weight [49,52,66,78-80]. Lopes et al. further showed that motor competence affects change in childhood adiposity independent of PA [51]. Body weight,

however, affects motor development as well. Motor development has been shown to be impaired in overweight/obese children and adolescents while weight loss was associated with a more pronounced motor development [81,82]. In addition to the inverse association between body weight and PA, the association between body weight and motor competence may be attributed to improved self-efficacy, which may contribute to an overall healthier lifestyle, including alterations in dietary choices that positively affect body weight.

Available research has also shown that interventions targeting motor development in children can be successful [56,61,83], which provides additional support for the potential of emphasizing motor development in the promotion of PA and a healthy body weight. Motor competence also appears to be a sustainable entity in youth and, therefore, could have important implications beyond the intervention period [37,84,85]. Despite low correlations between motor competence and PA as well as body weight during early childhood, motor competence has been suggested to provide the foundation for an active lifestyle [41,69]. Elementary school years appear to be of particular importance for motor development [41,86], which makes physical education a crucial setting for the promotion of motor competence by providing a wide range of movement experiences. In addition to physical education, schools can provide opportunities to enhance motor competence during recess or even short activity breaks in a regular classroom setting. While community settings or club sports may be other settings for the promotion of motor competence, school-based interventions have the benefit of reaching a large number of children independent of their socio-economic background. Motor competence has also been shown to have beneficial associations with academic performance [87,88], which could be an additional argument for the promotion of motor competence in school and after-school programs.

SUMMARY AND CONCLUSION

Even though there remains limited research on the sustainability of interventions targeting motor development for the promotion of PA and body weight, available data suggest that motor competence can be a crucial contributor to optimal physical development and health in youth [31,89]. Despite a bi-directional, synergistic association between motor competence and PA as well as body weight, it appears that the directionality shifts towards motor competence being a prerequisite for participation in PA in late childhood and adolescence. Youth with a better motor competence, therefore, are more likely to maintain higher PA levels, which can help with weight management. Low motor competence, on the other hand, has been linked with lower motivation for engagement in sports or General PA, which could also contribute to weight gain [51,90,91].The reciprocal relationship between body weight and motor competence further emphasizes the need for early preventive measures. Facilitating motor development during early childhood by providing various movement experiences along with age appropriate instruction and feedback, therefore, could be a viable option to facilitate PA and a healthy body weight in youth [52,56,91,92]. Even though interventions in elementary schools have been shown to be particularly important in the promotion of motor competence [93], beneficial effects are also possible in adolescents. In fact, adolescence is a crucial period for the development of lifestyle habits, including attitudes towards PA [94]. Accordingly, the promotion of motor competence during adolescence has been suggested to be an important contributor to establishing a lifelong commitment to PA [49,56,61,69]. As previous intervention strategies targeting increased PA and healthy body weight in youth have been of limited success, a stronger emphasis on motor competence should be considered as a viable alternative approach.

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