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Creative Physical Exercise Program To Improve Motor Movement Physical Fitness And Cognitive Ability In Chinese Preschool Children

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Abstract

Background and Aim: The early childhood stage is the most rapid development in all aspects, this study aims to Create a physical exercise program to improve motor movement physical fitness, and cognitive ability in Chinese preschool children, and to enrich the ways of exercise for young children in Guangdong Province, China.

Materials and Methods: In this study, the content and evaluation tools of the Physical Exercise Program were firstly interviewed with five experts using the expert interview method; secondly, two rounds of the Physical Exercise Program were conducted using the Delphi technique, and finally, the program was confirmed through focus groups. This study was conducted using the expert interview method, the Delphi expert questionnaire.

Results: (1) Through five expert interviews, the Physical Exercise Program covers movement development and fitness.; (2) The results of the first and second rounds of the Delphi Technique questionnaire, 19 experts unanimously agreed on the content of the Physical Exercise Program and the test indexes, with the median being greater than 4 and the quartile being less than 0.5； (3) After the meeting of the 5 experts, it was finally confirmed that the content of the training program included cognitive combined with motor development and physical fitness training.

Conclusion: Following expert interviews and the use of the Delphi technique, the exercise program to promote children's motor, fitness, and cognitive development was found to be feasible after three rounds of endorsement from 19 experts in the fields of sport and cognition.

Keywords: Physical Exercise Program; Motor Movement; 3-6 Years Old Children; Physical Fines; Cognitive Ability; Preschool Children

Introduction

Early childhood is an important age for the brain and cognitive development of children to have a high thirst for knowledge and curiosity, and they like to play with children of the same age, usually in "play" to acquire new knowledge. Providing children with high-quality interventions during this educational period will positively impact their well-being both in mind and body development (Clark & Kingsley, 2020). The development of sports is closely related to the physical and mental health development of preschool children.

Studies have shown that physical education based on the rules of children's motor development can promote the development of children's sensory integration ability (Mellor & Morini, 2023). Evidence supports that exercise can stimulate cognitive development in children, especially those in preschool (Bidzan-Bluma & Lipowska, 2018a). Skills and relationships learned during exercise have a continuous impact on other aspects of children's learning (Bidzan-Bluma & Lipowska, 2018a). The ability to focus attention is improved among children who participate in physical activities. Children who participate in sports activities improve their ability to concentrate. Cross-sectional studies have shown that regular physical activity is better for children's attention development in terms of cognitive flexibility and operational memory (Kubesch et al., 2009). Longitudinal research by Trudeau and Shephard (Trudeau & Shephard, 2008) found a positive correlation between the number of hours devoted to sports and school grades. Children who devoted more time to sports were found to have significantly better grades. One research of 20-min moderate-to-vigorous physical activity (MVPA) facilitated preschoolers' performance of cognitive flexibility (Zhang et al., 2020).

Early childhood sport is the main driving force to promote the healthy development of young children physically and mentally and are also an important element of a strong sports nation. However, the current

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early childhood sports in China started late and have a single mode, which needs to increase the research on early childhood sports. In summary, this study proposes early childhood cognitive sports training for the current research status quo, based on existing research, specifically designed for the growth and development of young children in cognitive sports training programs, young children have cognitive games based on the task to complete the corresponding action tasks, focusing on the development of young children's physical qualities such as balance, coordination, flexibility, sensitivity, endurance, flexibility, etc., and at the same time test the young children's power of observation, Logical thinking ability and memory ability, concentration and other comprehensive ability, for the current stage of early childhood sports training in China to provide theoretical and practical reference, and enrich the Guangdong Province, the lack of means of early childhood sports training.

Objectives

Creative physical exercise program to improve motor movement physical fitness and cognitive ability in Chinese preschool children, enriching Exercise for Young Children in Guangdong Province, China.

Literature review

Exercise has been proven to have a positive impact on preschool children's interpersonal relationships, attention, cognitive development, and academic performance, but many studies have only reported the unilateral results of sports on children, without detailed reports on the psychological changes during children's participation in sports. Children's education should start with "playing". Many studies have also discussed the development of sports games on children's growth, for example, functional sports games promote children's spatial perception ability (Chen et al., 2020), and active sports games are an effective tool to improve children's and adolescents' physical fitness and athletic ability. A 5-month intervention combining AVG with multicomponent training seems to have positive effects on muscle fitness, motor competence, and PA in children with overweight or obesity (Coomera-Chueca et al., 2022). Some studies have shown that sports involve higher cognitive engagement i.e. sports combined with cognitive training. Current research on cognitively-integrated physical activity focuses on patients with dementia or cognitive function (Johansson et al., 2023), and the results agree that it can effectively improve their cognitive, motor, and concentration abilities (Mellor et al., 2023). In recent years, there have also been reviews suggesting that sport combined with cognitive training has a significant effect on executive function in school-aged children (Drozdowska et al., 2022), but there are no data from Chinese studies.

Childhood and adolescence are critical stages of physical and mental development, and the competitive educational system, high parental expectations, and rapidly changing socioeconomic status all place stress on children and adolescents, making this group more vulnerable to mental health problems (O'Connor et al., 2022). Domestic and international studies reveal that the current situation of children and adolescents' mental health is not optimistic, with about 10-20% of children and adolescents worldwide having mental health problems, domestic studies also show that the detection rate of mental health problems among children and adolescents in China is increasing year by year (Duan et al., 2020).

Mental health problems can affect the learning effectiveness of children and adolescents, leading to low interest in learning and lower academic performance, and can even affect the development of children and adolescents later in life, making them lack self-confidence and suffer from mental disorders such as depression, anxiety, and autism; most seriously, children with mental health problems are more likely to develop suicidal thoughts, take suicidal actions, and eventually die. Therefore, paying attention to children's mental health, paying attention to children's nature of "play", and playing in the process of children's growth is crucial. However, they still pay attention to the improvement of children's "functional" results in sports and rarely consider whether children are happy in the process of participating in sports.

In summary, to compensate for the shortcomings of the toddler training program, this study creates a Physical Exercise Program from a cognitive perspective, not only to improve toddlers' motor development and fitness but also to enhance toddlers' cognitive abilities and enrich the training methods for toddlers in Guangdong Province, China.

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Conceptual Framework

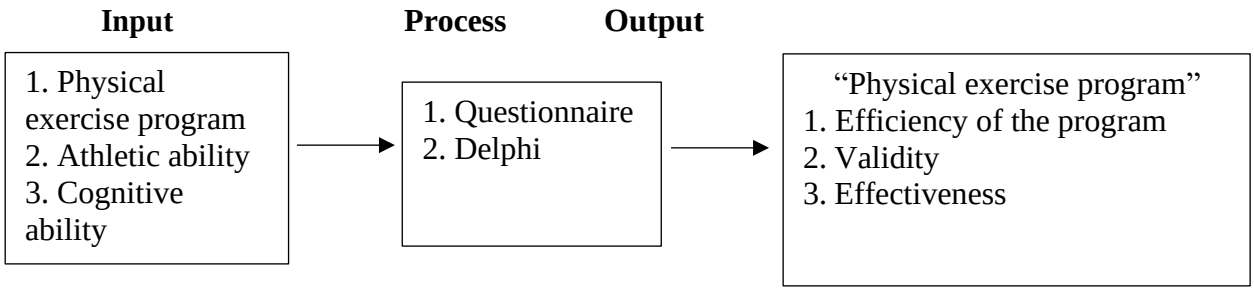

Figure 1 Conceptual Framework

Methodology

Population and sample

The expert interviews covered the concepts, plans, and test metrics of the Physical exercise program and were conducted by a panel of 19 experts, including coaches from the Physical Association, experienced physical education professors from universities, experts in cognitive neuroscience, and principals familiar with early childhood development.

Research Instrument

(1) Expert Interviews: Based on an in-depth review of the literature, experts from Guangdong Province in sports human science, sports rehabilitation, physical education, and cognitive neuroscience were invited to conduct interviews. All of these experts had been engaged in cognitive and sport-related research for more than 8 years, ensuring their authority.

(2) Delphi Questionnaire: Development of a physical exercise program using the Delphi technique, consisting of 2 questionnaires and focus group sessions on a 5-point scale. The 2nd questionnaire was the same as the 1st version of the questionnaire with the addition of recommendations and rationale for each question. There were 19 experts involved, please Appendix 3 for information on experts. The final exercise program was determined through focus groups. Focus group meetings were conducted with the participation of seven experts.

Data collection (Methods and Tools)

(1) Literature review to analyze the content with cognitive and physical training.

(2) Designing physical exercise program content, test indicators, and tools, and inviting 19 experts for the Delphi expert questionnaire in two rounds. Focus group meetings were conducted in the third round to confirm the final physical exercise program.

Data Analysis

The physical exercise program was established using the Delphi technique. In the first round, items with median values of 3.50 and above and inter-quartile ranges of 1.50 and below were considered for selection, using the median and inter-quartile ranges. Round 2 analyzed the data obtained from the expert questionnaires in Round 1, using the median and inter-quartile range for statistical analysis, and considered the selection of items with a median value of 3.50 and above and an inter-quartile range of 1.50 and below. The final training program is determined by a meeting of experts and certification.

Research Process The research will be conducted in the following seven steps:

Step 1: A literature review on children's physiological characteristics and growth and developmental patterns, physical activity styles, and cognitive physical training theories.

Step 2: Collect data, develop test indicators and training program

Based on the experts' opinions, initially formulate the test indicators and training contents of the physical exercise program, analyze and summarize the results, and make reasonable deletions and modifications to the initial training plan, test contents, and training load arrangement. Through several discussions with experts, the training plan and test indexes were finalized.

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Results

1. Results of the Expert Interviews

The open-ended questionnaire answered by the 5 experts in Round 1 can be summarized into two areas:

(1) physical exercise program addresses motor skills including mobility: running, striding, one-legged jump, standing long jump, forward sliding and integrated mobility, and fitness components: explosive power, agility, speed, coordination, reaction, balance, and integrated fitness; and cognitive play including auditory perception and visual perception

(2) Evaluation indicators and tools for cognitive physical training programs include: Gross Motor Development Scale "TGMD-2" (Test of Gross Motor Development) is used for motor development in the motor ability test, "Kindergarten National Physical Fitness Measurement Standard Manual (Early Childhood Section)" for physical ability, and "Indicators for Assessing the Motor Development of Children Aged 3-6" for physical fitness test; Sensory indicators were based on the "Children's Sensory Integration Ability Development Rating Scale";

The Behavioral Rating Inventory of Executive Functioning for Preschool Children (BRIEF-P) was used for the cognitive level test of concentration, the Schulte Scale for the test of attention, the Scratch and Dissolve Test for the test of visual attention stability, and the Proofreading and Correction Sheet for auditory attention stability.

2. Results of Delphi data analysis for round 1

The median and interquartile range values were used for the analyses, as shown in Table 1 and Table 2. The results from Table 3 and Table 4 show that the experts' agreement on the consistency of the physical exercise program is good.

Table 1 Content of physical training for young children

Physical Training content		Median	IQR.
Competence-specific	**Course content**		
Mobility	Cognition + Running	4.00	0.50
	Cognition + Stride	4.00	0.50
	Cognition + Parallel stride	4.00	0.50
	Cognition + forward sliding step	4.00	0.50
	Cognition + hopping on one foot	4.00	0.50
	Cognition + Mobility	4.00	0.50
Physical fitness	Cognition + agility	4.00	0.50
	Cognition + Balance	4.00	0.50
	Cognition + Co-ordination	4.00	0.50
	Cognition + Speed	4.00	0.50
	Cognition + Explosive Power	4.00	0.50
	Cognition + Reaction Time	4.00	0.50
	Cognition + Fitness	4.00	0.50

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Table 2 Physical Training Program Evaluation Indicators and Tools

Indicators and tools for evaluating training programs in cognitive physical training				Median	IQR.
Athletic ability		Movement Development	Gross Motor Development Scale TGMD-2 (Test of Gross Motor Development)	4	0.5
		Physical Ability	Indicators for Assessment of Motor Development of Children Aged 3-6 Years	4	0.5
		physical fitness	Manual of National Physical Fitness Measurement Standards for Kindergartens (Early Childhood Component)	4	0.5
Perceptual		sensory integration	Children's Sensory Integration Development Rating Scale (CSIRS)	4	0.5
Cognitive ability	Concentrate on	executive function	Behavioral Rating Inventory of Executive Functioning for Preschool Children (BRIEF-P).	4	0.5
	Attention	Attention	Table of Schulte.	4	0.5
		Visual Attention Stability	Scratch and Dissolve Quiz Sheets	4	0.5
		Auditory attention	Proofreading and Correction Sheets	4	0.5

As seen in Tables 3 and 4 experts' opinions on the content of cognitive physical training for young children and most of the evaluation indicators and tools are in agreement, and some experts have made suggestions in the context of cognitive physical training to improve the training program based on the content of the training, and to increase the time, period, and intensity of the training programmed. For this reason, this study reviewed the literature based on the second round of experts' opinions, revised the Delphi expert questionnaire on cognitive physical training programs for young children, and conducted the third round of distribution.

3. Delphi data analysis results for round 2

Some studies have shown that cognitive training can be effective in enhancing cognition in the brain, the latest research published in Nature Science shows that Nature (2024) latest research shows that exercising for 8 weeks can change the physical state comprehensively, and moderate intensity has also proved to be the most effective way of exercising for young children, so this study added 8 weeks of 1 hour twice a week to the third round of Delphi questionnaires, and used moderate intensity exercise, and the questionnaire was administered again.

The analyses conducted this time, still using median values and interquartile ranges, are shown in Tables 3 and 4 below. The period, frequency, intensity, and schedule of the training program were unanimously approved by the experts. (Interquartile range = 0.00-0.50)

Table 3 Physical exercise program

Physical exercise content		median	IQR.
Competence-specific	**Course content**		
Training Cycle	8 weeks	0.50	0.50

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Physical exercise content		median	IQR
Competence-specific	Course content		
Weekly Frequency	60 minutes 2 times per week	0.50	0.50
Training Intensity	Moderate intensity, 60-80 percent	0.50	0.50
Mobility	Cognition + Running	0.50	0.50
	Cognition + Stride	0.50	0.50
	Cognition + Parallel stride	0.50	0.50
	Cognition + forward sliding step	5.00	0.50
	Cognition + hopping on one foot	5.00	0.50
	Cognition + Mobility	5.00	0.50
Physical Fitness	Cognition + agility	5.00	0.50
	Cognition + Balance	5.00	0.50
	Cognition + Co-ordination	5.00	0.50
	Cognition + Speed	5.00	0.50
	Cognition + Explosive Power	5.00	050
	Cognition + Reaction Time	5.00	0.50
	Cognition + Fitness	5.00	0.50

Table 4 Physical Exercise Program Evaluation Indicators and Tools

Physical Exercise Program Evaluation Indicators and Tools			Median	IQR
Athletic Ability	Movement Development	Gross Motor Development Scale TGMD-2 (Test of Gross Motor Development)	5.00	0.50
	Physical Ability	Indicators for Assessment of Motor Development of Children Aged3-6 Years	5.00	0.50
	physical fitness	Manual of National Physical Fitness Measurement Standards for Kindergartens (Early Childhood Component)	5.00	0.50
Perceptual	Sensory	Children' Sensory	5.00	0.50

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Physical Exercise Program Evaluation Indicators and Tools			Median	IQR
	Integration	Integration Development Rating Scale (CSIRS)	5.00	0.50
Cognitive ability	Executive Function	Behavioral Rating Inventory of Executive Functioning for Preschool Children (BRIEF-P).	5.00	0.50
	Attention	Table of Schulte.	5.00	0.50
	Visual Attention Stability	Scratch and Dissolve Quiz Sheets	5.00	0.50
	Auditory	Proofreading And Correction Sheets	5.00	0.50

4. Delphi Round 3 from 5 expert professors

Early childhood is the most important developmental period, and it is also the key period of rapid motor development and cognitive development. Traditional physical exercise only takes into account the development of motor ability, and even though there is a lot of research on sports games, it has not yet seen the addition of cognitive content. A cognitive sports training program is a new concept, that can make up for the insufficiency of cognitive studies on early childhood sports in China, as well as enrich the way of early childhood physical exercise in Guangdong Province. The cognitive sports training program is a new concept that can make up for the lack of research related to Chinese children's sports cognition as well as enrich the way of sports exercise for children in Guangdong Province.

Discussion

It has been shown that motor development is the basis for emotional behavior and cognitive development, and the Physical Training Program in this study aims to promote motor, physical fitness, and cognitive development in young children. After expert interviews and Delphi techniques, the content of this research program focuses on the development of cognitive content interventions and intervention programs on top of the existing traditional motor development and fitness training for young children, which is at the cutting edge. Cutting-edge, makes up for the shortcomings of Chinese research and is of theoretical and practical guidance.

Motor development is critical to young children's emotional and cognitive development, influencing a wide range of behavioral and mental abilities. According to research, early motor skills are linked to later cognitive abilities, making physical activity an important component of children's overall development. The Physical Training Program discussed in this study focuses not only on traditional motor development and physical fitness but also incorporates cognitive content into its design, indicating a forward-thinking approach to child development interventions.

This comprehensive program reflects the results of expert interviews and the Delphi technique, which enabled the researchers to incorporate cognitive development strategies into the physical training curriculum. By going beyond traditional motor-focused programs, this study fills a significant gap in Chinese academic literature on early childhood education and development. It also offers theoretical and practical insights for educators and policymakers working to promote holistic child development in China, where similar interventions have received little attention (Xie et al., 2021). The integration of cognitive and motor development interventions exemplifies cutting-edge practice and emphasizes the importance of addressing multiple aspects of a child's development.

Conclusion

Following expert interviews and the use of the Delphi technique, the training program to promote children's motor, fitness, and cognitive development was found to be feasible after three rounds of endorsement from 19 experts in the fields of sport and cognition.

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Recommendation

Children aged 3-6 years are in a period of rapid development, and training programs to promote children's motor, physical, and cognitive development are feasible for further experimental validation and dissemination.

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