

Experimental Study on the Effect of Sports Games on Physical Fitness in Children Aged 4-5 Years

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Abstract

The research aimed to evaluate the impact of sports games on the physical fitness of children aged 4-5 years through an experimental study. Data were collected from 54 children, divided into experimental and control groups, over a 12-week period with a one-hour play session per week. The SPSS 17.0 frequency analysis method was used to analyse the data and compare results between the test and reference groups to assess the effectiveness of the gameplay curriculum on children's physical development. The independent sample T-test findings indicated that the effect of sports games on children's height and weight was insignificant in both pre- and post-tests, suggesting minimal influence on body shape among 4-5-year-olds. However, the effects on physical fitness components, particularly speed, coordination, and flexibility, were significant, demonstrating considerable improvements in these areas. Post-testing results further revealed that sports games significantly enhanced upper and lower limb strength, flexibility, power, and jumping ability in the experimental group. The study, incorporating a conceptual model, presents pioneering findings for children aged 4-5 years, providing valuable insights for policymakers and organizations promoting sports games, and emphasizing the importance of integrating such activities to foster young children's engagement and physical development.

Keywords: Sports Games, Young Children, Physical Fitness, Development.

Introduction

Early childhood represents a critical phase in children's growth and development, characterized by substantial physical and cognitive advancements, where influences during this period profoundly impact their future growth and development (Asmawati, 2023). While body organs and cognitive functions are still maturing, limb development reaches a pivotal stage (Suryadi et al., 2024). During this period, children engage with the world predominantly through physical movement, highlighting the importance of scientifically designed sports games in fostering their holistic development across moral, intellectual, physical, and aesthetic dimensions (Ginanjari, Widyawan, & Faruqi, 2023). These activities not only contribute to children's physical health but also cultivate resilience and a refined sense of aesthetics (Bilal Ahmad Gul, 2023). To truly enhance children's well-being, it is essential to integrate scientifically grounded games into their learning experiences, ensuring that sports and play become integral to their educational journey (Candra et al., 2023).

Sports games play a pivotal role in enhancing physical morphology by promoting muscle development and improving overall body coordination (Feng, Gao, & Liu, 2024). Regular engagement in sports activities contributes to better muscle tone, improved posture, and a more

balanced body composition, thereby reducing the risk of obesity (Ruban et al., 2024). These activities also enhance bone density and joint flexibility, essential factors for maintaining long-term physical health. Empirical evidence suggests that children who participate in sports tend to develop stronger and more agile bodies, which significantly contribute to their physical fitness in adulthood (Čović et al., 2023).

Furthermore, some studies have argued that sports games play a vital role in stimulating hormone production, which can positively impact height during developmental stages (Čaušević et al., 2023). Regular physical activity aids in weight regulation by burning calories and building muscle, thereby promoting healthier weight management and preventing obesity (Folhes et al., 2023). Sports games also enhance children's physical fitness by improving cardiovascular endurance, muscle strength, and flexibility (Ningning & Wenguang, 2023). Movements such as running, jumping, and stretching are integral to these activities, enhancing balance, reaction time, and respiratory function. Collectively, these benefits contribute to increased overall stamina and facilitate the performance of daily activities with greater ease (Astuti & Erianti, 2024).

Empirical studies have examined the impact of sports games on physical fitness and physical morphology;

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however, several research gaps remain. Previous studies have primarily focused on either the effects of sports games on physical fitness (Astuti & Erianti, 2024; Hambali et al., 2024; Ningning & Wenguang, 2023) or their impact on physical morphology (Feng et al., 2024; Luthra, Lal, & Shaw, 2020; Ruban et al., 2024). This study addresses the need to explore the combined impact of sports games on both physical fitness and morphology. Furthermore, prior research has often been limited to specific aspects such as height and weight when examining the effects of sports games, and has inadequately addressed key physical fitness indicators, including flexibility, speed, balance, upper limb strength, and lower limb explosiveness. This study seeks to investigate these specified dimensions of physical morphology and fitness comprehensively. Additionally, existing research has predominantly focused on other countries (Astuti & Erianti, 2024; Feng et al., 2024; Hambali et al., 2024; Luthra et al., 2020; Ningning & Wenguang, 2023), with limited attention given to developing nations, particularly Korea. In China, sports games play a crucial role in the development of children aged 4-5 years, enhancing physical fitness, social skills, and cognitive development, and establishing a foundation for lifelong health and well-being (Gwon & Shin, 2023; Kim & Kuan, 2020). Early involvement in sports also fosters teamwork and discipline at a young age (Gwon & Shin, 2023). Addressing these research gaps, this study focuses on examining the impact of sports games on the physical fitness of 4-5-year-old children in China.

The study highlights key implications based on its findings. In early childhood education, kindergartens should foster children's interest in learning and impart essential knowledge through well-structured and scientifically designed enlightenment courses. Integrating gameplay with sports curricula can help children develop healthy lifestyles, enhance their appreciation of aesthetics and teamwork, and shape positive moral and ideological values. Establishing an effective sports game curriculum during this stage can significantly impact children's growth and development. However, current kindergarten sports curricula are often unstructured and lack scientific grounding. This study, focused on 4-5-year-old children in a national kindergarten in Zhengzhou's new district, investigates the impact of sports game interventions on children's physical quality through theoretical and practical analyses, offering measures to improve physical education. The study is organized into four chapters: literature review, research methods, data analysis and results, and discussion and conclusion.

Literature Review

Definition of Relevant Concepts

Physical fitness is defined as the body's capacity to perform daily tasks and activities with sufficient energy, allowing for engagement in leisure and recreational pursuits and effectively managing emergencies. This study primarily examines the impact of sports games on the fundamental health-related components of children's physical fitness (Kazakov, 2023). According to other researchers, physical fitness refers to a state of physical well-being that enables individuals to efficiently perform daily tasks and participate in sports activities (Suryadi et al., 2023). It includes key elements such as cardiovascular endurance, muscular strength, flexibility, and body composition, all of which contribute to overall health and functional capability (Suryadi et al., 2023). Sports games, on the other hand, are structured activities that combine elements of play, physical fitness, and skill development, utilizing appropriate equipment, intensity, and load to enhance physical fitness, stimulate interest, and provide enjoyment (Kogoya et al., 2023; Ribas et al., 2023). These games integrate sports into playful contexts, engaging children in activities that foster fitness and skill acquisition, ultimately promoting overall physical development through enjoyable and structured gameplay.

In different contexts, the term "school-age children" refers to those who have not yet begun formal schooling. Since school age definitions vary across countries, the age at which children start school is not uniform. Typically, school age ranges from 5 to 6 years, though in some regions, it is defined as 7 years old. For this study, the definition of school-age children aligns more closely with the earlier range (Othman, Mohamed, & Shabib, 2023). Physical fitness encompasses various attributes, including strength, speed, balance, endurance, flexibility, and agility, representing the body's overall performance in daily life and sports. While genetic factors play a role in determining physical fitness, these qualities can also be significantly improved through acquired exercise (Ernazarov & Mavlonova, 2023). Previous research has consistently highlighted the importance of sports games in enhancing both physical fitness and physical morphology.

Empirical Studies and Hypothesis Development

Research on the Influence of Sports Games on Young Children Physical

Numerous studies have highlighted the significance of sports games in enhancing children's physical

development. According to Palao et al. (2024), games are a fundamental aspect of early childhood, serving as the primary form of physical activity for young children. Games significantly contribute to children's physical and mental health, enhancing cognitive abilities, emotional development, and decision-making skills (Mema & Lleshi, 2024). Maulana (2024) further explained that regular participation in physical activities, especially weight-bearing exercises such as running, jumping, and various sports games, can stimulate the secretion of growth hormones crucial for bone growth and height development. Palao et al. (2024) also observed that children engaged in regular physical games exhibited healthier growth patterns compared to their sedentary peers, although the impact on height specifically is often modest and influenced by additional factors like nutrition and overall health. Aksović et al. (2023) emphasized that intellectual development, a critical need for both societal progress and personal growth, is supported by sports games, which promote brain development and enhance cognitive functioning. Thus, sports games play a vital role in supporting children's overall physical growth, including height, while fostering intellectual development.

Zhong et al. (2024) and highlighted the importance of physical games like running and jumping in promoting healthier weight patterns by increasing energy expenditure, which helps prevent excess fat accumulation and supports balanced body composition. Similarly, Arnott (2023) and Astuti and Erianti (2024) found that children who engage in daily physical activities have lower body mass index (BMI) levels, reducing the risk of childhood obesity. Franke and Koch (2023) and also noted a significant relationship between physical activity and weight status, with structured physical games lowering the likelihood of becoming overweight or obese. Guntoro et al. (2023) further demonstrated that incorporating physical games into routines not only aids in weight management but also enhances overall fitness in overweight children. These findings underscore the critical role of sports games in promoting healthy weight management and long-term well-being in children, forming the basis for the following study's hypothesis,

H1: Sports games have a significant difference in weight in the experimental group

H2: Sports games have a significant difference in height in the experimental group

Study on the Influence of Sports Games on Children's Physical Fitness

The impact of sports games on physical fitness components such as speed, flexibility, balance, upper limb

strength, and jumping has been extensively examined in the literature. Rodríguez-Fernández et al. (2023) reported that consistent participation in sports activities significantly enhances flexibility in children and adolescents, primarily due to the dynamic movements and stretching inherent in many sports. Similarly, Sun and Chen (2024) observed that structured sports games, which include various stretching exercises, lead to substantial improvements in flexibility among young children, highlighting the importance of such activities for developing this aspect of physical fitness. Regarding balance, Antara et al. (2023) and found that activities requiring coordinated movements, such as balance beam exercises and hopping games, significantly enhance balance ability, which is crucial during early childhood when neuromuscular coordination is still maturing. Furthermore, Hambali et al. (2024) noted that sports games involving rapid directional changes and postural adjustments contribute to improved balance and overall motor skills. Additionally, Shimray and Pungding (2023) and demonstrated that sports games incorporating throwing, catching, and jumping activities positively influence upper limb strength and jumping ability.

Behm (2024) documented the significant impact of sports game curricula on children's physical development, highlighting that such curricula effectively stimulate children's enthusiasm for participation and align with their natural tendencies. This approach not only engages children actively in sports but also fosters persistence and commitment to regular physical activity. Similarly, Hambali et al. (2024) and emphasized the substantial benefits of sports games in enhancing children's physical attributes, particularly coordination skills. Sports games cater to children's innate activity levels, stimulate motor development, and satisfy their curiosity, thereby encouraging active participation and establishing enduring sports habits. This, in turn, addresses common developmental challenges and contributes to overall improvements in physical fitness.

Numerous studies have examined the effects of specific types of sports games on children's physical quality. For instance, Azra, Suherman and Munir (2024) demonstrated that sports activities involving dynamic stretching and range-of-motion exercises significantly enhance flexibility in children. Arwani and Sukanti (2024) further noted that these flexibility improvements are both immediate and sustained when activities are performed consistently and under proper guidance. Ügüten and Ersöz (2024) found that sports games designed to challenge balance lead to significant enhancements in both static and dynamic balance, which are crucial for motor development. Sharif,

Ramezani and Siavoshy (2024) indicated that activities such as throwing, catching, and pushing within sports games markedly improve upper limb muscular strength. Additionally, Smaal and Lounas (2024) reported that jumping games and plyometric exercises contribute to substantial gains in lower limb explosive power, evidenced by improved performance in standing long jumps and vertical leaps. Collectively, these studies underscore the vital role of sports games in enhancing various aspects of physical fitness in children. Thus, based on the preceding discussion, it is hypothesized that,

H3: *Sports games have a significant difference in speed in the experimental group.*

H4: *Sports games have a significant difference in balance ability in the experimental group.*

H5: *Sports games have a significant difference with upper limb strength in the experimental group.*

H6: *Sports games have a significant difference in Flexibility in the experimental group.*

H7: *Sports games have a significant difference in lower limb explosive power and jumping ability in the experimental group.*

Research Objects and Research Methods

Study Subjects

This study conducts an experimental investigation into the effects of sports games on the physical fitness of children aged 4-5 years. The sample comprises 54 children from Classes Two and Three of Baolong New District Ethnic Kindergarten in Zhengzhou, with Class Two serving as the experimental group and Class Three as the control group. To minimize any potential influence on the results, participants were selected based on their good physical health and the absence of significant injuries.

Study Methods

Literature and Data Method

By accessing widely used Chinese databases, such as VIP and CNKI, and systematically reviewing relevant literature, alongside consulting specialized texts on children's education and physical training, a comprehensive understanding of the principles and practices related to children's physical fitness was developed.

Field Investigation Method

Designating the city as the site for field investigation, we conducted in-depth observations and analyses within kindergartens and children's sports game facilities. This fieldwork provided direct insights into the children's participation in sports games, classroom dynamics, and curriculum design.

Interview Method

An outline was developed for interviews with various stakeholders, including the managers and coaches of children's sports game halls and kindergarten principals. These outlines were utilized to gather first-hand data on the operation and management of sports programs. The detailed interview protocols are included in Attachments I, II, and III.

Data Statistics Method

Utilizing SPSS software, frequency analysis was performed to assess changes in physical shape and quality in both the experimental and control groups before and after the exercise intervention. Independent samples were analysed to identify significant differences, thereby evaluating the effectiveness of sports games in enhancing the physical development of children aged 4-5.

Experimental Method

Experimental Site

A kindergarten located in Zhengdong New District, Zhengzhou City, encompasses an area of 300 square meters and is equipped with comprehensive functional facilities.

Survey Subjects

Fifty-four middle-class children aged 4-5 from Zhengdong New District Ethnic Kindergarten in Zhengzhou City were selected for the study. The participants were divided into an experimental group (Class Two) and a reference group (Class Three), each comprising 20 boys and 7 girls. All children in the study voluntarily participated, were in good health, well-developed, possessed the physical attributes required for the experiment, and were capable of independently performing the movements specified in the experimental curriculum.

Experimental Implementation Personnel

The experimental group's activities are primarily conducted by professional instructors from a children's physical training company, whereas the control group is instructed by the kindergarten's regular teachers.

Experimental Time

The experiment spanned 12 weeks, with training sessions conducted twice weekly for 45 minutes each. Both the experimental and control groups received training from 10:00 AM to 10:45 AM on Mondays and from 3:00 PM to 3:45 PM on Thursdays.

Experimental Content

Both the experimental and control groups received instruction twice a week according to the teaching syllabus. Data were collected and recorded following the 12-week intervention period. Subsequently, the data were analysed and organized to draw conclusions.

Table 1

Course Content of the Experimental Group Table 2. Course Content of the Control group

Process Arrangement	Temporal Arrangement	Content Arrangement
	Prepare part 5min, game warm-up	
	Basic part 25min Physical fitness training	
	Relax part 15min relaxation massage	
Process Arrangement	Temporal Arrangement	Activity Content
	Prepare part of the 10min running warm-up + simple joint exercises	
	Basic part 25min small game + equipment	
	End the part with 10min free activity	

Specific Content of the Experiment

Specific Steps of the Experiment

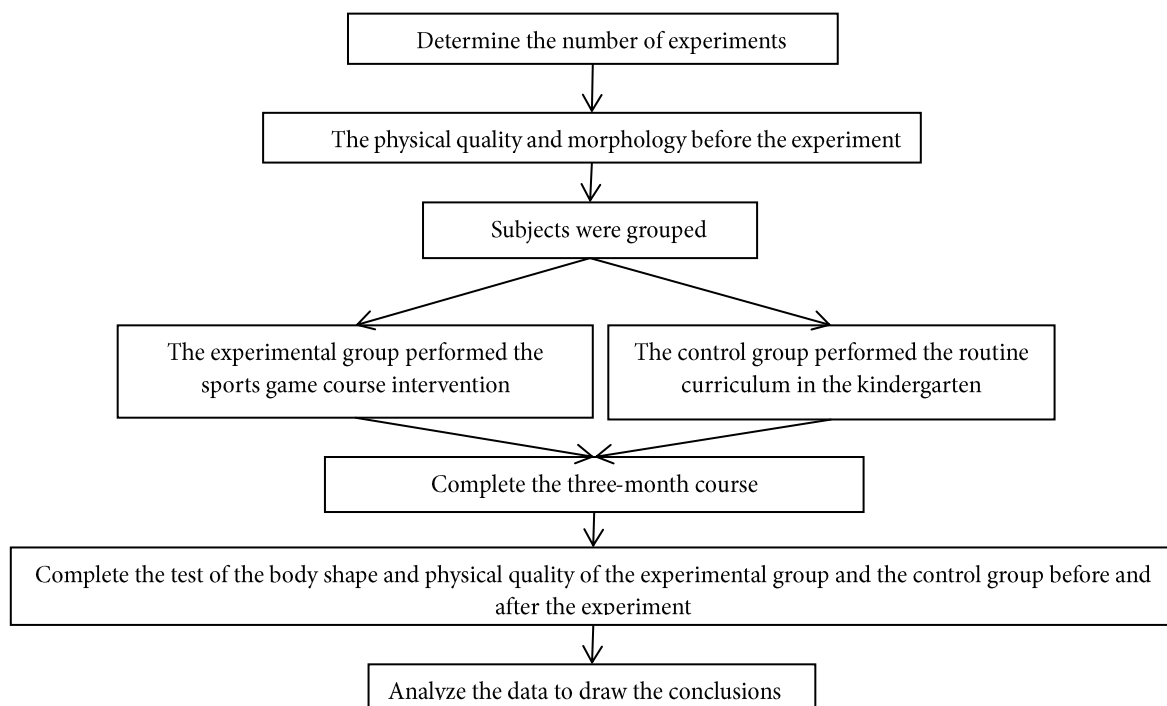


Figure 1: Schematic Representation of the Experimental Procedure.

Test Indicators and Methods of the Experiment

Experimental Indicators

In accordance with the national Physical Fitness Measurement Standard Manual for Children, this study evaluates both body morphology and physical fitness. The physical fitness assessments include six tests: the 10-meter return run, tennis ball throw, continuous foot jumps, seated forward bend, standing long jump, and balance beam. Body morphology is assessed through measurements of height and weight.

Experimental Instruments

In compliance with national physical fitness testing regulations, standardized measurement instruments were utilized. These included a height and weight meter, stopwatch, measuring tape, balance beam, and a seated

forward flexion tester.

Test Method

Prior to measurement, the physical fitness testing protocols were explained to the participants to ensure they understood the correct procedures. This preparation aimed to facilitate accurate and reliable evaluation data.

Results and Analysis

Arrangement of Exercise Load in the Experimental Group

In this study, to ensure that the exercise load remained within a reasonable range, heart rate changes were monitored for four randomly selected children. The procedure involved the following steps: measuring the

resting heart rate for 3 minutes before training, monitoring the heart rate during the exercise, and recording the heart rate for 5 minutes after completing the training. Adjustments to the exercise load were made based on real-time observations of the children to achieve the desired

exercise intensity for the experimental group. Ideally, the heart rate was maintained between 140 and 170 beats per minute. Table 3 presents the subjective performance observations of the children during exercise.

Table 3

Reference Table for Physiological Load Evaluation of Exercise Intervention in Young Children

Metric	Grade		
	Mild Fatigue	Moderate Fatigue	High Fatigue
Colour of face	A Little Red	Compare Red	Very Red or Pale
Volume of Perspiration	Thin Sweat	More	Sweat a Lot
Breathe	Normal	Fast	Short of Breath and Disordered Rhythm
Spirit	Joyful	A Little Tired	Tired

Note: From Ren Qi's *Preschool Children's Sports and Health*, 2012

Analysis of the Influence of Sports Games on the Physical Morphology of Children Aged 4-5 Years

Analysis of the Influence of Sports Games on Height

The results of the height measurements for the experimental and control groups post-intervention are presented in Figure 2 and Table 4. Following the exercise intervention, the experimental group experienced an increase in height from 106.92 cm to 110.96 cm, a change of 4.04 cm, while the control group saw an increase from 107.3 cm to 110.9 cm, amounting to 3.6 cm, indicating that the intervention positively influenced height growth. Specifically, the female experimental group increased

from 105.94 cm to 108.28 cm (2.34 cm), and the female control group increased from 105.57 cm to 108.72 cm (3.15 cm), reflecting similar effects. However, the overall impact of the exercise intervention on height for children aged 4-5 years was not markedly significant in the short term. Prior to the intervention, the P-values for height changes were 0.752 for the male experimental group versus the control group and 0.985 for the female experimental group versus the control group, both indicating no significant differences. In conclusion, while the sports game course contributed to height increases in children aged 4-5 years, the short-term effects were not statistically significant.

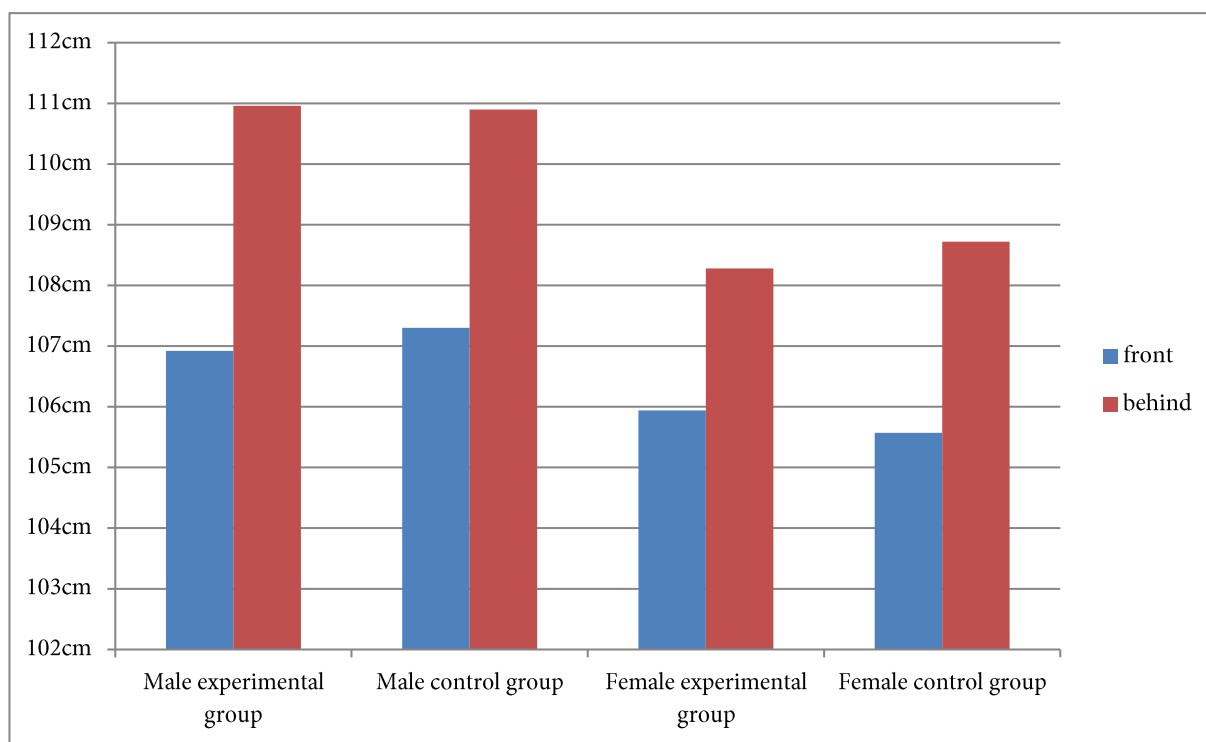


Figure 2: Analysis of the Effect of Exercise Intervention on the Body Height of Young Children.

Table 4

Control Table of Height Measurements of Control and Experimental Groups (unit: cm)

		Experimental Group			Control Group			P Price
		N	Mean	SD	N	Mean	SD	
Men	Before	20	106.92	4.383	20	107.3	4.053	0.752
	Experiment	20	110.96	4.523	20	110.9	3.547	0.985
Women	Before	7	105.94	6.084	7	105.57	5.307	0.905
	Experiment	7	108.28	5.170	7	108.72	4.750	0.874

Analysis of the Influence of Sports Games on Body Weight

The results of the weight measurements for the experimental and control groups following the exercise intervention are illustrated in Figure 3 and Table 5. Prior to the intervention, the weight of the male experimental group increased from 17.61 kg to 19.00 kg, a change of 1.39 kg, while the male control group saw an increase from 17.36 kg to 18.92 kg, or 1.56 kg. These findings

suggest that the exercise intervention could exert some control overweight gain in young children. For the female groups, the experimental group increased from 17.21 kg to 18.01 kg, a change of 0.79 kg, whereas the control group increased from 18.01 kg to 18.94 kg, a change of 0.93 kg, indicating a similar control effect of the intervention. Overall, the impact of the exercise intervention on weight for children aged 4-5 years appears minimal, which may be attributed to the short duration of the experiment.

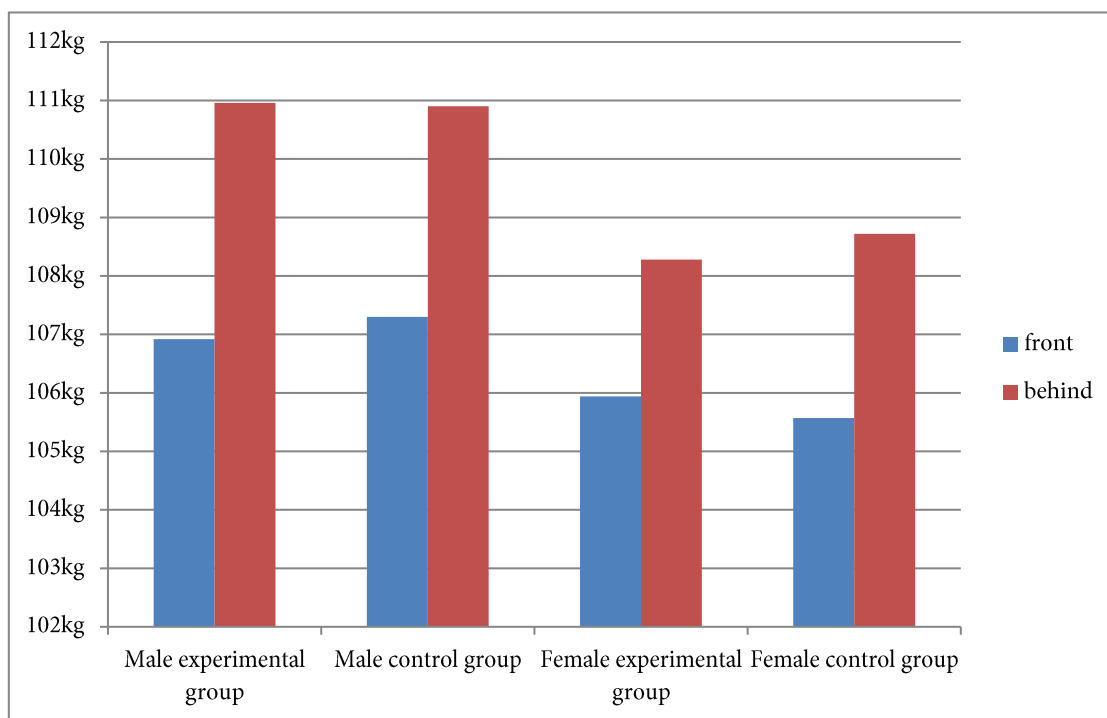


Figure 3: Analysis of the Effect of Exercise Intervention on Body Weight in Young Children.

The P-values for the male experimental and control groups were 0.764 before the sports game intervention and 0.935 after the intervention, indicating no significant differences. For the female groups, the P-values were 0.904 before the intervention and 0.590 after the intervention, also showing no significant differences. Thus, while the sports game course did lead to some changes in weight among children aged 4-5 years, these effects were not significant over the short term.

Analysis of the Influence of Sports Games on the Physical Fitness of Children Aged 4-5 Years Old
Analysis of the Influence of Sports Games on Speed and Sensitivity Quality

The sensitivity quality of students in both the experimental and control groups was assessed, with the results presented in Table 6 and Figure 4.

Table 5

Summary of Weight Difference Test Results Between Control and Experimental Groups (unit: kg)

sex		Experimental Group			Control Group			P Price
		N	Mean	SD	N	Mean	SD	
Men	Before Experiment	20	17.61	2.584	20	17.36	2.375	0.764
	After Experiment	20	19.00	2.833	20	18.925	2.957	0.935
Women	Before Experiment	7	17.214	4.386	7	18.014	3.2637	0.904
	After Experiment	7	18.014	3.263	7	18.942	2.998	0.590

Note: The comparison between experimental group and control group showed that the P figure of experimental group and control group was greater than 0.05.

Table 6

Summary of 10-Meter Return Runs of Control and Experimental Groups (Unit: S)

	Experimental Group (N=27)	Control Group (N=27)	P Price
	Mean	Mean	
Pre-Experimental Measurement	11.09±1.354	11.22±1.323	0.739
Experimental Post-Test	8.48±1.233	10.07±1.149	<0.001
P Price	<0.001	0.671	

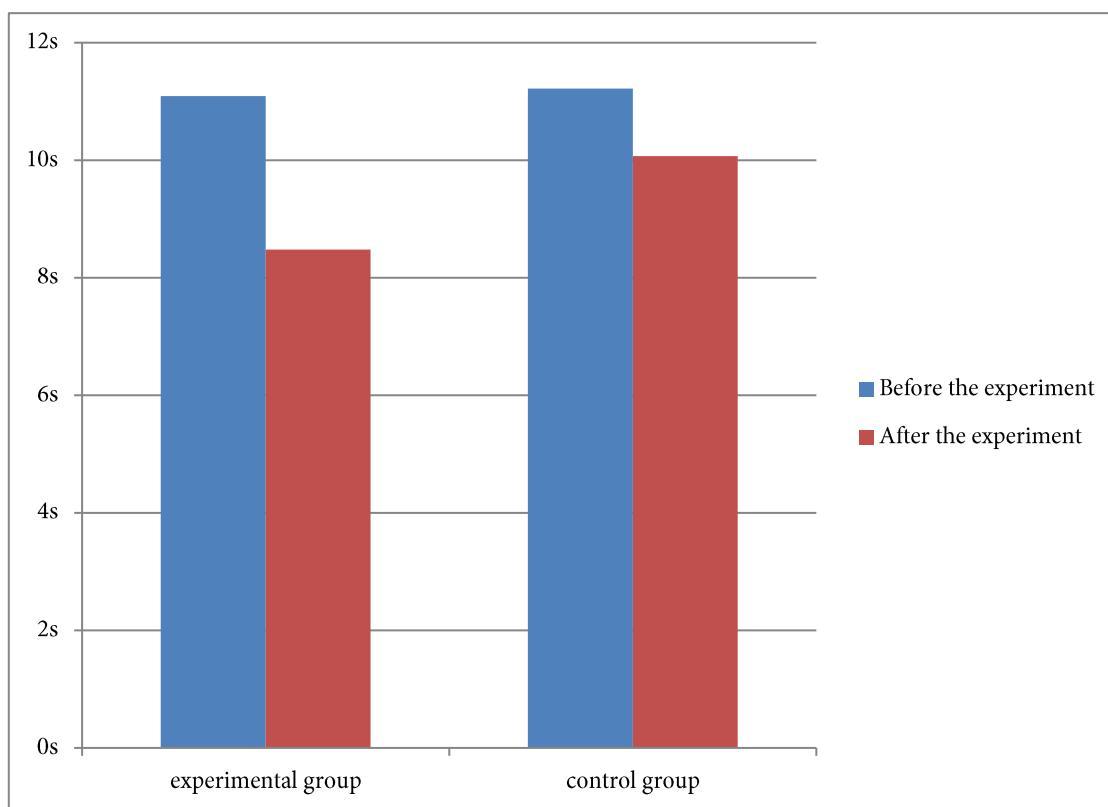


Figure 4: Effect of Exercise Intervention on Speed.

Following three months of intervention, the test results for speed quality in both the experimental and control groups revealed a significant difference ($P < 0.001$), indicating a notable impact of the sports game course on the speed quality of children aged 4-5 years. This effect was consistent across genders. Additionally, continuous two-foot jumping, a movement that engages full-body strength and reflects coordination and lower limb muscle strength,

was assessed. The results, detailed in [Table 7](#) and [Figure 5](#), demonstrated a marked improvement in continuous two-foot jumping performance. Gender-based analysis revealed a significant effect for boys ($P = 0.02$, $P < 0.05$), while the improvement for girls was not statistically significant ($P = 0.08$). This indicates that the sports game course notably enhanced two-foot jumping performance, with a more pronounced effect observed in boys.

Table 7

Summary of Continuous Jump Test Results of Control and Experimental Groups (Unit: S)

	Experimental Group (N=27)	Control Group (N=27)	P Price
	Mean	Mean	
Pre-Experimental Measurement	6.73±1.32	6.74±1.19	0.998
Experimental Post-Test	5.12±0.99	6.16±1.10	0.002
P Price	<0.001	0.577	

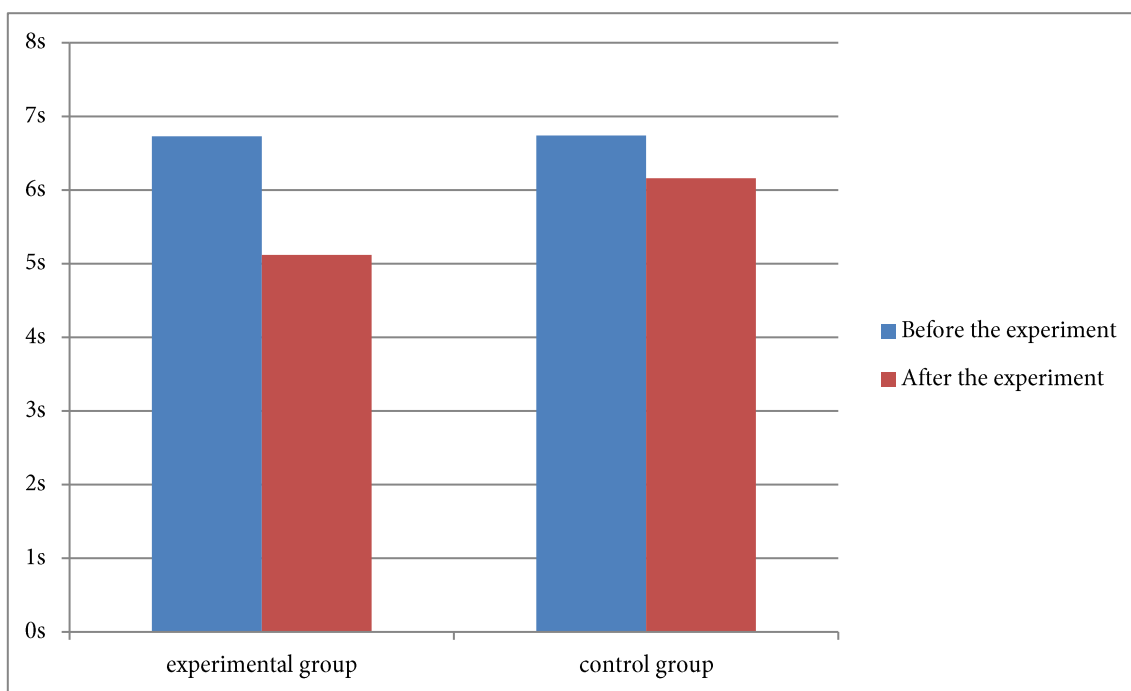


Figure 5: Analysis of the Effect of Exercise Intervention on Sensitivity.

Following the exercise intervention, statistical analysis revealed significant improvements in both continuous two-foot jumping and the 10-meter return run, with P-values of 0.002 and less than 0.001, respectively, indicating statistically significant differences ($P < 0.05$). Over the three-month period, the experimental group experienced a reduction in average time by 2.61 seconds, representing a 22.57% improvement, while the control group achieved a reduction of 1.15 seconds, with a 10.25% improvement. Similarly, in continuous two-foot jumping, the experimental group showed an average time improvement of 1.61 seconds and a growth rate of 23.89%, compared to the control group's

improvement of 0.58 seconds and a growth rate of 9.84%. These results demonstrate that the sports game curriculum significantly enhances both speed and sensitivity quality in children aged 4-5 years, with targeted sensitivity and speed training showing more pronounced effects.

Analysis of the Influence of Sports Games on Balance Ability

The balance beam test serves as a precise measure of children's balance ability. The results of the balance ability assessments conducted before and after the exercise intervention are presented in Table 8 and Figure 6.

Table 8

Summary of Balance Am Scores of Controls and Experimental Groups (Unit: S)

	Experimental Group (N=27)	Control Group (N=27)	P Price
	Mean	Mean	
Pre-Experimental Measurement	15.63±14.448	14.81±12.61	0.831
Experimental Post-Test	8.22±6.203	13.70±11.572	0.35
P Price	0.018	0.713	

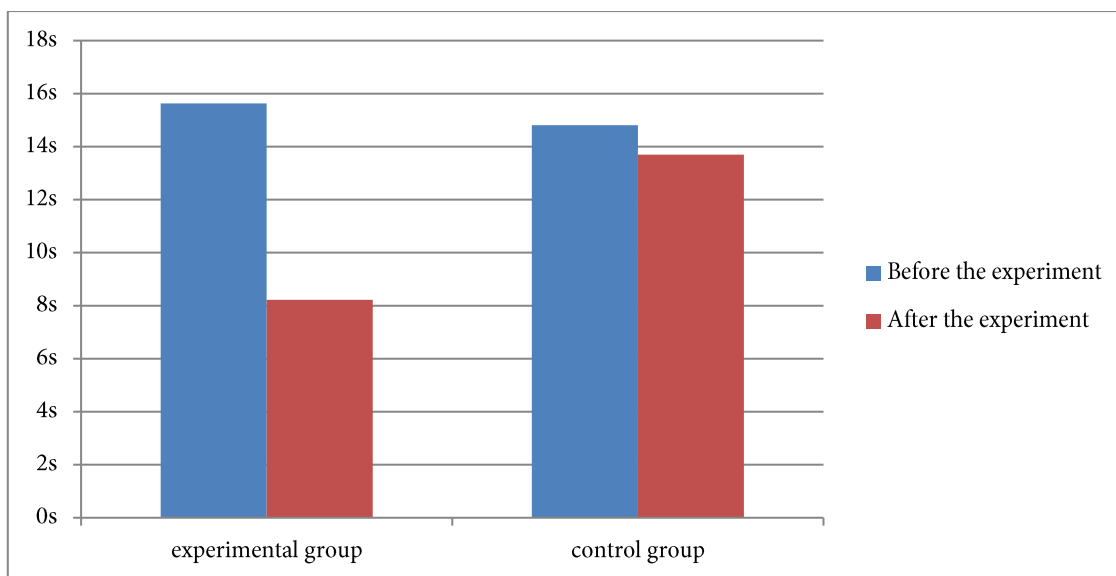


Figure 6: Effect of Sports Games on Balance Ability.

The balance beam test showed a significant difference post-intervention, with a P-value of 0.018, indicating improvement in balance ability. The experimental group saw a 7.41-second reduction in average completion time (47.41% improvement), compared to a 1.11-second reduction (6.08%) in the control group. The P-value for the control group was 0.713, and there was a gender difference in the experimental group, with boys showing a more significant improvement (P=0.021). Overall, the sports game course positively impacted balance ability, particularly in boys.

Analysis of the Influence of Sports Games on Upper Limb Strength

The tennis program evaluates upper and lumbar strength, as well as physical coordination. After a three-month intervention, the test results (see Table 9 and Figure 7) indicate a significant difference, with a P-value of 0.011 for both the experimental and control groups, which is below the 0.05 threshold. This result suggests a notable effect of the intervention. Additionally, no significant gender differences were observed.

Table 9

Summary of Control and Experimental Groups (Unit: M)

	Experimental Group (N=27)	Control Group (N=27)	P Price
	Mean	Mean	
Pre-Experimental Measurement	5.78±0.650	5.74±0.677	0.807
Experimental Post-Test	8.28±0.870	5.95±0.77	0.011
P Price	<0.001	0.290	

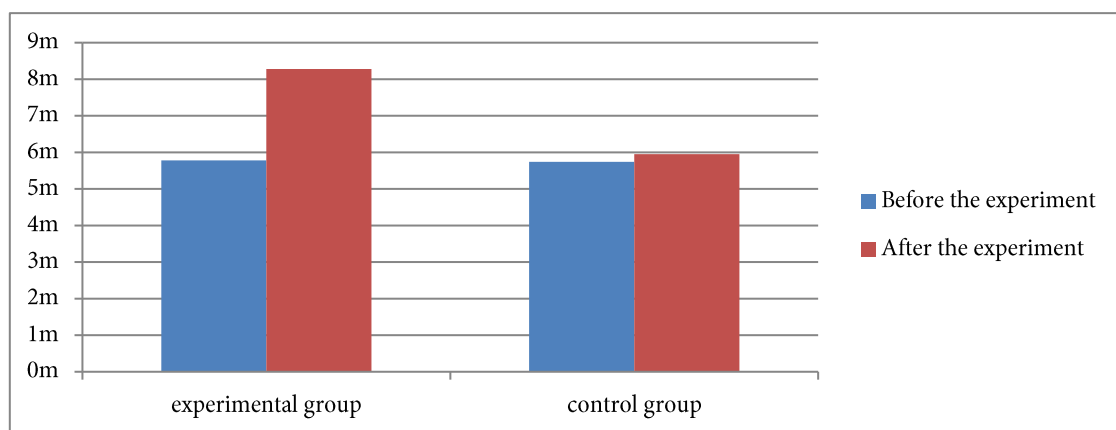


Figure 7: Analysis of the Impact of the Exercise Course Intervention on Upper Limb Strength

The P-value for the tennis throwing test was 0.001 ($P < 0.05$), indicating a significant difference. Following the intervention, the experimental group's average throwing distance increased by 2.5 meters, representing a growth rate of 43.25%. In contrast, the control group experienced a 0.21-meter increase with a growth rate of 3.65%. These results suggest that sports game courses effectively enhance upper limb strength in children aged 4-5 years, with more pronounced improvements observed in the targeted training group.

Analysis of the Influence of Sports Games on Flexibility

As indicated by Table 10 and Figure 8, the post-intervention P-value was 0.008 ($P < 0.05$), demonstrating a significant difference. Notably, gender-specific differences were observed: the P-value for males was 0.003 ($P < 0.05$), while for females it was 0.18 ($P > 0.05$). These results suggest that sports game courses significantly impact the quality of physical fitness in boys aged 4-5 years, though the effect was not significant for girls.

Table 8

Summary of Control and Experimental Groups (Unit: Cm)

	Experimental Group (N=27)	Control Group (N=27)	P Price
	Mean	Mean	
Pre-Experimental Measurement	6.82±5.11	6.157±4.72	0.618
Experimental Post-Test	10.56±4.83	6.195±4.57	0.001
P Price	0.008	0.977	

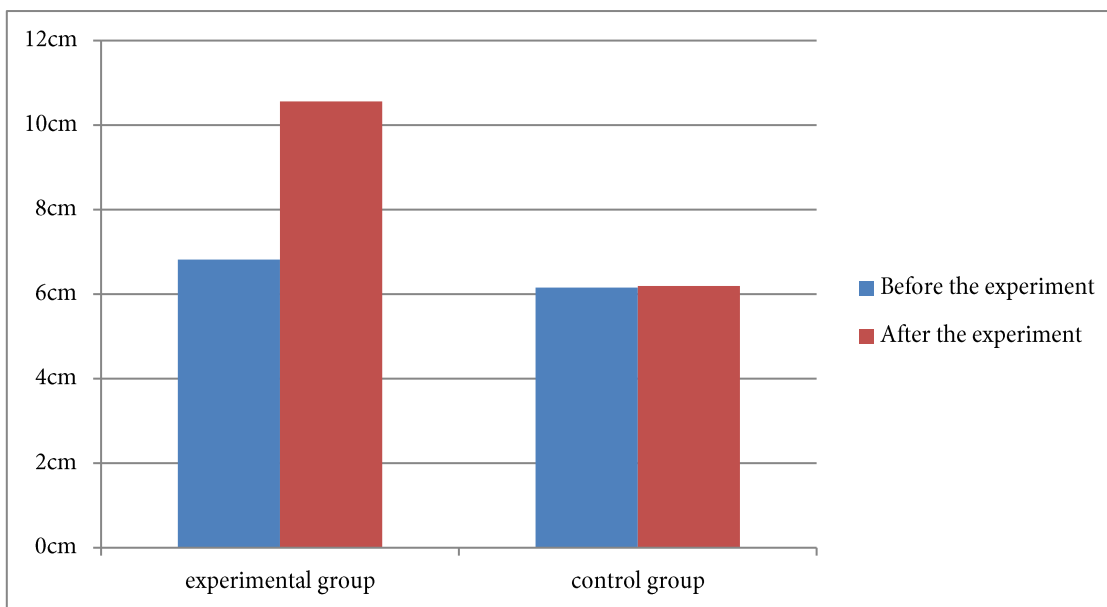


Figure 8: Analysis of the Effects of the Exercise Course Intervention on Ductility and Flexibility.

In the experimental group, the average increase in the sitting forward bend test was 3.74 cm, representing a 54.9% improvement. Notably, boys in the experimental group demonstrated a more pronounced effect, with an average increase of 3.77 cm and a 63.8% growth rate. In contrast, the control group showed minimal progress and, in some cases, a decline in performance. This highlights that while 4-5 years is a critical period for developing flexibility, inappropriate training can hinder flexibility development. It is crucial for training to be conducted gently, with movements designed to promote blood circulation and aid muscle recovery. Additionally, stretching should be performed with appropriate force and gradually increased

to avoid injury, with ongoing guidance to improve range safely.

Analysis of the Influence of Sports Games on Lower Limb Explosive Power and Jumping Ability

The standing long jump test evaluates jumping ability, coordination, and lower limb strength. The test results, presented in Table 11 and Figure 9, indicate that after three months of intervention, the standing long jump scores for children aged 4-5 years had a P-value of 0.524, which is greater than 0.05. This suggests that the intervention did not yield statistically significant improvements in standing long jump performance.

Table 11

Summary of Standing Long Jump Results of Control and Experimental Groups (unit: Cm)

	Experimental Group (N=27)	Control Group (N=27)	P Price
	Mean	Mean	
Pre-Experimental Measurement	72.89±8.36	72.84±9.62	0.806
Experimental Post-Test	81.00±6.83	75.26±7.71	<0.001
P Price	0.524	0.507	

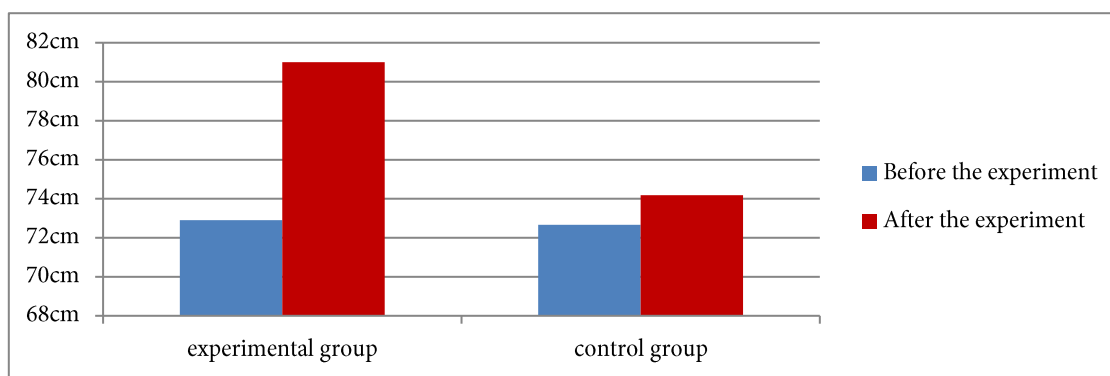


Figure 9: Analysis of the Effects of Exercise on Explosive Power and Jumping Ability.

The experimental data indicated that the standing long jump performance of the experimental group significantly improved after three months of intervention, with an average increase of 8.11 cm (10.2%). In contrast, the control group showed a smaller improvement of 2.42 cm (3.4%). Despite these improvements, the P-value for the standing long jump was 0.524, indicating no statistically significant difference between the groups. The limited exercise load and short duration of the intervention may have constrained the effectiveness of lower limb strength training. Consequently, it is recommended to adjust the lower limb strength training components within the sports game curriculum to enhance its impact.

Discussion

The research aimed to assess the impact of sports games on the physical fitness of children aged 4-5 years, specifically examining its effects on physical morphology, including height and weight. The findings revealed that while the experimental group exhibited slight increases in both height and weight, these changes were statistically insignificant. The minimal growth observed suggests that the three-month duration of the sports game's intervention may have been insufficient to produce significant physical changes. Physical growth in young children is influenced by a multifaceted interplay of genetics, nutrition, and physical activity, with sustained engagement over extended periods often required to achieve notable improvements. According to a prior study, which indicated that interventions targeting growth

parameters such as height and weight generally require several months, if not years, to effect substantial changes (Ahmed et al., 2022; Liu et al., 2024). Therefore, the modest increases observed in this study suggest that while physical activity is beneficial, its impact on growth may be incremental and necessitate prolonged intervention to yield more significant results.

The subsequent section of the study evaluated the impact of sports games on the physical fitness of children aged 4-5 years, focusing specifically on speed and agility. The results demonstrated a significant enhancement in these motor skills among the experimental group, indicating that the structured physical activities embedded in the sports games were effective in improving speed and agility. These components are crucial for physical development at this stage, and the notable improvements observed suggest that the sports games provided a substantial stimulus for skill development. This finding aligns with the prior literature, which similarly report that physical activities involving running, jumping, and rapid directional changes can markedly enhance motor skills in preschool-aged children. The results revealed gender differences, with boys showing greater improvements in balance and speed. This discrepancy may be attributed to differing developmental trajectories between boys and girls, as noted by prior literature that depicts that gender-specific approaches might be needed to optimize physical education benefits for early childhood.

The study examined the impact of sports games on upper limb strength and flexibility, revealing an insignificant

relationship between sports activities and these physical attributes before intervention. However, post-intervention results demonstrated a significant improvement in upper limb strength. These findings underscore the effectiveness of structured play in targeting specific muscle groups and enhancing physical coordination in young children. Upper limb strength and flexibility are essential for activities ranging from basic tasks like throwing and catching to more complex movements requiring fine motor control. The study aligns with [Bouguezzi et al. \(2023\)](#), who found that early childhood physical interventions significantly enhance muscle strength and flexibility. Nevertheless, the study highlights the need for caution in designing age-appropriate exercises to avoid potential injuries or developmental issues, as emphasized by [Behm \(2024\)](#).

The impact of sports games on explosive power and jumping ability showed significant improvements in the experimental group post-intervention, whereas changes in the control group were not significant. These results indicate that while sports games positively affected lower limb strength and jumping ability, the brief duration of the intervention may have constrained the extent of these benefits. Developing lower limb explosive power often requires specialized exercises targeting muscle strength and coordination, which may not be fully addressed by general sports activities. This finding aligns with [Hardiyono et al. \(2023\)](#), who noted that substantial improvements in lower limb strength and explosive power typically require extended, focused training. The study highlights the need for a balanced approach in physical education programs, suggesting that while general physical activities are beneficial, targeted interventions are crucial for achieving specific developmental objectives, particularly in enhancing lower limb strength and explosive power.

Implication and Future Directions

The study contributed from both of theoretical and practical perspective based on study findings.

Theoretical Implications

The study offers several theoretical contributions. First, it adds to the existing body of knowledge on early childhood physical development by empirically demonstrating the effects of structured sports games on various physical fitness attributes in children aged 4-5 years. As one of the pioneering studies in this specific age group, it enhances the theoretical understanding of how targeted physical activities can influence young children's growth and development. Second, the findings support established theories emphasizing the critical role of early physical

activity in motor skill development, coordination, and overall physical fitness. Third, the observed gender differences highlight the need for gender-sensitive approaches in physical education, offering new insights into how interventions may vary in their impact on boys and girls. Fourth, the significant findings provide a foundation for future research, particularly in exploring the long-term effects of early physical activity interventions. This suggests that the impact of sports games may be more pronounced over extended periods, potentially leading to more substantial improvements in physical fitness. Lastly, the study contributes an extended framework that may assist future researchers in designing and conducting similar investigations, further advancing the field of early childhood physical education.

Practical Implications

The study has several practical implications for early childhood education and physical fitness programs. It provides insights for educators, policymakers, and caregivers to design effective physical activity programs tailored to the developmental needs of children aged 4-5 years. The positive impact of sports games on speed, balance, and upper limb strength suggests that incorporating such activities into daily routines can enhance these key aspects of physical fitness. Additionally, the study underscores the importance of considering gender differences in physical activity interventions to ensure benefits for both boys and girls. It also highlights the need for sustained targeted interventions to improve areas like lower limb explosive power. Overall, the findings support the inclusion of structured sports games in early childhood curricula to promote physical fitness and healthy development.

Conclusion and Future Suggestions

The research investigated the impact of sports games on the physical fitness of 4-5-year-old children. The study provided a detailed analysis of various physical attributes, demonstrating that while short-term sports game interventions did not significantly affect height and weight, they positively impacted other critical areas of physical fitness. Specifically, children in the experimental group showed substantial improvements in speed, balance, motor coordination, upper limb strength, and flexibility compared to the control group. These findings underscore the potential of sports games as a valuable component of early childhood physical education programs. However, the study has limitations that warrant future research. Notably, the study observed less significant gains in lower limb explosive power, suggesting that a more targeted approach might be necessary. Additionally, the research

did not include regression analysis, which could enhance the study's predictive power. Future studies should consider incorporating moderating and mediating variables using Likert scales to explore a broader range of findings.

The study offers several recommendations. First, given the observed gender differences in balance and flexibility, further research should explore how exercise intervention, gender, and physical quality interact. Additionally,

addressing children's fear during balance beam tests through psychological counselling could improve results. Educational institutions should innovate curricula to enhance children's interest in sports, focusing on multidimensional effects such as speed, sensitivity, and competitiveness. Ensuring safety and managing exercise load is crucial, so teachers should closely monitor and adjust exercise intensity based on children's physiological responses.

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