THE RELATIONSHIP BETWEEN PHYSICAL WELL-BEING AND COGNITIVE OUTCOMES WITH EXECUTIVE FUNCTION AS A MEDIATOR

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THE RELATIONSHIP BETWEEN PHYSICAL WELL-BEING AND COGNITIVE OUTCOMES WITH EXECUTIVE FUNCTION AS A MEDIATOR

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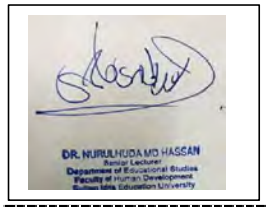

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ABSTRACT

Physical well-being and cognitive outcomes have the irreplaceable function of ensuring survival and promoting growth for children development, especially in the early childhood. The aim of this study was to investigate the role of executive function as mediator in the relationship between physical wellbeing and cognitive outcomes among preschool children aged from 3 to 6 years old in Shaanxi, China. Besides, this study also aimed to identify the age and gender difference in terms of physical wellbeing, executive function and cognitive outcomes among the preschool children. This study employed a correlational design involving 222 preschool children from four kindergartens of Shaanxi province. Structural Equation Modelling was used to test the mediating relationship, while Descriptive Analysis was used to identify the age and gender differences. Chinese National Student Physical Fitness Standard battery, Early Screening Profiles and the Peabody Executive Function Assessments were used to assess the ten observable variables. The obtained findings showed that all variables are interrelated and executive function mediates the relationship between physical wellbeing and cognitive outcomes. In addition, the findings also showed that there is significant age differences in all variables except physical fitness while significant gender differences in physical fitness, fine motor skill, gross motor skill and inhibitory control but not in cognitive flexibility, working memory, verbal concept, visual discrimination, logical relation, and basic school skills. As a conclusion, this study proved that physical wellbeing play important role to increase preschool children's cognitive outcomes through executive function. This study implicates the need for developing intervention in physical wellbeing and executive function to improve cognitive outcomes among preschool children in Shaanxi, China.

HUBUNGAN ANTARA KESEJAHTERAAN FIZIKAL DAN HASIL KOGNITIF DENGAN FUNGSI EKSEKUTIF SEBAGAI SATU PENGANTARA

ABSTRAK

Kesejahteraan fizikal dan hasil kognitif mempunyai fungsi yang tidak boleh ditukar ganti untuk memastikan kelangsungan hidup dan menggalakkan pertumbuhan untuk perkembangan kanak-kanak, terutamanya pada awal kanak- kanak. Tujuan kajian ini adalah untuk menyiasat peranan fungsi eksekutif sebagai pengantara dalam hubungan antara kesejahteraan fizikal dan hasil kognitif di kalangan kanak-kanak prasekolah berumur 3 hingga 6 tahun di wilayah Shaanxi, China. Selain itu, kajian ini juga bertujuan untuk mengenal pasti perbezaan dari segi kesejahteraan fizikal, fungsi eksekutifdanhasilkognitif berdasarkanumur dan jantina dalam kalangan kanak-kanak prasekolah. Kajian ini menggunakan reka bentuk korelasi yang melibatkan 222 kanak-kanak prasekolah dari empat tadika di wilayah Shaanxi. Model Persamaan Berstruktur digunakan untuk menguji hubungan pengantaraan, manakala Analisis Diskriptif digunakan untuk mengenal pasti perbezaan kesejahteraan fizikal, fungsi eksekutif dan hasil kognitif berdasarkan umur dan jantina. Bateri Standard Kecergasan Fizikal Pelajar Kebangsaan Cina, Profil Pemeriksaan Awal dan Penilaian Fungsi Eksekutif Peabody digunakan untuk mengukur pembolehubah-pembolehubahkajian. Dapatan yang diperolehi menunjukkan bahawa semua pembolehubah saling berkaitan dan fungsi eksekutif menjadi pengantara dalam hubungan antara kesejahteraan fizikal dengan hasil kognitif. Di samping itu, dapatan juga menunjukkan bahawa terdapat perbezaan yang signifikan dalam semua pembolehubah berdasarkan umur kecuali kecergasan fizikal, manakala perbezaan jantina yang signifikan dalam kecergasan fizikal, kemahiran motor halus, kemahiran motor kasar dan kawalan perencatan tetapi tidak signifikan dalam fleksibiliti kognitif, memori kerja, konsep lisan, diskriminasi visual, hubungan logik, dan kemahiran asas sekolah. Sebagai kesimpulan, kajian ini membuktikan bahawa kesejahteraan fizikal memainkan peranan penting untuk meningkatkan hasil kognitif kanak- kanak prasekolah melalui fungsi eksekutif. Kajian ini memberi implikasi terhadap keperluan untuk membangunkan intervensikesejahteraan fizikal dan fungsieksekutif untuk meningkatkan hasil kognitif dalam kalangan kanak-kanak prasekolah di Shaanxi, China.

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LIST OF ABBREVIATIONS

BSS	Basic School Skills
CF	Cognitive Flexibility
CNSPFS	Chinese National Student Physical Fitness Standard
CO	Cognitive Outcomes
EF	Executive Function
ESP	Early Screening Profiles
FM	Fine Motor
FMS	Fine Motor Skills
GM	Gross Motor
IC	Inhibitory Control
LR	Logical Relations
PF	Physical Fitness
PLS-SEM	Partial Least Squares Structural Equation Modeling
PW	Physical Well-being
SEM	Structural Equation Modeling
SPSS	Statistical Packages for the Social Science
VC	Verbal Concepts
VD	Visual Discrimination
VMI	Visual Motor Integration
WM	Working Memory
WoS	Web of Science

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CHAPTER 1

INTRODUCTION

1.1 Introduction

Entering the 21st century, the Chinese government has made education a strategic priority, upholding the strategic principle of revitalizing the country through science and education. With the deepening of reform on education, the Outline of National Medium and Long-term Education Reforms and Development Program (2010-2020)

was issued by the Chinese government which aimed at promoting the development of education of all stages in China. On account of the establishment and implementation of relative policies and promoting programs, preschool education in China has made rapid progress since the 21st century. To be specific, the Chinese central government has planned to guarantee that early childhood education is accessible to all preschool-aged children all over the country. As a result, local governments have been required to establish more public or semi-public kindergartens both in the urban and rural areas to meet the increasing demands of preschool education.

Early childhood education in mainland China refers to education for children from birth to six years old. There are two mainly forms of early childhood education which are preschool education and nursery. Preschool education only provides service for children from three to six years old in kindergarten. For children from birth to three years old, nurseries provide care and education service for them. Traditionally, kindergartens are in the charge of Chinese Ministry of Education whereas nurseries are in the charge of Chinese Ministry of Hygiene. In China, early childhood education is not involved as a part of compulsory education. The state and local education financial budgets are mainly distributed to the nine-year compulsory education involving primary school (students from 6 to 12 years old) and middle school (students from 12 to 15 years old). Children in kindergarten are generally grouped by age. Government regulations recommend three groups: junior (3 years old), middle (4

years old) and senior (5 years old) (Chines Ministry of Education, 2019). Class size in a normal kindergarten increases with age ranging from 20 to 40 children, and each group typically has two teachers and a nurse (Liu, 2016). The government approved early education curriculum is health, language, science, art, and socialization (Chinese Ministry of Education, 2019).

Mainland China has a centralized education system, and education legislation, policies, and objectives are applied uniformly across all provinces and regions. The Ministry of Education of the People's Republic of China is the central authority responsible for formulating and implementing education policies and regulations at the national level. It sets the overall direction and guidelines for education in mainland China. The education system in mainland China follows a national curriculum and syllabus, which is standardized and enforced throughout the country. This ensures consistency in educational content and standards across different regions.

The current educational landscape in China heavily prioritizes students' academic performance as a primary criterion for evaluating the quality of school education (Li & Ji, 2016). Unfortunately, this emphasis has resulted in the neglect of other vital aspects of education, such as physical education, within the education system. As schools strive to excel in academic standardized tests, they invest more time and effort

in academic pursuits, often at the expense of opportunities for physical activity (Lai et al., 2007).

The consequences of reduced physical activity are evident in the Student Health Report, which highlights a significant decline in the overall physical fitness of children since 2004, particularly among adolescents in urban China (Jiang and Wang, 2014). Worryingly, the obesity rate among China's urban adolescents has reached 13.3 percent, surpassing the 10 percent safe limit set by the World Health Organization (Jiang and Wang, 2014). To address this issue, the Chinese Ministry of Education has taken steps to monitor the physical fitness status of children. The ministry mandated that all public schools in China report their annual physical fitness test results to the National Physical Health Administration Center, relying on the China National Student Physical Fitness Standards as the assessment scale (Ministry of Education of the People's Republic of China, 2014).

To gain deeper insights into the physical fitness situation, a major research project called the Youth Survey was conducted in 2016 by a Chinese research team. This extensive survey covered approximately 200,000 children residing in both urban and rural areas across 32 provinces in China (Zhu et al., 2017). The study used China's National Student Fitness Standards to evaluate various fitness aspects, including BMI, mobility fitness, strength fitness, and aerobic endurance fitness. The

findings revealed that around 8% of students of compulsory school age did not meet the physical fitness standards. Furthermore, the research indicated that children in urban areas exhibited poorer physical fitness levels compared to their rural counterparts. Additionally, boys were found to face a more severe fitness crisis than girls (Zhu et al., 2017).

Since 2006, the Chinese government has started popularizing and promoting a policy named Sunshine Sports to promote the physical health and fitness of children (Ministry of Education of the People's Republic of China, 2006). However, the effect of this policy is not satisfactory. A survey of the daily time spent by Chinese children in physical activity found that only 32.2% of children in this research met the guidelines of the Sunshine Sports Policy, for example doing 60 minutes of physical activity each day at school (Li & Wang, 2016). A government report has shown that the high-risk nature of standardized academic tests leads to exam-oriented teaching in schools. As a result administrators and teachers have to devote more time on improving their education (Central Committee of the Communist Party of China, 2007).

The Chinese government also begin to implement many reforming measures to improve the quality of preschool education system so that optimized classroom experiences are provided to more and more preschool-aged children. It is generally

believed that the conceptualization of preschool education quality is profoundly affected by traditional Chinese culture. The key cultural feature of Chinese preschool education is teacher-centered activities that emphasize the range of knowledge and academic achievement (Tobin, Hsueh, & Karasawa, 2009). However, some improvements have been implemented during these years. The Chinese preschool education system is changing to be more child-centered. For example, publications by the Chinese Ministry of Education emphasis on the need of children to play with happiness rather than formal schooling, which is crucial for children's individual development.

To be specific, it is pointed out that preschool teachers should be able to understand the knowledge of physical and cognitive development rules of children at different ages so that appropriate strategies and methods could be used to promote the comprehensive development of children in the document that named Professional Standards for Kindergarten Teachers (Trial) issued by the Ministry of Education in 2012. It is necessary for preschool teachers to understand the individual differences in children's development in terms of developmental level, speed and advantage areas so that they can master corresponding strategies and relative teaching methods. Moreover, the document also pointed out that preschool teachers should have the ability to make phased educational teaching plans and specific operation scheme. The development level of children should be observed in teaching activities in order to

adjust teaching methods and give appropriate guidance according to children's performance and needs.

According to Guidelines on Learning and Development for Children Aged 3-6 issued by Chinese government (2012), it is required to ensure that children have enough time to do outdoor activities in order to promote the physical well-being of children. To be specific, the Kindergarten Work Procedures (Ministry of Education, 2015) proposed that children's outdoor activities time (including outdoor sports time) shall not be less than 2 hours a day in normal circumstances. For boarding kindergarten, the time shall not be less than 3 hours a day. But the content and form of activities is not stipulated. As a result, kindergartens have their own a lot of independent choice to carry out various outdoor activities to promote children's physical well-being. So the researches on the physical and psychological development level of preschool children seem to be very important.

The impact of physical activity on academic achievement in children and adolescents is indeed a topic of ongoing debate and research in the field of education and neuroscience. Different studies and experts have presented varying viewpoints on the relationship between physical activity and cognitive functions. Some researchers, like Sun (2002), have suggested that intense physical exercise may lead to physical fatigue, which could potentially reduce learning efficiency. On the other hand, Suzuki

(2017) and Hansen (2017) argue that physical activity can have transformative effects on brain function, enhancing brain development and promoting cognitive functions. They highlight the role of neurotrophic factors, which are derived from the brain and facilitate cognitive functions, suggesting that physical activity can positively influence learning and memory. Ratey & Hagerman (2008) and Hansen (2017) also point out that physical training can have positive effects on non-cognitive factors, such as mood regulation, concentration, and motivation to learn. This is attributed to the increased levels of neurotransmitters in the body, which can contribute to improved mental well-being and cognitive performance.

The concept of the mind-body connection has gained attention from neuroscientists, as mentioned by Hansen (2017), Chaddock (2010), Suzuki (2015), and Erickson et al. (2011). The idea is that physical activity and exercise can impact brain function and cognitive abilities, and vice versa, suggesting an interconnected relationship between the mind and body. While there may be differing perspectives on the specific effects of physical activity on academic achievement, many researchers agree that there is a connection between physical activity, brain function, and cognitive development. The field of neuroscience is continuously exploring the intricate relationship between physical activity and cognitive outcomes, and ongoing research may shed further light on this complex topic.

A number of researchers in various countries have reported a positive correlation between general physical well-being and academic performance in children and adolescents (Chomitz et al., 2008; Eveland-Sayers et al. 2009; London & Castrechini). 2010). Some investigators have conducted more detailed studies using statistical techniques of correlation or regression to examine the degree of relationship between each component of physical well-being and standardized test performance in one or more key subjects (Castelli et al., 2007; Sasayama et al., 2019; Wittberg et al., 2012).

A report by Public Health England in 2014 highlighted that aerobic-fit students do better on standardized tests in school. In addition, several intervention studies have shown a causal relationship between the effects of physical training on academic performance in adolescents. The intervention program Zero Time Physical Education at Naperville Central High School in the United States has amazed the world with the results it has achieved. Students at the school have improved academic performance from below the national average and achieved top positions in international mathematics and scientific research trends tests (Ratey & Hagerman, 2008). The secret to this success is believed to lie in the physical education sessions conducted prior to academic instruction (Ratey & Hagerman, 2008).

A number of findings suggest that positive associations have been established not only in school aged children but also preschool aged children. This research topic

remains controversial due to inconsistent results (Donnelly et al., 2016). Several studies have shown different outcomes depending on gender (Eveland-Sayers et al., 2009). Other results from longitudinal studies suggest different degrees of correlation between different ages (Sasayama et al., 2019; Wittberg et al., 2012). One reason for this discrepancy may lie in the different measurements tools used to assess each component of physical well-being and cognitive outcomes. For example, in the United States, most researchers used the FitnessGram assessment and the PACER test (Bass et al., 2013; Castelli et al., 2007; Chomitz et al., 2008; Hermoso et al., 2017).

In China, the standards of the China National Student Fitness Standard were used to measure the physical fitness level of all students at the stage of both compulsory education and preschool period (Ministry of Education, People's Republic of China, 2014). Therefore, different measurements and criteria may affect the consistency of study results. Additionally, confounding factors can lead to inconsistent results.

Overall, the interplay between physical well-being, executive function, and cognitive outcomes remains a complex and evolving area of research. The Chinese government's initiatives to promote physical activity and improve the quality of preschool education are essential steps towards fostering the comprehensive development of children in the country. However, further research and effective

policies are needed to strike a balance between academic responsibilities and physical well-being in the education system.

1.2 Background of the Study

Preschool education in China has experienced remarkable growth and transformation, becoming a crucial component of the country's education system (Li, 2019). With the Chinese government's strategic emphasis on revitalizing the nation through science and education, early childhood education has become a key priority in the Outline of National Medium and Long-term Education Reforms and Development Program (2010-2020) (Ministry of Education, 2011). The plan aims to promote the development of education at all stages, with special attention given to preschool education.

To ensure widespread access to quality early childhood education, the Chinese government has implemented various policies and initiatives. Efforts have been made to increase the number of kindergartens, particularly in rural and underprivileged areas, making preschool education more accessible to children across the country. Financial allocations have been enhanced to support early childhood education, and

the government has emphasized its primary responsibility in providing this essential foundation for children's learning and development (Li, 2019).

In line with the goal of improving quality, the preschool curriculum in China is designed to offer a holistic learning experience for young learners. Beyond academic subjects like language, mathematics, and science, the curriculum includes activities that foster creativity, physical development, and social skills. Play-based learning is highly valued, recognizing its role in promoting cognitive, emotional, and social growth in children (Wang, & Sheridan, 2021).

Qualified and well-trained teachers are instrumental in delivering effective early childhood education. The Chinese government has taken significant strides to enhance teacher qualifications and provide ongoing professional development opportunities. This focus on teacher training ensures that educators are equipped with the necessary skills to support children's development effectively (Chen & Wang, 2018).

Moreover, parental involvement is actively encouraged and considered a crucial aspect of preschool education. Schools regularly organize parent-teacher meetings, workshops, and other activities to engage parents in their child's education journey, fostering a collaborative learning environment that extends beyond the classroom.

While standardized testing is not widely implemented at the preschool level, teachers employ various assessment methods, such as observations and informal assessments, to monitor each child's progress and development. This individualized approach allows educators to tailor their teaching methods to meet the unique needs of each student (Zhou & Zhang, 2020).

However, challenges persist in the preschool education landscape. Disparities in access to quality education between urban and rural areas remain a concern, as do variations in the standards and fees of private kindergartens. The Chinese government continues to focus on implementing reforms to address these issues, with a particular emphasis on teacher training, curriculum development, and the integration of modern educational technologies.

Preschool education in Shaanxi province, China, has seen significant development and progress in recent years. The province has placed a strong emphasis on providing high-quality early childhood education to its young population. The government's commitment to preschool education is evident in the implementation of various policies and initiatives aimed at expanding access and improving the overall quality of preschool programs. One notable initiative in Shaanxi province is the implementation of one year of free education for children aged 5 to 6 years old. This policy, introduced in September 2011, has been instrumental in increasing preschool

enrollment rates and ensuring that more children have access to early childhood education. The government allocates substantial funding, around 200 million annually, to support this one-year free early childhood program, making it more accessible to families from diverse socioeconomic backgrounds (Shaanxi provincial government, 2011).

In recent years, China has experienced a concerning decline in the physical fitness of its preschool children. However, the 2014 National Physical Fitness Monitoring Report, published by the Administration of Sport of China, revealed a slight improvement compared to previous years. Despite this positive trend, the overall situation remains unsatisfactory, indicating that there is still much room for improvement in promoting the physical well-being of young children (Administration of Sport, 2015).

To address the issue and recognize the importance of physical fitness and motor skills in assessing child development, the Ministry of Education and relevant departments took action in 2013. They revised the physical fitness tests for children, leading to the issuance of the new National Students' Physical Health Standards in 2014. This move reflected a growing emphasis on the concept of all-round development for children, highlighting the need to consider physical well-being alongside academic achievements (Learning, 2000).

Unfortunately, despite the positive shift towards acknowledging the significance of physical well-being, the traditional focus on academic achievements in Chinese preschool education still persists. The prevailing belief is that strong academic performance paves the way for better opportunities in further education and access to superior educational resources. Consequently, many parents and teachers prioritize academic achievements over physical health as essential preparation for primary education.

This academic-centric approach has resulted in increasing academic pressures on young children. As a consequence, physical well-being, including physical fitness and motor skills development, tends to be neglected. Studies have identified the academic burden as a contributing factor to poor physical fitness among children (Zhu, 2016; Liu, 2018). Reduced time allocated for physical exercise has led to rising obesity rates and declining physical health in child development.

To counter this imbalance, it is crucial to promote physical well-being as an integral part of early childhood education. Researchers and educators advocate for integrating physical activities and motor skill development into preschool curricula, emphasizing that this approach can improve children's cognitive outcomes and overall academic achievements (Liu, 2021). By considering physical fitness and motor skills

as equally important as academic results, a more balanced and holistic educational environment can be created to support children's all-round development.

Recognizing that physical fitness and motor skills are fundamental aspects of physical well-being, researchers have studied their association with various physical developments, such as body composition, muscle strength, and aerobic endurance (van der Niet et al., 2014). Moreover, early childhood is a critical period for cognitive development, as mastering sensory and perceptual skills is essential for improving physical health and progressing to more complex cognitive functions, such as action planning and control (Osorio-Valencia et al., 2018).

In recent years, research has increasingly focused on exploring the relationship between physical exercise and academic performance in children. Surprisingly, evidence suggests that physical exercise does not negatively impact academic achievement; rather, it may even indirectly improve cognitive development and academic performance (Liu, 2021). For instance, some studies have found that aerobic endurance benefits higher-level cognitive functions, including executive function.

Apart from physical fitness, researchers have also stressed the importance of motor skills in cognitive outcomes. Motor skills play a significant role in physical and cognitive development, facilitating children's adaptation to their environment. As

these skills continue to develop throughout an individual's life, they signify changes in the interaction between the individual and the environment, making them critical indicators of children's physical and cognitive development and social adaptation.

Integrating physical well-being into preschool education can drive educational reform, influencing curriculum design, teaching methods, and evaluation systems to prioritize children's physical and psychological development. Encouraging the learning of complex motor skills helps children develop independence and self-confidence while broadening their horizons, ultimately benefiting their physical and psychological health and social adaptability.

However, some parents still harbor concerns that physical exercise may negatively impact academic performance. Three main reasons contribute to this viewpoint (Liu, 2018): concerns about physical exercise consuming too much energy and causing fatigue, worries that time spent on physical exercise will reduce study time and academic achievements, and the prevailing cultural emphasis on academic achievements over physical well-being.

To change this perception, robust evidence demonstrating the positive impact of physical well-being on cognitive outcomes and academic achievements is crucial. Educators emphasize the integration of executive function and cognitive skills to

support children's success in formal schooling (Liu, 2021; Snow, 2006). Executive function, a high-level cognitive ability, plays a vital role in regulating thoughts, emotions, and behaviors to solve problems and complete tasks.

This study also highlights the significance of psychological variables, particularly executive function, in shaping children's academic achievements and overall cognitive development. Executive function, a high-level cognitive ability, plays a crucial role in regulating thinking, emotions, and behavior to produce coordinated and appropriate actions. It encompasses sustained and flexible attention, inhibitory control, and working memory skills, which are vital for success in formal schooling. Research indicates that executive functioning not only predicts short- and long-term outcomes in young children's lives but also contributes to their adaptability and problem-solving capabilities.

In the realm of early childhood education, the integration of executive function and cognitive skills is deemed essential by educators (Liu, 2021; Snow, 2006). A growing body of evidence supports the importance of executive function in academic achievement, especially in structured learning environments. Early childhood curricula focusing on the development of executive function can significantly influence children's progress in various areas, such as early literacy and mathematical skills. However, the specific roles of individual executive functions and their

prioritization in preschool interventions continue to be subjects of debate, necessitating further research.

Furthermore, the study underlines the pivotal roles of physical well-being and cognitive outcomes in ensuring children's survival and fostering their growth. Particularly during early childhood, when language abilities are still limited, movement and physical development become crucial indicators of individual progress. Physical fitness and motor skills serve as key benchmarks for monitoring children's overall development, and researchers continually explore physical interventions that can improve academic achievements. By strengthening the relationship between physical well-being and cognitive outcomes, preschool education can be enhanced, leading to more comprehensive and well-rounded learning experiences for children.

It is essential to recognize that promoting a balanced approach to education, one that values and integrates both academic achievements and physical well-being, is vital for ensuring children's holistic development. As the understanding of the connection between physical well-being and cognitive outcomes deepens, evidence-based strategies can be implemented to support children's cognitive and physical development effectively.

1.3 Statement of Problem

In recent years, global concerns about childhood obesity, echoed by the WHO's 2017 report highlighting a tripling of obesity rates since 1975, have magnified the urgency of understanding and addressing physical well-being in children. While developed nations like the United States navigate high percentages of overweight and obese children, developing countries, particularly China, grapple with their unique challenges. Liu's (2021) observations emphasize a serious problem of physical well-being in China, signaling a crucial need for comprehensive efforts to promote physical activity and health.

China's situation is compounded by a noticeable decline in the overall physical fitness of children, especially urban adolescents, evident since 2004. Reports indicating an urban adolescent obesity rate of 13.3%, exceeding the WHO's safe limit, emphasize the severity of the issue (Jiang and Wang, 2014; Zhu et al., 2017). Recognizing the significance of physical education and sports, the Chinese government initiated efforts to elevate national fitness, but these endeavors face the challenge of a prevailing imbalance in preschool education.

Rapid urbanization and economic development led to changes in dietary patterns. Increased consumption of energy-dense, nutrient-poor foods became more common, contributing to obesity issues. Urbanization and changes in lifestyle were associated with decreased physical activity, especially among urban children. Sedentary behaviors, such as screen time, increased, further contributing to health issues.

The Chinese government implemented various initiatives to address childhood obesity. The "Sunshine Sports" program aimed to enhance physical education in schools, promote extracurricular sports activities, and raise awareness of the importance of physical activity. Disparities in health indicators and access to health resources persisted between urban and rural areas. Urban areas generally had better health infrastructure, including facilities for physical activities. The Chinese National Survey on Students' Constitution and Health regularly assessed the physical fitness of students. Reports indicated concerns about the overall decline in physical fitness levels among Chinese children and adolescents.

Academic pressure on students, driven by the competitive nature of China's education system, sometimes resulted in longer study hours and reduced time for physical activities. This was particularly notable in urban areas. There was a growing awareness of the importance of a healthy lifestyle, including regular physical activity

and a balanced diet. Public health campaigns sought to educate parents and communities about the risks of childhood obesity.

The shift towards an emphasis on intellectual and cognitive development in Chinese preschool education, sidelining physical fitness and motor skills, is a matter of growing concern (Liu, 2016). This shift is reflected in reports suggesting that up to half of Chinese children entering kindergarten lack essential skills for school readiness (Chang & Gu, 2018; Rimm-Kaufman, Pianta & Cox, 2000). Consequently, the dearth of research on the role physical well-being plays in Chinese children's adaptation to their environment and social interactions is striking, particularly in a non-Western, non-alphabetic script society like China (Liu, 2021; Biddle & Asare, 2011).

Moreover, the persistent isolation of variables in existing studies, examining physical fitness, motor skill, and cognitive outcomes independently, neglects the intricate interconnectedness of these factors (Schmidt et al., 2017). A crucial aspect that has received insufficient attention is the gender and age differences in physical well-being, executive function, and cognitive outcomes among Chinese preschool children. Existing literature suggests varying degrees of correlation between these variables at different ages and among different genders, but specific data on age and

gender disparities in China are notably lacking (Sasayama et al., 2019; Wittberg et al., 2012).

Understanding these nuanced differences is imperative for developing effective, targeted physical activity plans tailored to the diverse needs of preschool children in China. The urgency is further underscored by recent data on declining physical fitness levels and rising obesity rates. Investigating the intricate relationship between physical fitness, motor skills, and cognitive outcomes among Chinese preschool children, with specific attention to gender and age differences, is not only a scholarly pursuit but a crucial step toward addressing current challenges and fostering a healthier future generation. Such research is indispensable for informing evidence-based interventions, ensuring they are nuanced, culturally sensitive, and capable of mitigating the multifaceted challenges faced by Chinese preschool children today.

The problem in the research on physical well-being and cognitive outcomes with executive function as a mediator lies in the need to comprehensively understand the intricate relationships and mechanisms involved in these domains. The interactions between physical well-being, cognitive outcomes, and executive function are complex and multifaceted. Understanding how these factors interplay and influence each other

is challenging due to the dynamic nature of child development.

Establishing the mediating role of executive function in the relationship between physical well-being and cognitive outcomes requires rigorous investigation. Determining whether improvements in physical well-being directly contribute to enhanced cognitive outcomes, and how executive function acts as a mediator, is crucial.

Child development is a dynamic process with age-related variations. Investigating how these relationships evolve across different age groups is essential for developing targeted interventions and educational strategies. Theoretical frameworks vary, ranging from maturation theories to dynamic systems theories. Integrating these diverse models and understanding their collective implications is a complex problem.

Thus, the gaping hole between previous studies and the current research underscores the urgency of investigating the complex relationships between physical fitness, motor skills, and cognitive outcomes. This is not merely an academic pursuit; it is a pressing need to bridge the existing research gap and inform evidence-based interventions that cater to the specific needs of Chinese preschool children. Translating research findings into practical interventions poses a challenge.

Understanding how educators, parents, and policymakers can leverage these insights to optimize child development and learning outcomes is a key issue. The current study aims to fill this void, contributing valuable insights for the formulation of holistic, culturally sensitive approaches to foster the physical and cognitive well-being of the future generation in China.

1.4 Conceptual Framework

The intricate interplay between physical well-being, executive function, and cognitive outcomes holds paramount significance in understanding and optimizing developmental trajectories, particularly in preschool children. Executive function, encompassing the orchestration of cognitive processes like working memory, cognitive flexibility, and inhibitory control, emerges as a pivotal mediator in bridging the connection between physical well-being and cognitive prowess.

Considerable evidence suggests a profound correlation between physical well-being and cognitive outcomes. Rigorous investigations consistently reveal that routine physical activity fosters cognitive functions, including memory, attention, and problem-solving. Mechanistically, physical endeavors enhance brain health by

augmenting cerebral blood flow, fortifying neurotrophic factor release for neuronal growth, and mitigating inflammation and oxidative stress.

Executive function operates as the linchpin in this symbiotic relationship. Engaging in physical activities, such as sports or aerobic exercises, serves as a crucible for executive function refinement. Activities demanding planning, coordination, and strategic thinking act as catalysts for the enhancement of executive skills.

The augmentation of executive function, in turn, augments cognitive abilities by optimizing the allocation and utilization of cognitive resources. Improved working memory and attentional control, forged through heightened executive function, transmute into heightened concentration and adept information processing during cognitive endeavors. This nexus consequently yields superior academic performance.

Moreover, executive function wields substantial influence over lifestyle choices. The ability to set goals, plan actions, and curb impulsivity substantiates adherence to healthy living practices. This reciprocal relationship asserts that executive function not only acts as a mediator but also as a proactive driver, steering individuals toward a lifestyle that perpetuates both physical well-being and cognitive acuity.

In the envisaged model for this thesis, we posit specific hypotheses. Firstly, we anticipate a direct link between physical well-being and executive function among preschool children. Secondly, we hypothesize a direct association between executive function and cognitive outcomes in this demographic. Lastly, we propose the existence of both a direct and an indirect relationship between physical well-being and cognitive outcomes among preschool children, acknowledging the mediating role played by executive function.

This conceptual framework sets the stage for an in-depth exploration of the intricate dynamics between physical health, executive function, and cognitive development in preschool-aged children, offering a nuanced lens to decipher the multifaceted pathways shaping early childhood well-being.

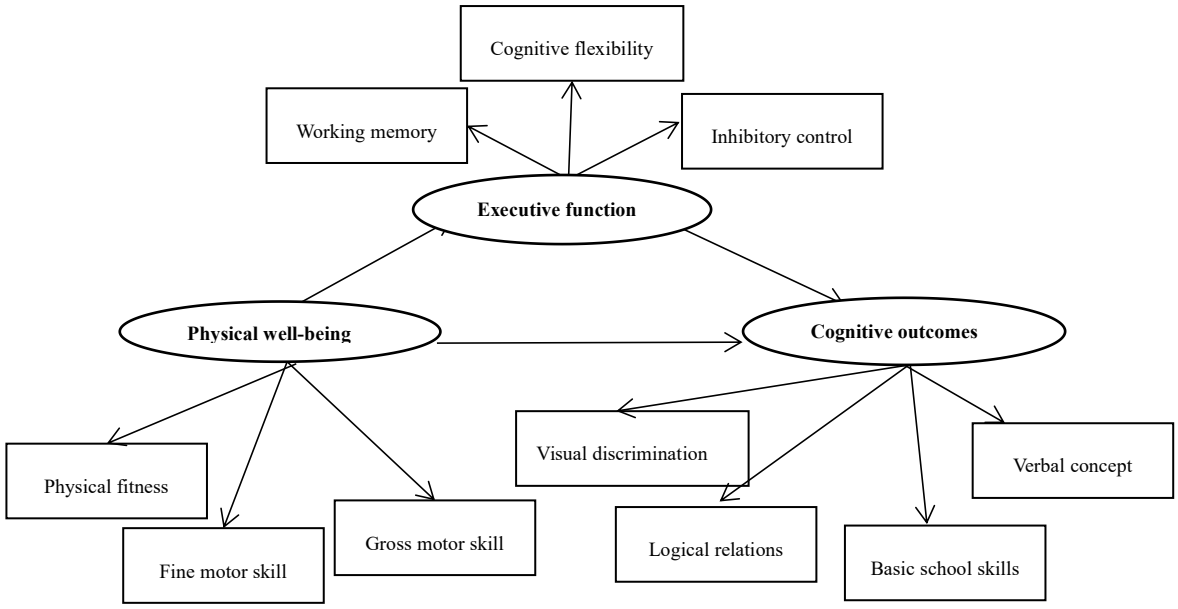

Figure 1.1. Conceptual Framework with Sub-constructs

In order to test the model, structural equation modeling will be used to analyze the mediation effect of executive function on the relationship between physical well-being and cognitive outcomes. Chinese National Student Physical Fitness Standard battery, Early Screening Profiles and the Peabody Executive Function Assessments will be used to assess different variables. The framework of the present study is shown in the Figure 1.2. Physical well-being includes three sub-constructs which are physical fitness, fine motor skill, and gross motor skill. Executive function includes three sub-constructs which are inhibitory control, working memory, and cognitive flexibility. Cognitive outcomes include four sub-constructs which are verbal concepts, visual discrimination, logical relations, and basic school skills. To conclude, there are three constructs and ten sub-constructs in total in the model.

1.5 Research Objectives

The objectives of the present study are to identify the interrelationship among physical well-being, executive function and cognitive outcomes for preschool children. At the same time, the developmental information in terms of physical well-being, executive function and cognitive outcomes of Chinese boys and girls age from 3 to 6 is also the objectives. Age difference and gender difference on physical well-being, executive function and cognitive outcomes has been tested to demonstrate the

developmental features of Chinese preschool children. The detailed objectives are listed below respectively:

1. To identify the relationship between physical well-being and executive function among preschool children.
2. To identify the relationship between executive function and cognitive outcomes among preschool children.
3. To identify the relationship between physical well-being and cognitive outcomes among preschool children.
4. To identify whether executive function plays a mediating role in the relationship between physical well-being and cognitive outcomes among preschool children.
5. To identify the significant difference in terms of physical well-being based on age.

5a. To identify the significant difference in terms of physical fitness based on age.

5b. To identify the significant difference in terms of gross motor skill based on age.

5c. To identify the significant difference in terms of fine motor skill based on age.

6. To identify the significant difference in terms of executive function based on age.

6a. To identify the significant difference in terms of inhibitory control based on age.

6b. To identify the significant difference in terms of cognitive flexibility based on age.

6c. To identify the significant difference in terms of working memory based on age.

7.To identify the significant difference in terms of cognitive outcomes based on age.

7a. To identify the significant difference in terms of verbal concepts based on age.

7b. To identify the significant difference in terms of visual discrimination based on age.

7c. To identify the significant difference in terms of logical relation based on age.

7d. To identify the significant difference in terms of basic school skills based on age.

9. To identify the significant difference in terms of physical well-being based on gender.

8a. To identify the significant difference in terms of physical fitness based on gender.

8b. To identify the significant difference in terms of gross motor skill based on gender.

8c. To identify the significant difference in terms of fine motor skill based on gender.

10. To identify the significant difference in terms of executive functions based on gender.

9a. To identify the significant difference in terms of inhibitory control based on gender.

9b. To identify the significant difference in terms of cognitive flexibility based on gender.

9c. To identify the significant difference in terms of working memory based on gender.

10. To identify the significant difference in terms of cognitive outcomes based on gender.

10a. To identify the significant difference in terms of verbal concept based on gender.

10b. To identify the significant difference in terms of visual discrimination based on gender.

10c. To identify the significant difference in terms of logical relation based on gender.

10d. To identify the significant difference in terms of basic school skills based on gender.

1.6 Research Questions

The objective of the present study is to identify the interrelationship among physical well-being, executive function and cognitive outcomes for preschool children and to get the developmental information in terms of physical well-being, executive function and cognitive outcomes of Chinese boys and girls age from 3 to 6 is also the objectives. Based on this objective, ten research questions are formulated as follow:

1. Is there any significant relationship between physical well-being and executive function among preschool children?
2. Is there any significant relationship between executive function and cognitive outcomes among preschool children?
3. Is there any significant relationship between physical well-being and cognitive outcomes among preschool children?

4. Does executive function play a mediating role in the relationship between physical well-being and cognitive outcomes among preschool children?

5. Is there any difference of physical well-being based on age?

5a. Is there any difference of physical fitness based on age?

5b. Is there any difference of gross motor skill based on age?

5c. Is there any difference of fine motor skill abased on age?

6. Is there any difference of executive function based on age?

6a. Is there any difference of inhibitory control based on age?

6b. Is there any difference of cognitive flexibility based on age?

6c. Is there any difference of working memory based on age?

7. Is there any differences of cognitive outcomes based on age?

7a. Is there any differences of verbal concepts based on age?

7b. Is there any differences of visual discrimination based on age?

7c. Is there any differences of logical relation based on age?

7d. Is there any differences of basic school skills based on age?

8. Is there any differences of physical well-being based on gender?

8a. Is there any differences of physical fitness based on gender?

8b. Is there any differences of gross motor skill based on gender?

8c. Is there any differences of fine motor skill based on gender?

9. Is there any differences of executive function based on gender?

9a. Is there any differences of inhibitory control based on gender?

9b. Is there any differences of cognitive flexibility based on gender?

9c. Is there any differences of working memory based on gender?

10. Is there any differences of cognitive outcomes based on gender?

10a. Is there any differences of verbal concept based on gender?

10b. Is there any differences of visual discrimination based on gender?

10c. Is there any differences of logical relation based on gender?

10d. Is there any differences of basic school skills based on gender?

1.7 Research Hypotheses

According to the research questions and research objectives, ten research hypotheses are formulated as follow to answer the research questions above.

1. There is a significant relationship between physical well-being and executive function among preschool children.
2. There is a significant relationship between executive function and cognitive outcomes among preschool children.
3. There is a significant relationship between physical well-being and cognitive outcomes among preschool children.

4. Executive function plays a mediating role in the relationship between physical well-being and cognitive outcomes among preschool children.

5. There is a significant difference of physical well-being based on age.

5a. There is a significant difference of physical fitness based on age.

5b. There is a significant difference of gross motor skill based on age.

5c. There is a significant difference of fine motor skill based on age.

6. There is a significant difference of executive function based on age.

6a. There is a significant difference of inhibitory control based on age.

6b. There is a significant difference of cognitive flexibility based on age.

6c. There is a significant difference of working memory based on age.

7. There is a significant difference of cognitive outcomes based on age.

7a. There is a significant difference of verbal concept based on age.

7b. There is a significant difference of visual discrimination based on age.

7c. There is a significant difference of logical relation based on age.

7d. There is a significant difference of basic school skills based on age.

8. There is a significant difference of physical well-being based on gender.

8a. There is a significant difference of physical fitness based on gender.

8b. There is a significant difference of gross motor skill based on gender.

8c. There is a significant difference of fine motor skill based on gender.

9. There is a significant difference of executive function based on gender.

9a. There is a significant difference of inhibitory control based on gender.

9b. There is a significant difference of cognitive flexibility based on gender.

9c. There is a significant difference of working memory based on gender.

10. There is a significant difference of cognitive outcomes based on gender.

10a. There is a significant difference of verbal concept based on gender.

10b. There is a significant difference of visual discrimination based on gender.

10c. There is a significant difference of logical relation based on gender.

10d. There is a significant difference of basic school based on gender.

1.8 Importance of the Study

During the critical preschool years, spanning from ages 3 to 6, children undergo significant physical and cognitive development. At this stage, they display an incredible enthusiasm for learning and mastering motor skills. Children have a remarkable ability to imitate and practice these skills persistently, unburdened by the fear of making mistakes. Given the right opportunities and a nurturing environment, preschoolers can rapidly acquire a diverse range of motor skills, which can be both impressive and heartwarming to witness.

Gross motor skills, in particular, play a pivotal role in shaping preschool children's personalities and fostering independence. When children gain proficiency in

certain motor skills, they experience a sense of autonomy, empowering them to perform tasks without constant adult assistance. This newfound independence not only boosts their confidence but also contributes to the development of a strong and self-reliant personality. Moreover, many motor skills serve as tools for effective communication and interaction with peers. Children who exhibit good motor skills find it easier to engage and play with others, gaining admiration and praise from their peers, which further enhances their social experiences and self-esteem.

Motor skills are not merely isolated physical abilities but have far-reaching implications on various aspects of a child's development. They are essential means for children to adapt to their environment and, in turn, significantly influence their physical and cognitive growth. In essence, the acquisition of motor skills represents a crucial component of children's development of adaptive behaviors. As children develop and refine their motor skills, the interactions between the child and their environment undergo transformative changes. This process plays a fundamental role in shaping their cognitive, emotional, and social behaviors during early childhood. Researchers have repeatedly emphasized that motor skills hold a pivotal position in the developmental trajectory of young children, acting as key indicators and windows through which to observe their overall development.

Recognizing the value of preschool children's physical fitness, both parents and governments place special emphasis on promoting a healthy lifestyle from an early age. Physical fitness during early childhood lays the groundwork for lifelong well-being. Extensive research has shown that physical fitness not only supports children's physical health but also positively impacts their cognitive development, personality formation, and social adaptability. Therefore, dedicated research focused on the well-being of young children, with a specific emphasis on physical fitness, holds immense importance.

This study has broader implications for the field of early childhood development and educational research. By comprehensively evaluating physical fitness, motor skills, cognitive development, and executive function within one study, researchers can achieve a more comprehensive understanding of preschool children's development. Importantly, this research will contribute to filling gaps in our understanding of the developmental interplay between physical and cognitive aspects in preschool-aged children, especially in non-Western and non-alphabetic script societies. The insights gained from this study have the potential to inspire future intervention studies aimed at enhancing the performance and well-being of preschool children.

From a practical standpoint, the results of this study will prove invaluable for preschools and families seeking to optimize physical activity plans to enhance cognitive and physical performance in young children. Understanding the intricate relationships between physical fitness, motor skills, executive function, and cognitive outcomes will help inform the design of curricula and learning experiences in kindergartens. By identifying and addressing the physical and cognitive needs of preschool children, teachers and parents can play a proactive role in supporting their holistic development. Encouraging children to actively participate in physical activities that foster physical fitness and motor skill development can lead to improved cognitive outcomes and lay the foundation for a healthier and more successful life ahead.

1.9 Limitation of the Study

Indeed, every research study comes with its limitations, and it is crucial to acknowledge them to ensure a clear understanding of the findings. In the context of this study focusing on preschool children in Shaanxi province, mainland China, there are several limitations that should be highlighted.

The first limitation pertains to the generalizability of the results. As the study was conducted solely in Shaanxi province, the findings may not be fully representative of preschool children from all provinces across mainland China. Different areas and communities may have distinct socio-cultural, economic, and environmental factors that could influence physical fitness, motor skill development, executive function, and cognitive outcomes differently. Therefore, caution should be exercised when attempting to generalize the findings to the entire population of preschool children in mainland China.

Another limitation concerns the age range of the sample. The study only included preschool children aged three to six years old, excluding younger children (from birth to three years old). Including a broader age range could have provided a more comprehensive understanding of the developmental trajectory of physical fitness, motor skills, executive function, and cognitive outcomes during the early childhood period. Additionally, the small sample size for the six-year-old group due to some children already transitioning to primary school may limit the ability to draw conclusive findings for this age group.

Furthermore, the correlational design of the current study poses limitations on establishing causal relationships between physical fitness, motor skill, executive function, and cognitive outcomes. While correlations indicate associations between

variables, they do not provide evidence of causation. To determine cause-and-effect relationships, further research employing experimental or longitudinal designs would be necessary. Such studies could involve interventions that target physical fitness or motor skill development and observe subsequent changes in executive function and cognitive outcomes.

1.10 Operational Definition

Physical well-being:

Physical well-being is a multifaceted construct that has been extensively studied in three main fields: physical anthropology, medicine, and physical education. While there may be slight variations in how these fields define physical fitness, they collectively agree that physical well-being encompasses both physical and mental functions and states. In the context of this present study, physical well-being is specifically defined as the combination of physical fitness and motor skills, offering a comprehensive representation of preschool children's physical development. Physical well-being, as examined in this study, is a multidimensional construct that comprises three important dimensions: physical fitness, fine motor skills, and gross motor skills.

Each of these dimensions plays a significant role in shaping a child's overall physical health and cognitive development.

Physical fitness:

Physical fitness, as defined in the present study, encompasses a wide range of bodily movements performed by skeletal muscles that require energy expenditure (Dwyer et al, 2001). This definition aligns with the concept of physical fitness commonly recognized in the fields of physical anthropology, medicine, and physical education. It includes several key components that contribute to an individual's overall physical health and well-being. In this study, physical fitness is assessed through eight specific aspects, which serve as indicators of various physical abilities: height; weight; standing long jump; crook before the seat body; tennis throw far; both legs jump in succession; 10 meters coming-and-going run; balance beam. The Chinese National Student Physical Fitness Standard battery (Chinese Ministry of Education, 2019) is utilized as the standardized testing method to assess these eight aspects of physical fitness. This battery of tests is a well-established tool in China for evaluating the physical fitness levels of students, including preschool children. The use of this standardized battery ensures consistency and comparability of results across different studies and regions.

Motor skill:

Motor skills are learned sequences of movements that are combined to produce smooth and efficient actions, enabling individuals to master specific tasks. This definition of motor skills aligns with established concepts in the fields of physical education, child development, and motor learning. In the present study, motor skills are assessed using the motor sub-profile of the Early Screening Profiles (ESP). The motor sub-profile of the ESP assesses various motor skills through specific test items, providing a comprehensive evaluation of both gross and fine motor abilities in preschool children. Some of the test items include: walking a straight line, imitating arm and leg movements, tracing mazes, and drawing shapes.

Gross motor skill:

Gross motor skill is an important part of motor skill. Gross motor skill is mainly movements involving large muscles or muscle groups of the body including skills to move the body in space (displacement skills) and skills to control objects (manipulation skills). In the present study, gross motor skill is tested by ESP motor profile involving imitating movements walking forward on the walking line, standing on one foot on the walking line, walking forward heel-to-toe on the walking line and, standing broad jump.

Fine motor skill:

Fine motor skills are indeed a crucial aspect of motor development, particularly concerning the coordination of small muscles in the hands and fingers. These skills are essential for precise and controlled movements that allow individuals to perform tasks that require dexterity and manipulation. Fine movements also include toe movements but fine movements are based on hand movements in this study. In the present study, fine motor skill is tested by a motor profile involving tracing mazes, and drawing shapes.

Cognitive outcome:

Cognitive outcomes are indeed a complex and multifaceted aspect of child development, encompassing various cognitive abilities and academic achievements. These outcomes represent the degree of cognitive development and the performance of children in tasks that require cognitive skills. In the context of the present study, cognitive outcomes are defined as the results of cognitive activities, which include both basic cognitive skills and academic achievements within the kindergarten setting. This comprehensive definition considers various domains of cognitive functioning, offering a holistic perspective on children's cognitive development during early childhood. The cognitive outcomes in the present study are assessed using the

cognitive and language sub-profile of the Early Screening Profile. This assessment likely evaluates a range of cognitive abilities and language skills relevant to preschool-aged children. The specific aspects of cognitive outcomes that are evaluated in the study include: reasoning skills, visual organization and discrimination, receptive and expressive vocabulary, and basic school skills.

Verbal concepts:

In the present study, verbal concepts were tested by a sub-test of cognitive or language profile in Early Screening Profile. Verbal concepts involve both receptive and expressive language ability. For example, the child points to pictures of objects named or described by the examiner and names objects shown or described by examiner.

Visual discrimination:

In the present study, visual discrimination is a subtext of cognitive or language profile in Early Screening Profile. Visual discrimination is measured by nonverbal reasoning ability. For example, the child selects, from several pictures, all the ones that duplicate the stimulus.

Logical relation:

In the present study, logical relation is a subtext of cognitive or language profile in Early Screening Profile. Logical relation is measured by nonverbal reasoning ability. For example, the child points to pictures and solves visual analogies.

Basic school skills:

In the present study, basic school skill is a subtext of cognitive or language profile in Early Screening Profile. Basic school skill is measured by preacademic and beginning academic skills. For example, the child answers questions about number and quantity concepts, and names and recognizes numbers, letters, and words.

Executive function:

Executive function is widely accepted as a higher order cognitive resources that supervises some cognitive functions, however, the specific components involved in executive function are still under debate (Jurado & Rosselli, 2007). In the present study, executive function is defined as a set of operations involving cognitive flexibility, inhibition control and working memory. It will be measured by the

Peabody Executive Function Assessments which is a reliable and valid instrument on child development including executive function.

Inhibitory control:

In the present study, inhibition control involves the ability to suppress or inhibit irrelevant or impulsive responses, thoughts, or behaviors. It enables individuals to exercise self-control and resist distractions, facilitating goal-directed behavior and decision-making. Inhibitory control was tested by a sub-test of The Peabody Executive Function Assessments.

Cognitive flexibility:

In the present study, this component refers to a child's ability to adapt and switch between different tasks, thoughts, or strategies. Cognitive flexibility allows individuals to shift their attention and cognitive resources efficiently based on changing demands and circumstances. Cognitive flexibility was tested by a sub-test of The Peabody Executive Function Assessments.

Working memory:

In the present study, working memory is the capacity to temporarily hold and manipulate information in mind while engaged in cognitive tasks. It is crucial for problem-solving, planning, and carrying out complex cognitive activities. Working memory is tested by a sub-test of The Peabody Executive Function Assessments.

Preschool children:

Preschool children refer to children who are between the ages of three and six years old and are enrolled in preschool education programs. This age range corresponds to the early childhood period, during which children undergo significant cognitive, physical, social, and emotional development.

1.11 Conclusion

The progress of preschool education in China during the 21st century has been remarkable, thanks to the establishment and implementation of relevant policies and promoting programs. As researchers and educators recognize the critical role of physical fitness and motor skills in children's development, there is an increasing call

to investigate the associations between these factors and cognitive outcomes during the preschool years.

Physical fitness and motor skills play an irreplaceable role in ensuring the survival and promoting the growth of preschool children, especially during their early childhood. These skills are essential for adaptive behaviors, physical health, and overall well-being. As a result, it becomes imperative to understand how physical fitness and motor skills relate to cognitive outcomes in this critical developmental stage.

Previous research has explored the links between physical well-being, executive function, and cognitive outcomes separately, but there remains a gap in understanding how these variables interact with each other when studied together, especially within the sample of preschool children. The present study aims to fill this gap by investigating the comprehensive relationships between physical fitness, motor skills, executive function, and cognitive outcomes in preschool children.

The findings of this study will not only benefit researchers by contributing to the existing knowledge about the interplay of physical and cognitive development but also have practical implications for preschools and families. Understanding the importance of physical fitness and motor skills in the context of cognitive outcomes

can inform the development of targeted interventions and physical activity plans to support preschool children's overall performance and development.

Preschools and families can use the research findings to gain a more holistic understanding of their children's development and identify areas that may need additional support. By recognizing the significance of physical well-being in cognitive outcomes, preschools can incorporate more structured physical activities into their curricula to enhance children's overall cognitive and physical growth.

In summary, the present study holds the potential to shed light on the complex relationships between physical fitness, motor skills, executive function, and cognitive outcomes during the preschool years. By investigating these associations, the study can provide valuable insights into the comprehensive development of preschool children and offer practical guidance for promoting their well-rounded growth and success in early childhood education.