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Correlation between different types and intensities of physical activity and children's sports performance †

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Abstract: This study used the literature method to systematically review correlation studies on the sports performance of school-aged children aged 7–12 years. Twenty related studies were summarized and sorted out. Results showed that most of the studies used the motion sensor method to measure the intensity of physical activity, and few used the observation and survey methods. Most studies measured sports performance on the basis of changes in various physical fitness indicators to reflect differences in sports performance. Moderate- and high-intensity comprehensive sports were beneficial in improving the sports performance of school-aged children. At present, the differences in the improvement effects of various physical activities on children's sports performance need to be further compared. The research results can provide scientific theoretical guidance for the selection of children's physical activities and sports methods and the development of comprehensive courses such as school sports activities, as well as help children's sports performance improvement and effective development of physical and mental health.

Keywords: physical activity; type; intensity; children; athletic performance

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1. Introduction

Physical activity refers to any bodily movement with energy expenditure caused by skeletal muscle contraction, and consists of four basic elements: frequency, intensity, duration, and type [1]. It has an important impact on health and exercise capacity and is one of the important signs of an active and healthy lifestyle [2]. "Sports performance" refers to the collective display of various physical qualities, including speed, strength, endurance, flexibility, agility, and coordination, when people participate in a certain sport or perform a certain physical activity [3]. Children are the future of the country and the hope of the nation. Sports performance in childhood can intuitively reflect their athletic talent, which is very important for the development of their physical fitness and athletic ability in the future. Improving children's sports performance is a fundamental part of promoting the construction of a sports powerhouse and provides an important guarantee for the national reserve of sports talents. In recent years, many studies have confirmed that appropriate physical activity in childhood helps to improve sports performance. Sex research is not perfect. On this basis, the present study adopted the literature data method to systematically summarize and organize the types, intensity, and influencing factors of physical activity and sports performance in school-aged children and their measurement methods. Moreover, the correlation between physical activity and sports performance was analyzed. The results of this study can be used to provide a basis for further research in related fields.

2. Review of Correlation Studies on Physical Activity

2.1. Types of activity

Various types of human physical activity exist. This study summarized different studies related to physical activity and classified the types of physical activity in three different ways (see Table 1): (1) people's daily life style and behavior habits, (2) characteristics of energy metabolism during activities, and (3) form of activities.

Table 1. Types of physical activity.

Classification criteria	Type	Activities
People's daily life style and behavior habits	Occupation	Physical activity (labor) involved in an 8-h working day
	traffic	Physical activity involved in everyday modes of transportation, such as walking, cycling, riding, and driving
	Leisure	Recreational activities other than basic activities such as physical exercise, dancing, playing with children, going up and down the stairs, and walking; physical activities that involve little body movement in leisure time, such as watching TV, playing computer, chatting, and playing cards
	Housework	Housework such as grocery shopping, cooking, laundry, moving/lifting light objects, mopping the floor, cleaning glass, and weaving
Characteristics of energy metabolism during activity	Aerobic metabolism	Mainly includes physical activities such as agricultural production labor, housework, long-distance running, walking, cycling, and swimming
	Anaerobic metabolism	Physical activity that causes short, powerful muscle contractions (e.g., carrying heavy objects, running fast, throwing, long jump)
Form of activities	Single class	Extension, flexion, and rotation activities of the body or limbs (e.g., squatting, bending, turning)
	Impedance	Repetitive movements that work against resistance through muscles (e.g., weightlifting, bouncing machine exercises, push-ups, pull-ups)
	Combination class	Combination activities to improve the balance and coordination of the human body (e.g., gymnastics, boxing, dance)

Note: The data in the table are compiled by the authors after collecting relevant information.

2.2. Exercise intensity

According to the US Centers for Disease Control and Prevention, American College of Sports Medicine, and World Health Organization, physical activity is divided into three levels (low, medium, and high) on the basis of different classification standards (see Table 2). The classification standards include (1) metabolic equivalent (kilocalories or METs consumed per minute), (2) daily physical activity level (PAL [1]; PAL = total energy expenditure in 24 h/basal metabolic energy expenditure in 24 h), and (3) "subjective exercise intensity scale" (RPE).

Table 2. Classification of physical activity levels.

Classification criteria	Grade	MET value/PAL value/RPE range	Activity example/speaking test
Metabolic equivalent	Low	<3.0	General activities of daily living such as shopping, cooking, and laundry
	Middle	3.0–6.0	Activities such as dancing, riding, mowing, yoga, golf, walking, Tai Chi, table tennis, doubles tennis, biking (<10 mph), and carrying heavy objects (<20 kg)
	High	>6.0	Activities such as walking, skipping, running, fast cycling, football, heavy physical labor (e.g., logging, construction), basketball, tennis, swimming, backpacking, and carrying heavy objects (>20 kg)
Daily physical activity level	Low	1.40–1.69	Office work, repairing electrical clocks, sales clerks, hotel waiters, chemical experiment operation, and giving lectures
	Middle	1.70–1.99	Students' daily activities, motor vehicle driving, electrical installation, lathe operation, and metal cutting
	High	2.00–2.40	Non-mechanized agricultural labor, steelmaking, dancing, sports, loading and unloading, and mining
Subjective exercise intensity scale	Low	<12	Can talk/sing
	Middle	12–14	Can talk but not sing
	High	≥15	Difficulty speaking

Note: The data in the table are compiled by the authors after collecting relevant information.

2.3. Measurement method

By reviewing a large number of studies, the current physical activity measurement methods can be roughly summarized into calorie consumption measurement, heart rate monitoring, motion sensor, observation, and survey methods (see Table 3).

Table 3. Physical activity measurement methods.

Measurement methods		Advantages and disadvantages
Calorie consumption measurement	Direct method	This method has a high accuracy, but it is technical. Moreover, the equipment and test cost are high. The method can only be performed in the laboratory, which is suitable for subject research.
	Indirect method	This method has a high accuracy. However, the equipment is expensive, and the method requires a breathing mask, which will cause mild discomfort to test subjects. This method is often used to determine the validity of other measures of physical activity or small sample studies.
	Double standard water method	The sample collection and measurement process is simple and safe and does not cause toxic side effects. It has a wide range of applications, but the cost is high. The method can only test TEE for a period of time and cannot accurately reflect the ratio of AEE, DEE, and BMR. It is often used to assess the validity of other measures of physical activity.
Heart rate monitoring		It is simple and easy to operate. However, it is unstable, with large individual differences, and is easily affected by many factors such as body composition, training level, smoking, caffeine, and nervousness. It is suitable for epidemiological investigations with large samples.
Motion sensor method	Pedometer	It has a small size and is cheap and easy to wear. It does not affect the activities of the survey object and has accurate measurement

Accelerometer	results. However, it does not provide information on activity intensity, duration of activity, and activity pattern, making it difficult to sense movements that do not involve significant body movement, muscle isometric contractions, or upper extremity activity. It is suitable for small population studies. It is small, light, and easy to use and can provide information on physical activity intensity and activity patterns. It can store data for days, weeks, or even months. It can explain changes in TEE well, but it cannot easily detect TEE. It cannot be used to measure energy expenditure in physical activities that do not involve significant body movement, such as cycling and upper extremity exercise. It also cannot be used in swimming and diving
Observation	Various parameters of the physical activity of the observed subject and the surrounding environment during the activity can be completely recorded, and the obtained data are objective and reliable. However, this method requires a well-trained observer, and the cost is high. This method is suitable for small sample surveys, especially preschool children with poor recall of details.
Survey	This method is inexpensive; simple to operate; and provides information such as activity type, frequency, time, and intensity. However, the results are greatly influenced by subjective factors and are prone to bias, especially for people with limited cognitive ability, recall ability, and comprehension ability. This method is suitable for large-scale epidemiological investigations.

Note: According to Qiao Yucheng, 2017.

3. Review of Correlation Studies on Athletic Performance

In recent years, more and more correlation studies on the important influence of childhood sports performance on exercise ability and physical fitness in adulthood are being conducted. The sports performance level of school-age children needs to be observed from multiple perspectives. As children grow older, their physical fitness performance will continue to improve. In general, boys outperform girls in the teenage years, and trends in strength are consistent with body weight and muscle mass, with peak gains following PHV [4]. Thus, early in the juvenile growth spurt, boys have longer legs relative to height, which may affect running speed and lower torso flexibility. The static strength and explosive power of girls' arms also increase sharply after peak growth.

Factors that affect children's sports performance include physical fitness levels, growth and development status, interest in learning sports, and family genetic factors, but more and more studies have shown that children's coordination ability is the key to determine their sports performance [5]. The most indispensable thing for people to exercise after mastering the movement is the coordination ability [6], and after mastering the new movement and then coordinating and comprehensively making the movement, the performance level is displayed.

After reviewing a large number of literature, we found that the current reports on the measurement methods of sports performance are insufficient. Some studies objectively reflected the sports performance level by assessing children's basic motor skills (FMS). FMS consists of motor skills (e.g., walking, jumping), balance/stabilization skills (e.g., balancing, turning), and object control skills (e.g., throwing, catching) [7]. Some studies also measured various physical qualities of children, quantified sports performance, and then intuitively reflected changes in sports performance levels.

4. Review of Empirical Research on Physical Activity and Sports Performance

Appropriate physical activity at school age has been found to contribute to the improvement of athletic performance. However, the effects of different types and intensities of physical activity on children's athletic performance are not well established. Guo Jiajun et al. (2022) studied the relationship between basic motor skills, physical activity, and body perception ability of children aged 8–9 years and found that basic motor skills can significantly predict physical activity and body perception ability [8]. Wu Haitan et al. (2018) introduced guidelines and suggestions on the combination of different exercise loads for adolescents and children. The research results suggest that physical education classes should promote students' moderate-intensity accumulation time to reach more than 50% of the total physical education class time; physical activities should be set up with special physical fitness exercise time, and promote the comprehensive development of students' sports health and sports performance [9]. Hou Tongtong (2021) found that motor coordination ability is positively correlated with physical activity, and moderate- and high-intensity physical activity can promote motor coordination ability. There is a positive correlation between sports coordination ability and interest in learning sports, and the degree of sports participation, active interest in learning sports, and degree of autonomous learning can promote sports coordination ability [10].

Peng Yong et al. (2021) summarized literature related to human sports performance and found that the INT plan may be more in line with the structural characteristics of the actual training content of sports training, avoid single development, and can comprehensively develop the different sports qualities required by athletes. Integral neuromuscular training enhances health- and skill-related fitness in children during physical education [11]. Sui Jianbing (2020) found that effective intervention through sports games can improve the motor ability of children with autism [12]. Damiano Formenti (2021) studied open and closed skills and found that the open skills movement group showed higher inhibitory control and motor performance (reaction time, speed, agility, and strength) compared with closed skills movement group [13]. Teachers' perceptions of children's motor learning ability can predict their basic motor skills [14]. Sebastiaan Platvoet (2020) found an association between children's motor learning ability and the level of basic motor skills and their changes. This phenomenon is particularly pronounced in children with lower levels of motor learning, with lower proficiency and lower progress on lateral tests [15].

5. Conclusion

5.1. Regular or open-ended, comprehensive, and interesting sports for school-age children will be more conducive to the improvement of sports performance and ability.

5.2. Moderate- and high-intensity physical activity in leisure time can promote motor coordination ability, which can further improve children's sports performance.

5.3. In the selection of physical education courses and after-school activities for school-age children, sports games can be used to drive students' interest in learning sports, develop their physical qualities, and continuously improve their sports performance. Each activity should last at least 30–60 min.

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