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The importance of motor behavior and balance training in the acquisition of physical activity/sports-related motor skills among children – review

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Abstract

Proper motor skill aptitude execution in childhood is critical since it empowers the advancement of other formative spaces. Besides, motor execution may too be necessary for successful life skills, such as having a physically dynamic way of life and scholastic accomplishment. Be that as it may, despite its significance, children's levels of motor skills execution have diminished essentially over the past decades.

In the present review, the first aim was to highlight the importance of motor behavior throughout childhood and beyond. Secondly, to emphasize the effect of balance-specific training in everything related to acquiring motor skills in close connection with general motor behavior. Finally, the desire to highlight the process of acquiring physical activity / sports-related motor skills among children and its importance throughout the ontogenetic period.

Keywords: motor behavior, balance training, motor skills

Introduction

Infancy is the particularly crucial time of a person's life and the fastest period for complete and healthy movement throughout human existence, as well as cognitive development (***, 2017); expanded physical action may give sports and cognitive benefits throughout childhood and adolescence (Riethmuller et al., 2009; Fisher et al., 2011). Therefore, understanding the potential of physical activity in improving underage youngsters' motor skills and knowledge is crucial, and it can provide pediatricians and additional well-being professionals with information on its effectivity as an involvement method. There is some pressing need for comprehensive RCT studies to determine the impact of sports and physical activity regarding the level of motor skills and cognition and determine the dose-response relationship in the community of preschool youngsters (Zeng et al., 2017).

The early stage of childhood is seen as a critical time for adopting healthy behaviors (such as physical activity) (Ward et al., 2010). The physical activity plan provides an environment for developing motor skills for young children, and motor skills are the basis for physical activities in the early and subsequent years (Jones et al., 2011). Today's young children show insufficient motor skills (Hardy et al., 2010). Young children's environments play a significant involvement in encouraging physical activity/sports participation and motor ability improvement because these environments usually have the resources to implement physical behavior and motor ability programs (Ward et al., 2010; Khan & Hillman, 2014; Zeng et al., 2017).

Exercise and language are essential for early development from one to three years of age. Language is the best indicator of cognitive function. Fine motor skills are related to self-help ability. The most typical development in early life is to form one's own identity. Through the period of three years, the youngster may be self-reliant. In this stage of early childhood, children acquire independent life skills such as eating behavior, toilet training, and self-dressing. Early childhood development promotes the development of questioning skills (Balasundaram & Avulakunta, 2021) (Fig.1).

Middle and late youth is the period when youngsters progress from subordinate preschoolers to youthful grown-ups who influence their family and local area organizations. Their reasoning develops more distinctively, their feelings and practices become more controlled, and their choices become more unrestricted. The middle and late childhood periods, which interest us in this article, are when neurons are answerable for astuteness, language, and social/sports capacities/skills (Szabo et al., 2020a; Szabo et al., 2020b; Szabo et al., 2020c; Tulbure et al., 2020) are framed (Mah & Ford-Jones, 2012) (Fig. 1).

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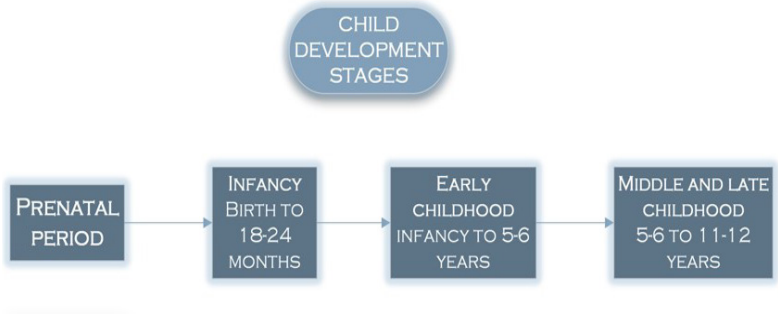

Fig. 1 – Child development stages.

Throughout the life cycle, the advantages of physical behavior are not limited to physical health, but also extend to cognitive function, which refers to the mental abilities involved in the basic process of perception and action. A recent systematic review and consensus statement positively correlated children's physical activity, health, cognition, and academic performance (Donnelly et al., 2016). In addition, cross-sectional research has demonstrated that adolescents and children with higher physical fitness or who regularly participate in physical exercises have better cognitive functions than adolescents and children with poor physical fitness or sedentary activity (Ballester et al., 2018; Ballester et al., 2015; Chueh et al., 2017; Pontifex et al., 2012; Formenti et al., 2021).

Throughout the premature phases of childhood, children may decide to participate in open or closed skill sports. Therefore, because of the differences in open and closed ability sports requirements, this option may be preferable and help affect their motor skill acquisition and cognitive development. Physical skills represent a multi-dimensional concept, including health-related (cardiovascular health, BMI, strength and muscle endurance, flexibility) and skill-related components. The latter, also known as sports health, consists of the capacity to learn and perform motor skills (reaction time, speed, agility, strength, and in our case, balance), which may also be related to cognitive performance in the areas of perceptual speed and executive function (***, 2018; McMorris, 2015; Formenti et al., 2021).

Therefore, the objective of this review article is to methodically examine the existing evidence to examine the impact of balance and motor control on the acquisition of sports-related skills and cognitive improvement in healthy children. Specifically, this review aims to identify, synthesize, and interpret the best available evidence for the minimum and optimal physical activity required to acquire children's cognitive development and motor skills development. In addition, this review seeks to assist academics and health professionals in understanding the advantages of regular physical exercise and developing evidence-based physical activity guidelines for children.

The Development of Motor Behavior

Motor development research was previously considered *the icing on the cake* of developmental science: the core of children's experience, but it has received little attention (Rosenbaum, 2005; Adolph et al., 2010). The historically mature methods of motor skills were dominant in the early 20th century. It was mainly believed that motor development was carried out through predetermined biological changes, and there was almost no intervention from the environment or the cognitive domain (Gonzalez et al., 2019).

Motor development is often broadly divided into gross motor and fine motor skills. Gross motor abilities involve significant muscular movements, such as sitting independently, crawling, walking, or sprinting. Fine motor skills entail using smaller muscles, such as grabbing, manipulating objects, or sketching (Gonzalez et al., 2019).

Previous research has established a close connection between sports experience and developments in other fields. As part of this research topic (Michel et al., 2016) regarding the evolution of infant hand preferences, it was found that infants with consistent hand preferences in the early stages of development also showed advanced cognitive development. This indicates that infants who show stable hand preference in the early stage may follow a different developmental path, rather than those who develop hand preference later and provide evidence for the influence of exercise experience on cognitive development (Libertus & Hauf, 2017).

Motor behavior includes various movements from unconscious twitches to goal-oriented actions, different components of the physique from head to toe, and various physical and social environments from playing alone to group interaction. Motor behavior improvement happens through the life cycle, beginning with the leading embryonic motion and ending with the final breath (Adolph et al., 2017). Participation in movement education, where children discover body awareness, space, relationship, and effort, has historically resulted in learning fundamental motor skills and their progression to various, complex movement forms (Castelli, 2019).

According to the formative system, sports behaviors cannot be comprehended in isolation, and they cannot be separated from the physical, environmental, and social/cultural backgrounds in which they occur (Adolph & Robinson, 2015). Movement is inevitably nested in the body-environment system. The body and the environment develop simultaneously. New or strengthened motor skills enable new parts of the environment to function, thereby providing new or enhanced opportunities for learning and doing things. The nursing practice promotes and limits the

development of sports. Therefore, differences in the way caregivers construct the environment and interact with children affect the form of new skills, the age at which they first appear, and the shape of their developmental trajectory (Adolph et al., 2017).

Balance Ability and Balance Training

Balance, especially the balance of the human body, refers to the body being in a balanced state under stress not to fall (Pollock et al., 2000). The different balance domains may be under static conditions, where the center of gravity (CoG) remains the same, or under dynamic conditions, where the balance must be maintained when moving under the foundation support (Patton et al., 1999). Balance ability can determine the performance of extremely concerted sports (i.e., gymnastics, alpine skiing, figure skating), but it can also predict the risk of injury, especially in the lower limbs (Hrysomallis et al., 2011). Physical activity is universally acknowledged as requiring balance skills (Sopa & Pomohaci, 2021), and stability workouts are extremely incorporated into almost all sports training programs. Although sports static balance and stability are typically demonstrated to be better than in non-sports practitioners, little is known about the differences in balance control between them, especially in different foot positions (Harmon et al., 2020).

Several original studies have shown the efficacy of balance training in increasing several components of children's and adolescents' balance performance (Heleno et al., 2016; Pau et al., 2012; Schedler et al., 2020a), and these discoveries have been summarized in reviews and systematic reviews (Gebel et al., 2018; Gebel et al., 2020). On the contrary, the advice on designing balance training for different load dimensions (for example, training volume, training intensity) so that it is most effective for skills acquisition in children and adolescents is rather unspecific and only comes from review articles (Gebel et al., 2018; Granacher et al., 2011). For example, reducing the basis of support/sensory input and tasks involving unstable surface/cognitive and motor interference has been proposed as an effective means to increase the task difficulty, thereby improving young people/children (Granacher et al., 2011). However, although these recommendations seem reasonable based on the existing literature, there is still a lack of empirical evidence. In a systematic review (Gebel et al., 2018), a meta-analysis was conducted to analyze the impact of balance training on youth balance performance and the dose-response relationship. However, this method should be used to compare dose-response relationships indirectly rather than directly. In other words, for example, comparing the results of a study with a short intervention period to the results of a study with a more extended intervention period but not comparing the effects of different intervention periods in a single study. In addition, the dose-response relationship of children's balance training can only be quantified for specific training methods (i.e., training time, training frequency). In summary, the following studies are needed: directly comparing different training methods in a single study and investigating load dimensions that have not yet been analyzed (Schedler et al., 2020b).

A published meta-analysis quantified the balance training dose-response relationship in healthy young individuals (Lesinski et al., 2015a). These authors quantified the training frequency, period, and training volume; however, the intensity was not quantified because there is no psychometrically reliable measurement method to describe balanced exercise intensity for children (Farlie et al., 2013). The meta-analysis results show that the training method is mainly in the shape of an inverted U, indicating the best training stimuli below and above the threshold. We hypothesized that the balance training dose-response connection in the elderly might show a model-specific inverted U-shaped transition compared to healthy young people and children. The difference in training status/physical level may require an age-specific balance training protocol to achieve the best training effect. The perfect training doctrine of enlightened overload means that the training method (for example, training frequency, training volume) should be compared to the current preparing state of a specific person to avoid overloading of their respective biological systems (Ackland et al., 2009). In addition to the training status, advanced age, and related neuromuscular degeneration processes (e.g., the decrease in the amount and dimension of type II muscle fibers, as well as the loss of sensory and motor neurons), the time pattern of the adaptation process after training appears to have an impact (Pew & Van Hemel, 2004). Based on some suppositions, there are sufficient reasons to ascertain the phase-particular dose-response relationship after balance training (Lesinski et al., 2015b).

Acquisition of Physical Activity/Sports-Related Motor Skills

The discovery about neuroplasticity, that is, the brain's ability to reorganize itself by forming new neural connections in white matter and gray matter, does confirm that people can learn new things in later life; however, for the development of fundamental motor skills and physical awareness, the best time is in early childhood (Dayan & Cohen, 2011). People would think that children living in industrialized and economically developed countries have access to technological innovation, a high standard of living, and advanced medical screening and treatment. Compared to children living in substandard human conditions, they are more effective in mechanical and muscular conditions. There is an advantage in bones, but this is not the case at present; genetic and psychological elements have a more significant influence than physical aspects—cultural and background factors (Baker & Horton, 2004; Castelli, 2019).

Excellent motor skills are supposed to stand crucial for children's physical, social, and psychological development (Gallahue & Ozmun, 2002), and they may even be the basis for an active lifestyle since numerous studies have established a link between good motor skills and more significant proportions of physical behavior (Lubans et al., 2010; Williams et al., 2008). As a result, there is evidence that improving motor abilities has several health advantages. For example, it has been shown that excellent motor skills have a beneficial impact on cardiorespiratory fitness (Lubans et al., 2010; Okely et al., 2001), body weight (Lubans et al., 2010; Krombholz, 2013), and sports

participation (Lubans et al., 2010; Krombholz, 2006); all of this suggests that the early ability of motor skills may have significant health implications and is essential for general well-being (Viholainen et al., 2014). However, most available motor performance studies are cross-sectional and do not give evidence of a probable causal link or only involve short-term follow-up (Hestbaek et al., 2017).

MSC (motor skill competence) is described as the development of common core motor skills, especially object control (e.g., throwing, kicking) and locomotor abilities (e.g., running, jumping, hopping) (Stodden & Goodway, 2008). Because learning to move is a fundamental skill underlying future physical activity, the improvement of motor skill proficiency has been postulated as a causal predictor supporting physical fitness, physical activity behaviors, and health outcomes in infancy (Stodden & Goodway, 2008; Stodden & Goodway, 2007). Studies have demonstrated that motor skill growth in adolescence and childhood is related to improved cardiovascular fitness, muscular endurance, muscular strength, physical activity, and perceived competence (Barnett et al., 2009; Hands et al., 2009). Longitudinal studies in youngsters show that higher motor skill competence is connected to long-term physical activity levels and health-related physical fitness (Barnett et al., 2008; Gao & Wang, 2019).

Motor learning is a person's capacity to acquire motor abilities with a reasonably permanent change in performance due to practice or experience (Schmidt, 2005). The resulting behavioral outcome is now the most often utilized approach to measure motor learning (Schmidt, 2005). In order to enhance motor learning processes, instructions and additional feedback are key influencing variables. Athletes, and in our case, children, are provided with instructions on the proper movement pattern or technique in nearly any training setting where motor skills are taught (Wulf, 2013). Instructional language impacts both movement performance and motor learning outcomes (Fraizer & Mitra, 2008). A skill must be practiced consistently in order to develop proficiency and induce a motor learning adaptation. When determining how practice should be structured, several elements include the type of practice and the timetable. Successful procedure planning should enhance immediate performance impacts and encourage long-term learning by improving skill retention and transfer. Furthermore, task-specific or task-oriented practices relevant to the child should be employed (Gokeler et al., 2019).

Regarding the methodology of physical education and sports, first, Göhner (Göhner, 2013) emphasized the usefulness of functional sports analysis in segmenting sports to facilitate the learning of complex motor skills. In this sense, it is possible to deduce that if and only if the results are partly meaningful from a functional point of view, if and only if they reflect certain functions, and these functions are associated with specific functions, the movement should be split into sub-goals. In addition, when pursuing the parts method, a question arises, that is, whether the initial functional state of a particular moving part can be sufficiently guaranteed. If this is not the case, the instructor or coach should be consulted and ensure that the lost previous function is appropriately supplied due to the isolation. Finally, while separating movement portions, the learner may be presented with the learning of units referring to auxiliary sub-actions, suggesting that the learner would presumably attempt to achieve a sub-goal that may subjectively not match the overall movement objective (Hossner et al., 2015).

Conclusions

1. The current review encourages the use of organized sports to improve motor performance, by means specific to balance training and not only in normally growing youngsters, and offers a foundation for determining whether involvement in organized sports could be beneficial for children by forming acquisitions of physical activity / sports-related motor skills.

2. It will be essential to investigate the long-term impact and sustainability of novel physical activity programs on various aspects of child development, which will lead to a better grasp of how different approaches can be used in communities and schools to promote physically active lifestyles.

3. Longitudinal studies will be required to ascertain if the link between balance training and the acquisition of physical activity/sports-related motor abilities in youngsters changes over time.

4. More research is needed, mainly longitudinal studies in early life/childhood.

Conflicts of interest

Nothing to declare.

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