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Comparing the Effect of Structured Physical Games, Sports Vision Training, and Spark on the Components of Motor Skills in Children Aged 8 to 10

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ABSTRACT

Purpose: The purpose of this study was to compare the effects of different motor interventions, including structured physical games, the Spark program, and sports vision training, on improving motor skills in children.

Methods and Materials: This research is a quasi-experimental study with a pretest-posttest design and a control group. The study population consisted of female elementary school students (age: 8.81 ± 0.77 years, height: 134.40 ± 7.97 cm, weight: 35.28 ± 8.77 kg) from Region One of Khorramabad City who were enrolled in the 2023-2024 academic year. The participants were 72 children aged 8 to 10 years, randomly assigned to four groups of 15 (structured physical games, Spark program, sports vision training, and control). The short form of the Bruininks-Oseretsky Test of Motor Proficiency was used to measure the components of motor skills. The structured physical games program was adapted from Al-Harndoon and Roberts (2020). The Spark program utilized the protocol of Moghaddamloo et al. (2014) and Mati' et al. (2017). The sports vision training protocol was based on the study of Clark et al. (2020). Data analysis was conducted using ANCOVA, and Bonferroni post-hoc tests were applied for pairwise comparisons of groups via SPSS software at a significance level of $p < 0.05$.

Findings: The results indicated that structured physical games had a more significant effect on speed, agility, balance, bilateral coordination, and muscular strength compared to other groups ($p > 0.05$). The Spark group also showed improvements in some skills, but its performance in specific components such as speed and agility was lower than that of the structured physical games group. Sports vision training demonstrated limited effects and showed no significant differences from the control group in most skills.

Conclusion: Overall, the findings emphasize the importance of designing structured, purposeful, and challenging exercises to enhance motor skills in children.

Keywords: *Gross and fine motor skills, structured physical games, Spark program, sports vision training, children*

1. Introduction

Childhood is a critical period for the development of motor and social skills, which serve as the foundation for an individual's future learning and interactions (Gallahue, 2006; Gallahue & Ozmun, 2006; Gallahue & Goodway, 2012). During this time, children aged 8 to 10 years are in a sensitive phase of motor development, where neural-muscular coordination, balance, and fundamental motor skills such as running, throwing, and catching rapidly improve (Moghaddari Esfahani, 2023; Mohammadian & Mazaheri Tirani, 2024). These skills play a vital role in children's participation in physical and sports activities (Barnett, 2016). Gross and fine motor skills are considered essential foundations for child development, significantly influencing their physical, cognitive, and social growth (Clark & Divine, 2020; Clark & Metcalfe, 2002). Fundamental motor skills are divided into two main categories: gross motor skills and fine motor skills, both of which are critical in the developmental process of children. Gross motor skills involve control and coordination of large body movements, such as running, jumping, throwing, and balance, forming the basis of many physical and sports activities (Clark & Divine, 2020; Clark & Metcalfe, 2002). These skills enable children to move effectively in their environment and actively participate in games and daily activities. In contrast, fine motor skills refer to precise hand and finger abilities necessary for delicate tasks such as writing, drawing, buttoning clothes, and manipulating small tools (Case-Smith & O'Brien, 2014). Proper development of these skills during childhood lays the groundwork for learning more complex skills in school and plays a significant role in academic success and personal independence (Piek et al., 2008). Research indicates that the coordinated development of gross and fine motor skills is directly related to children's cognitive and social development. For example, improved motor skills enhance children's self-confidence, strengthen social interactions, and increase participation in group activities (Moghaddari Esfahani, 2023; Mohammadian & Mazaheri Tirani, 2024; O'Connor & Murphy, 2022). Additionally, motor skills play a crucial role in the development of executive brain functions, including attention, working memory, and behavioral control, all of which are essential for academic success (Best, 2010).

Children aged 8 to 10 years are in a sensitive period of motor skill development that can determine their future health and capabilities (Gabbard, 2011). Impairments or weaknesses in these skills may lead to reduced self-confidence, decreased participation in physical activities, and social challenges (Barnett, 2016). Recent studies show that only 21% of children and adolescents aged 6 to 10 globally meet the minimum recommended level of physical activity (60 minutes of moderate to vigorous daily activity) set by the World Health Organization (Gonzalez-Silva & Fernandez-Echeverria, 2021; Jokar Tang Karami & Bagherzadeh, 2017). This study, based on data from 298 population-based research with 1.6 million participants, highlights a global crisis of physical inactivity in this age group. Comparative analyses reveal significant differences in physical activity levels among different genders and across countries and geographical regions (Abdollahipour & Wulf, 2017). For instance, in many societies, boys typically exhibit higher levels of physical activity than girls. Regarding Iran's status, research indicates that 62% of Iranian girls compared to 45% of boys in the 6–10 age group have insufficient physical activity levels (Chen & Hypnar, 2020; Cook & Forchelli, 2019). This study, part of the large CASPIAN-IV project, also shows that physical activity participation declines significantly with age, particularly among girls. This concerning trend has prompted many researchers to warn that physical inactivity is becoming a social norm among children and adolescents (Lourenço & Liu, 2020).

To enhance children's motor skills, numerous methods and programs have been developed, including structured physical games, sports vision training, and structured programs such as Spark (Akbari, 2013; Bartholomew & Katula, 2006; Faal Moghanloo & Mikaeili Manee, 2013; Faghih Soleimani & Bahram, 2016; Ghaderi & Karimi, 2016; McKenzie & Ballard, 2015; Mohammadian & Mazaheri Tirani, 2024; Moti'e, 2017; Safarzadeh & Baradaran, 2014; Salehian & Hosseinzadeh Pighan, 2023; Sallis & Hovell, 1997). These programs, emphasizing regular exercises, diverse activities, and motivation for children, have achieved notable improvements in gross and fine motor skills. Structured physical games and sports vision training are recognized as effective educational tools during elementary school and are designed as dynamic and engaging teaching methods to strengthen children's motor and cognitive skills. These games create an inspiring and structured environment, leading to significant improvements in motor skills (Ghaderi & Karimi, 2016; McKenzie & Ballard, 2015). Studies show that these activities simultaneously enhance motor and cognitive skills by creating a positive and structured foundation (Faal

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Moghanloo & Mikaeili Manee, 2013). Physical games, which constitute a major part of elementary school educational programs, improve balance, coordination, and motor control through stimulation of the motor system (Ghaderi & Karimi, 2016; McKenzie & Ballard, 2015). These improvements result from the strengthening of neural motor pathways and increased brain capacity to manage complex movements.

Sports vision training, by influencing the visual-motor system, enhances fundamental skills such as eye-hand coordination, accuracy, and information processing speed (Nazifi & Shahbazi, 2022; Zahedi & Yazdi, 2023). These exercises focus on eye-hand coordination and visual improvements, aiding children with attention and focus deficits in motor skill development (Buscemi et al., 2024). These exercises, which include specialized techniques to strengthen eye muscles, develop visual skills such as tracking moving objects, focus, and eye coordination. Neuroimaging studies have shown that these exercises improve cognitive and decision-making functions by increasing activity in the sensory-motor cortex (Babaei & Badami, 2019; Zahedi & Yazdi, 2023). Integrated motor-visual programs such as eye-tracking exercises and visual discrimination have proven effective in reducing reaction time and increasing movement accuracy, particularly in fine motor skills (Nazifi & Shahbazi, 2022; Park, 2017). Longitudinal studies indicate that children who regularly participate in these activities show significant progress in basic motor skills and related cognitive abilities (Clark & Divine, 2020). These findings emphasize the importance of incorporating structured, purposeful, and challenging motor and sports vision programs into children's educational curricula.

Among these, structured intervention programs such as the Spark program are evidence-based approaches designed to develop both motor and social skills through organized physical activities (McKenzie & Ballard, 2015). The structured motor program Spark (SPARK) is a successful approach combining sports, games, and creative activities within regular sessions to enhance children's motor and social skills (Bartholomew & Katula, 2006). Studies show that regular implementation of the Spark program increases children's motor skills and can serve as an effective intervention for improving motor performance (Safarzadeh & Baradaran, 2014). These programs operate through various mechanisms, including stimulation of the neuromuscular system, increased arousal levels, and strengthening of social relationships. Research evidence, such as the study by Salis et al. (1997), indicates that regular implementation of such programs can lead to significant improvements in children's cognitive and social abilities (Sallis & Hovell, 1997). Due to existing lack of literature, this study aimed to compare the effects of different motor interventions, including structured physical games, the Spark program, and sports vision training, on improving motor skills in children.

2. Methods and Materials

2.1. Study Design and Participants

This study is a quasi-experimental research design conducted using a pretest-posttest approach and implemented in the field. The study population consisted of female children aged 8 to 10 years (age: 8.81 ± 0.77 years, height: 134.40 ± 7.97 cm, weight: 35.28 ± 8.77 kg) from Region One of Khorramabad City, who were enrolled in the 2023–2024 academic year. The participants were 72 children aged 8 to 10 years, randomly assigned to four groups of 18 (structured physical games, Spark program, sports vision training, and control). Initially, invitations were sent to parents and students in schools in Region One of Khoramabad. In the second phase, all individuals who volunteered for their children's participation were invited to attend a group session. During this session, the research objectives, methodology, class schedules, and tools were explained, and informed consent forms along with personal information were collected from the parents. Simultaneously, verbal consent was obtained from the students for their participation. Subsequently, children meeting the inclusion criteria (female gender, physical and mental health, voluntary participation consent, ability to perform the research process, no history of sports, parental involvement, and teacher collaboration) were selected and randomly divided into four groups. Those who wished to withdraw from the study were excluded.

2.2. Measures

Short Form of the Bruininks-Oseretsky Test of Motor Proficiency: The Bruininks-Oseretsky Test of Motor Proficiency is a standardized, norm-referenced assessment evaluating motor performance in children aged 4.5 to 14.5 years. Its full version includes eight subtests with 46 individual components, while the short form comprises eight subtests in 14 items, administered individually. Bruininks developed this test in 1978 by revising Oseretsky’s motor

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proficiency tests. The long form takes 45–60 minutes, and the short form takes 15–20 minutes. It includes four subtests for gross motor skills, three for fine motor skills, and one for both (agility, balance, bilateral coordination, strength, upper-limb coordination, response time, visual-motor control, perceptual speed, and upper-limb speed). Bruininks standardized this test on a sample of 756 children selected according to census data from 1970, considering age, gender, race, population size, and geographic region. The test-retest reliability coefficient of this test is 87%, and its validity is reported as 84%. This test is valid and reliable, with a validity coefficient of 90% for the Bruininks-Oseretsky Test of Motor Proficiency in assessing motor skills. The test-retest reliability for the long form is 0.78, and for the short form is 0.86. It is important to note that the short form evaluates motor skills generally, with the total score reflecting overall motor proficiency, including gross and fine motor skills (Lourenço & Liu, 2020).

2.3. Interventions

Based on existing studies and resources, the protocol for structured physical games for children is designed according to four main principles proposed by Al-Harndoon and Roberts (2020). These principles include 1) enhancing motor skills (gross and fine), 2) improving balance and coordination, 3) increasing attention and working memory, and 4) strengthening social and cognitive skills. The structured physical games protocol consists of 24 sessions, each lasting 45 minutes, conducted three times per week over eight weeks. The program emphasizes the development of gross motor skills, including eye-hand coordination, accuracy, balance, spatial orientation, and gross motor coordination through a variety of activities designed to be engaging and purposeful. Each session incorporates tasks such as ball-throwing games (e.g., "Ball Toss to Basket"), jumping through colored hoops, finger painting, object recognition games, and obstacle navigation (e.g., "Balancing on a Water Glass" and "Walking on a Line"). Activities also include problem-solving tasks (e.g., "Puzzle Games with Visual Cards") and social interaction exercises (e.g., "Group Games like "Ping-Pong Ball Carrying" and "Obstacle Course Challenges"). The program integrates dynamic movements, such as "Jumping in Different Directions" and "Balancing on a Pillow," to enhance physical coordination, balance, and strength, while also fostering creativity and cognitive skills through tasks like "Building with Blocks" and "Imaginary Play." The interventions are structured to stimulate multiple sensory-motor systems, with materials such as soft balls, hoops, plastic cups, and visual puzzles used to target specific motor components.

The Spark physical training program (SPARK) is a structured physical activity protocol designed to improve children's motor and social skills. It includes a combination of sports, games, and creative activities conducted in 45-minute sessions (10 minutes of warm-up, 25 minutes of skill-based games, and 10 minutes of cool-down) over 8 weeks. The duration of each activity was set between 4 to 6 minutes to control training intensity, ensure enjoyment for children, and prevent fatigue. During the program, participants were asked about fatigue, and they were allowed to rest in the designated rest area before resuming training after recovery. It is important to note that the movements in the Spark program were accompanied by music and the use of engaging and stimulating toys for participants (Mohammadian & Mazaheri Tirani, 2024). The Spark program protocol is also structured, with 24 sessions of 45 minutes each, held three times per week for eight weeks. The program focuses on improving gross motor skills, balance, and social interaction through a combination of physical activities, spatial perception exercises, and dynamic games. Sessions include activities like "Static and Dynamic Balance Training" (e.g., "Balance on a Board"), spatial awareness tasks (e.g., "Finding Objects in Sand and Sand"), and obstacle navigation (e.g., "Balancing on a Swedish Ladder"). The program incorporates games such as "Speed Games" (e.g., "Reaction Speed Games") and "Team-Based Activities" (e.g., "Group Ball Carrying Competitions") to enhance coordination, agility, and cognitive engagement. Specific exercises, like "Throwing Rings into a Specific Area" and "Puzzle Games with Visual Cards," are designed to improve visual-motor integration and problem-solving abilities. The protocol emphasizes repetitive and varied movements, such as "Jumping in Different Directions" and "Obstacle Course Challenges," to strengthen neuromuscular coordination and promote physical activity. Materials like balloons, rings, and visual puzzles are used to create a structured environment that encourages active participation and enhances motor development through a mix of physical and cognitive tasks.

Sports Vision Training Protocol: Sports vision training is an exercise program designed to enhance visual and cognitive motor skills, consisting of 24 sessions. After the 16th session, it was repeated every eight sessions. The sports vision training protocol used in this study is derived from the study of Clark et al. (2020) (Clark & Divine, 2020).

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2.4. Data Analysis

In this research, analysis of covariance (ANCOVA) was used for data analysis, and the Bonferroni post-hoc test was applied for pairwise comparisons of groups via SPSS software at a significance level of $p < 0.05$.

3. Findings and Results

The table below shows that, based on the average scores obtained in motor skills, the experimental groups exhibited greater increases or decreases compared to the control group in the posttest relative to the pretest.

Table 1

Descriptive Statistics of Pretest and Posttest Scores of Motor Skills

Motor Skills	Group	Pretest	Posttest
		Mean	*Standard Deviation*
Gross Motor Skills	Structured Physical Games	30.58	7.69
	Spark Training	30.78	10.02
	Sports Vision Training	29.96	11.11
	Control	30.30	8.96
Running Speed and Agility	Structured Physical Games	6.13	1.72
	Spark Training	5.00	1.92
	Sports Vision Training	5.46	1.88
	Control	4.53	1.92
Balance	Structured Physical Games	14.73	3.86
	Spark Training	16.73	6.35
	Sports Vision Training	15.40	7.21
	Control	16.46	5.31
Bilateral Coordination	Structured Physical Games	6.73	2.37
	Spark Training	6.33	2.41
	Sports Vision Training	7.06	2.49
	Control	6.73	2.52
Strength	Structured Physical Games	2.98	0.75
	Spark Training	2.71	0.75
	Sports Vision Training	2.02	0.45
	Control	2.57	0.59
Fine Motor Skills	Structured Physical Games	26.93	3.08
	Spark Training	24.66	5.31
	Sports Vision Training	24.00	4.89
	Control	23.93	3.15
Visual-Motor Control	Structured Physical Games	14.80	1.20
	Spark Training	13.80	1.69
	Sports Vision Training	13.00	1.73
	Control	12.86	1.72
Upper Limb Speed and Agility	Structured Physical Games	12.13	2.23
	Spark Training	10.86	3.83
	Sports Vision Training	11.00	3.66
	Control	11.06	3.61
Upper Limb Coordination	Structured Physical Games	6.66	1.87
	Spark Training	5.86	2.67
	Sports Vision Training	5.13	2.38
	Control	5.73	2.43
Overall Motor Skills	Structured Physical Games	64.18	12.11
	Spark Training	61.31	17.36
	Sports Vision Training	59.09	17.93
	Control	59.97	13.64

Prior to conducting the analyses, statistical assumptions were verified, including normality ($p < 0.05$) using the Shapiro-Wilk test, homogeneity of variances ($p < 0.05$) using the Levene test, and absence of multicollinearity for linearity through scatter plots and regression lines. The linearity of the relationship between pretest and posttest scores was confirmed. Homogeneity of regression slopes (gross motor skills: $F = 2.35$, $p = 0.083$; fine motor skills: F

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= 1.12, p = 0.349; upper limb coordination: F = 0.016, p = 0.997; overall motor skills: F = 0.621, p = 0.434) and homogeneity of covariance matrices ($p < 0.05$) using Box's M test (gross motor skills: F = 1.76, p = 0.06; fine motor skills: F = 1.05, p = 0.07; p = 0.02; 39.02). All analyses were conducted using SPSS software at a significance level of $p < 0.05$.

Based on the results of the multivariate analysis of covariance (MANCOVA) on posttest scores of motor skills, the Wilks' lambda, Hotelling's T^2, and the largest eigenvalue indicated significant differences between the experimental groups and the control group in at least one of the motor skill components ($p < 0.001$). To further investigate these differences, a univariate analysis of covariance (ANCOVA) was conducted on the data. The results showed that the ANCOVA F-values for gross motor skills (F = 28.22, p = 0.001), fine motor skills (F = 67.08, p = 0.001), and upper limb coordination (F = 31.37, p = 0.001) were statistically significant. These findings indicate significant differences in the overall motor skill scores (gross, fine, and upper limb coordination) between the experimental groups and the control group in the posttest.

Table 2

Results of the Univariate Analysis of Covariance on Posttest Scores of Motor Skill Components

Motor Skill	Effect	Component	Sum of Squares	Degrees of Freedom	Mean Square	F	p	Effect Size
Gross Motor Skills	Group	Speed and Agility	32.24	3	10.74	8.57	0.001	0.331
		Balance	179.04	3	59.68	11.35	0.001	0.396
		Bilateral Coordination	87.64	3	29.21	26.88	0.001	0.608
		Strength	2.503	3	0.834	8.11	0.001	0.319
	Error	Speed and Agility	65.14	52	1.25			
		Balance	273.24	52	5.25			
		Bilateral Coordination	56.51	52	1.08			
		Strength	5.34	52	0.103			
	Total	Speed and Agility	2520	60				
		Balance	22735	60				
		Bilateral Coordination	4161	60				
		Strength	505.34	60				
Fine Motor Skills	Group	Visual-Motor Control	73.98	3	24.66	15.82	0.001	0.468
		Agility	447.73	3	149.24	75.02	0.001	0.806
	Error	Visual-Motor Control	84.19	54	1.55			
		Agility	107.42	54	1.98			
	Total	Visual-Motor Control	14972	60				
		Agility	15010	60				
Overall Motor Skills	Group	Speed and Agility	64.18	3	21.39	8.57	0.001	0.331
		Balance	179.04	3	59.68	11.35	0.001	0.396
		Bilateral Coordination	87.64	3	29.21	26.88	0.001	0.608
		Strength	2.503	3	0.834	8.11	0.001	0.319
	Error	Speed and Agility	65.14	52	1.25			
		Balance	273.24	52	5.25			
		Bilateral Coordination	56.51	52	1.08			
		Strength	5.34	52	0.103			
	Total	Speed and Agility	2520	60				
		Balance	22735	60				
		Bilateral Coordination	4161	60				
		Strength	505.34	60				

A Bonferroni post-hoc test was used to examine differences between groups and pairwise comparisons.

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Table 3

Bonferroni Post-Hoc Test for Pairwise Comparisons of Posttest Mean Scores Among the Research Groups

Variable	Groups	Mean Difference	Standard Deviation	Significance (p)
Gross Motor Skills	Control vs. Structured Physical Games	-10.96	1.30	0.001
	Control vs. Spark Training	-8.27	1.15	0.001
	Control vs. Sports Vision Training	-4.64	1.16	0.001
	Structured Physical Games vs. Spark Training	2.68	1.25	0.224
	Structured Physical Games vs. Sports Vision Training	6.36	1.33	0.001
	Spark Training vs. Sports Vision Training	3.64	1.16	0.018
Fine Motor Skills	Control vs. Structured Physical Games	-8.52	0.831	0.001
	Control vs. Spark Training	-9.94	0.737	0.001
	Control vs. Sports Vision Training	-5.26	0.745	0.001
	Structured Physical Games vs. Spark Training	-1.42	0.804	0.504
	Structured Physical Games vs. Sports Vision Training	3.26	0.853	0.002
	Spark Training vs. Sports Vision Training	4.67	0.746	0.001
Upper Limb Coordination	Control vs. Structured Physical Games	-3.46	0.423	0.001
	Control vs. Spark Training	-3.03	0.375	0.001
	Control vs. Sports Vision Training	-1.206	0.379	0.015
	Structured Physical Games vs. Spark Training	0.436	0.409	0.998
	Structured Physical Games vs. Sports Vision Training	-2.25	0.434	0.001
	Spark Training vs. Sports Vision Training	1.82	0.38	0.001

As indicated in the table above, the three interventions (structured physical games, Spark training, and sports vision training) showed significant effects on gross motor skills, fine motor skills, and upper limb coordination ($p < 0.05$). However, significant differences were observed between sports vision training and the other two interventions. No significant differences were found between structured physical games and Spark training ($p > 0.05$).

A Bonferroni post-hoc test was used to examine differences between groups and pairwise comparisons.

Table 4

Bonferroni Post-Hoc Test for Pairwise Comparisons of Posttest Mean Scores of Motor Skill Components Among the Research Groups

Variable	Groups	Mean Difference	Standard Deviation	Significance (p)
Running Speed and Agility	Control vs. Structured Physical Games	-1.95	0.469	0.001
	Control vs. Spark Training	-1.90	0.418	0.001
	Control vs. Sports Vision Training	-0.473	0.473	0.368
	Structured Physical Games vs. Spark Training	0.057	0.452	0.995
	Structured Physical Games vs. Sports Vision Training	-1.05	0.536	0.332
	Spark Training vs. Sports Vision Training	-0.994	0.503	0.321
Balance	Control vs. Structured Physical Games	-5.20	0.961	0.001
	Control vs. Spark Training	-3.74	0.856	0.001
	Control vs. Sports Vision Training	-1.47	0.969	0.804
	Structured Physical Games vs. Spark Training	-1.46	0.925	0.719
	Structured Physical Games vs. Sports Vision Training	-3.72	1.090	0.008
	Spark Training vs. Sports Vision Training	-2.26	0.877	0.010
Bilateral Coordination	Control vs. Structured Physical Games	-3.76	0.437	0.001
	Control vs. Spark Training	-2.44	0.389	0.001
	Control vs. Sports Vision Training	-1.20	0.441	0.042
	Structured Physical Games vs. Spark Training	-1.32	0.421	0.016
	Structured Physical Games vs. Sports Vision Training	-2.56	0.500	0.001
	Spark Training vs. Sports Vision Training	-1.23	0.469	0.033
Strength	Control vs. Structured Physical Games	-0.65	0.134	0.001
	Control vs. Spark Training	-0.354	0.120	0.020
	Control vs. Sports Vision Training	-0.164	0.136	0.548
	Structured Physical Games vs. Spark Training	-0.295	0.129	0.159
	Structured Physical Games vs. Sports Vision Training	-0.485	0.154	0.016
	Spark Training vs. Sports Vision Training	-0.19	0.144	0.755
Visual-Motor Control	Control vs. Structured Physical Games	-2.27	0.499	0.001

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	Control vs. Spark Training	-3.01	0.468	0.001
	Control vs. Sports Vision Training	-2.39	0.456	0.001
	Structured Physical Games vs. Spark Training	-0.731	0.468	0.747
	Structured Physical Games vs. Sports Vision Training	-1.112	0.493	0.998
	Spark Training vs. Sports Vision Training	-0.479	0.465	0.999
Upper Limb Speed and Agility	Control vs. Structured Physical Games	-6.61	0.563	0.001
	Control vs. Spark Training	-7.22	0.529	0.001
	Control vs. Sports Vision Training	-2.75	0.515	0.001
	Structured Physical Games vs. Spark Training	-0.615	0.529	0.998
	Structured Physical Games vs. Sports Vision Training	-3.86	0.557	0.001
	Spark Training vs. Sports Vision Training	-4.47	0.525	0.001

The results presented in Table 4 indicate that the mean differences in the components of running speed, balance, and strength were statistically significant between the structured physical games and Spark training groups and the control group ($p < 0.05$). However, the mean differences between the control group and the sports vision training group were not statistically significant in these three components ($p > 0.05$). In the coordination component, the mean differences in scores among all three intervention groups compared to the control group were statistically significant ($p < 0.05$). In the running speed component, no significant differences were observed between the intervention groups, but structured physical games and Spark training were more effective than sports vision training. In the coordination component, all three intervention methods (structured physical games, Spark training, and sports vision training) were effective, with structured physical games and Spark training being more effective than sports vision training. In the strength component, sports vision training was not effective, but structured physical games and Spark training were effective. In the visual-motor control and upper limb speed and agility components, the mean differences between the intervention groups and the control group were statistically significant ($p < 0.05$), indicating that all three interventions (structured physical games, Spark training, and sports vision training) were effective. Among the three intervention methods, no statistically significant differences were observed in the visual-motor control component, but structured physical games and Spark training were more effective than sports vision training in the upper limb speed and agility component.

4. Discussion and Conclusion

The results of the study indicated that there were statistically significant differences between the three experimental groups and the control group in the component of visual-motor control. However, no significant differences were observed in pairwise comparisons between the experimental groups. According to the data in Table 1, the effectiveness of the three interventions on visual-motor control was approximately equal, which explains the lack of significant differences between the groups. Most studies confirm that the three types of interventions (structured physical games, sports vision training, and Spark) can improve visual-motor control compared to the control group. These findings are consistent with the theory of sensory-motor integration, which suggests that any intervention activating the visual-motor system can enhance this skill (Wolpert & Flanagan, 2011). Morgan et al. (2007) demonstrated that the three types of interventions (structured physical games, visual-motor, and combined) significantly improve visual-motor control in children. This improvement is attributed to the enhancement of sensory-motor integration and the accuracy of visual information processing. Faber et al. (2018) reported that systematic interventions can improve visual-motor control similarly, as all emphasize the visual-motor system (Faber & Nijhuis-Van der Sanden, 2018); however, the results of Faghih Solimani et al. (2016) indicated that visual-motor training has a greater effect on visual-motor control than combined interventions, as it directly targets the visual-motor system. Additionally, the results of the study by Faghih Solimani et al. (2016) showed that structured physical games, due to their focus on specific motor goals, are more effective than Spark in improving visual-motor control (Faghih Soleimani & Bahram, 2016).

The findings of the study regarding the component of agility indicated statistically significant differences between the three experimental groups and the control group. It was observed that there were no significant differences between the structured physical games and Spark groups, but the Spark group showed significant differences in favor of the sports vision training group. In this component, the best performance was attributed to the Spark group, followed by the structured physical games group, then the sports vision training group, and finally the control group. These results

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align with the prior findings (Gonzalez-Silva & Fernandez-Echeverria, 2021; Smith & Lubans, 2022). Smith et al. (2022) stated that combined programs like Spark improve agility in children aged 8–12 years through dynamic movements and interval training, which is attributed to the simultaneous activation of the neuromuscular and cardiovascular systems. González-Silva et al. (2021) reported that structured physical games, which include sudden directional changes (e.g., throwing at moving targets), have a similar effect on agility as structured programs like Spark (Gonzalez-Silva & Fernandez-Echeverria, 2021). Wilson et al. (2023) confirmed that visual-motor training improves reaction time but has a lesser effect on agility due to its focus on the whole body (Wilson & Reid, 2023). However, the results of the study by Chien et al. (2020) indicated that structured physical games, designed for agility (e.g., speed courses), are more effective than Spark in improving agility (Chen & Hypnar, 2020). This is consistent with the findings of the study, which showed that the Spark program and structured physical games enhance visual-motor control through the interaction of environmental, individual, and task-related factors (Thelen & Smith, 2020).

The superiority of Spark is likely due to its similarity to agility requirements (e.g., running with directional changes) (Bartholomew & Katula, 2006). In this context, the Spark program may enhance the coordination of fast-twitch muscle units and the central nervous system through interval training, reducing reaction time. Structured physical games and Spark may improve the sensitivity of the visual-motor system, leading to faster reaction times (Wilson & Reid, 2023). This is also consistent with the findings of González-Silva et al. (2021), who reported that the Spark program and structured physical games enhance the activation of core stabilizing muscles, facilitating faster weight transfer during directional changes (Gonzalez-Silva & Fernandez-Echeverria, 2021).

The results of this study showed that structured physical games, especially in components like running speed and agility, had a significant effect on improving children's motor skills. Children who participated in these games demonstrated better performance compared to other groups. This is likely due to the integrated, purposeful, and challenging structure of these games, which increased children's motivation and led to significant improvements in these skills. In contrast, the Spark program, while increasing physical activity levels, was less effective in improving running speed and agility compared to structured physical games. Sports vision training also failed to show significant differences compared to the control group. In the balance component, structured physical games showed better results. Children who participated in these games demonstrated greater improvements in balance. This is likely because these games engage multiple systems, including the central nervous system, vestibular system, and proprioceptive system, enhancing balance. In the bilateral coordination component, structured physical games showed significant improvements, followed by the Spark group and then the sports vision training group. These findings suggest that structured interventions, through neuromuscular engagement, improve coordination and brain-muscle interaction. Well-designed games with diverse and complex movements can simultaneously enhance cognitive-motor processes and physical coordination. In the strength component, structured physical games and the Spark program had positive effects, improving children's strength compared to the control group. However, sports vision training did not show significant improvements. The results indicate that structured physical games and Spark programs, through repetitive dynamic movements targeting major muscle groups, were effective in enhancing strength.

Overall, the results of this study highlight the critical role of the design and type of motor interventions in children's motor skill development. Programs specifically targeting components like speed, agility, balance, and coordination, especially structured physical games, can be more effective than general programs. While sports vision training may play a complementary role in some areas, it is insufficient on its own for improving gross motor skills. Therefore, it is recommended to prioritize structured, purposeful, and challenging interventions in designing motor programs for children. Additionally, the type of intervention should be selected based on the specific motor needs and individual characteristics of each child to maximize effectiveness.

Authors' Contributions

All authors significantly contributed to this study.

Declaration

In order to correct and improve the academic writing of our paper, we have used the language model ChatGPT.

Transparency Statement

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Data are available for research purposes upon reasonable request to the corresponding author.

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Declaration of Interest

The authors report no conflict of interest.

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Ethical Considerations

In this study, to observe ethical considerations, participants were informed about the goals and importance of the research before the start of the study and participated in the research with informed consent.

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