PJPT PAKISTAN JOURNAL OF PHYSICAL THERAPY
ISSN NO: 2663-0796 (Print) | ISSN NO: 2663-080X (Online)

Original Article

# EFFECTS OF SPORTS, PLAY AND ACTIVE RECREATION FOR KIDS VERSUS FUNDAMENTAL MOTOR SKILL TRAINING ON MOTOR SKILLS IN CHILDREN WITH AUTISM SPECTRUM DISORDER

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**ABSTRACT**

Children with autism spectrum disorder (ASD) often struggle with motor skills and coordination, making motor planning and execution difficult. Despite challenges in healthcare and education, improving mobility and functional status in autistic children remains a crucial area of research. **Objective:** The study aimed to assess and compare the effects of the Sports Play and Active Recreation for Kids (SPARK) program and Fundamental Motor Skill (FMS) training in improving the motor skills of children with ASD. **Methods:** The study protocol received ethical approval and was registered in the National Clinical Trial Registry (NCT05986760). Participants meeting inclusion criteria were referred by healthcare professionals and underwent a comprehensive screening process. Randomised allocation assigned participants to either Group A (SPARK) or Group B (FMS). Assessments of koij skill development using the Bruininks-Oseretsky Test of Motor Proficiency (BOTMP) were conducted at baseline and post-intervention by blinded assessors. **Results:** Both Group A (SPARK) and Group B (FMS) exhibited significant improvements in motor skills across various domains assessed by BOTMP. Group A showed substantial enhancements in different domains of BOTMP ($p<0.05$ for all). Group B similarly demonstrated significant improvements in these domains ($p<0.05$ for all). Baseline comparisons showed no significant differences between the groups, and post-treatment comparisons indicated no significant difference in motor skill outcomes ($p>0.05$). **Conclusion:** Both SPARK and FMS interventions effectively enhanced motor functions in children with ASD. These findings emphasise the importance of individualised physical activity programs for children with ASD.

**Keywords:** Autism Spectrum disorder, Coordination, Gross motor proficiency, Motor skills proficiency, Spark program

## INTRODUCTION

Children with autism spectrum disorder (ASD) may have deficient gross and fine motor skills, in-coordination in movement, and difficulty in motor planning and execution. The effort to improve the functional status or mobility of autistic children faces new challenges amid changes in healthcare and education, but it remains a significant focus of research[1]. ASD is a neurodevelopmental disorder with social and communication problems as well as behavioural difficulties that affect millions of children around the world. In 2020, the Pakistan Autism Society estimated that approximately 350,000 children in Pakistan are affected by ASD[2]. Among the diverse range of difficulties children with ASD face, two of the most important are the development of social and motor skills [1].

Social skills, encompassing everything from communication and cooperation to understanding emotions and forming relationships, are essential for a child's overall well-being and integration into society [3]. Concurrently, gross and fine motor skills

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**Received:** December 16, 2023 | **Revised:** March 09, 2024 | **Accepted:** May 15, 2024

are also critical to a child's ability to move around his environment, participate in physical activities, or play with other children, and early development of these skills encourages the child to participate in physical activities[3]. These basic skills become extremely difficult for children with ASD to master, blocking their entry into school and recreation activities and the world of everyday life [1].

In light of contemporary societal recognition regarding the importance of promoting inclusivity and equitable opportunities for children with diverse abilities, two prominent and promising approaches have emerged for facilitating the development of social and motor skills in children with ASD: the Sports, Play, and Active Recreation for Kids (SPARK) program and Fundamental Motor Skill (FMS)Training [4].

SPARK is a comprehensive, evidence-based program designed to engage children in structured physical activities, sports, and games. It emphasises the inclusion of children with ASD in recreational activities alongside their neurotypical peers. SPARK aims not only to enhance physical fitness but also to nurture social skills through group interactions, cooperation, and the joy of play. Advocates of SPARK argue that its multifaceted approach not only promotes physical well-being but also provides an excellent opportunity for children with ASD to develop crucial social competencies[4].

On the other hand, Fundamental Motor Skill Training zeroes in on foundational building blocks of motor development. This targeted approach seeks to improve children's gross and fine motor skills through structured exercises and activities that isolate and develop specific movements. Advocates of this approach claim that by improving motor skills, kids with ASD can become self-confident about their physical capabilities, which increases their social engagement since they feel more capable of participating in physical play and activities [5].

SPARK program and FMS training are two essential intervention techniques that are the subject of this article's focused investigation in response to the increasing recognition of the importance of improving the motor skills of children with ASD. Since these children may have particular difficulties in developing their motor skills, it is critical to determine the best method for enhancing these abilities in this particular demographic. The primary objective of this article was to evaluate and compare the effectiveness of the SPARK program and FMS in enhancing the motor skills of children with ASD. To assess motor skills, the "Bruininkse Oseretsky Test of Motor Proficiency (BOTMP) was used. It is a reliable and standardised tool for measuring motor development in ASD patients. To help practitioners, parents, and educators who are dedicated to promoting motor skill growth in this population, this research attempts to offer empirical insights on the influence of these interventions on the enhancement of motor skills among children with ASD.

## MATERIAL AND METHODS

Ethical approval for this randomised clinical trial was sought from the Research Ethical Committee of Riphah International University, Lahore, and the Institutional Review Board (IRB) number for this study was 31588 F21C14G101011. The trial was registered in the National Clinical Trial Registry US (NCT05986760) before conducting the study. This study was conducted following the CONSORT guidelines[6]. The calculated sample size, through the Epi tool, using Bruininks-Oseretsky test's mean and standard deviation (Mean Dynamic Balance) [7] as outcome measure was 20 in each group. Participants with Autism Spectrum Disorder (ASD) meeting the eligibility criteria for inclusion in the research were referred to the study by a pediatric neuro-physician and psychologist at the Health Care Hospital, Gujrat and included in the study using a non-random convivence sampling technique[8].

The inclusion criteria for the study were children aged 5-12 years, diagnosed with ASD based on the Diagnostic and Statistical Manual of Mental Disorders, 4th edition, text revision (DSM-IV-TR) criteria[9] at a high-functioning level, including pervasive developmental disorder-not otherwise specified (PDD-NOS) and Asperger's disorder based on clinical judgment and supported by the Autism Diagnostic Observation Schedule (ADOS)[10]. Participants also needed to have moderate or more significant behavioural problems, as measured by a pre-treatment score of >15 on the Aberrant Behavior Checklist–Irritability subscale[11], and the ability to follow directions and perform requested motor skill proficiency and executive function measures. Guardians provided written informed consent for their children's participation. The exclusion criteria included participants with diagnosed cognitive impairments, inability to walk independently, history of traumatic injury, previous surgery history, and inability to understand the procedure

or unwillingness to participate. All referred participants underwent a comprehensive screening process, which included the assessment of motor behaviour problems using the Bruininks-Oseretsky Test of Motor Proficiency (BOTMP).

All referred participants underwent a comprehensive screening process, which included the assessment of motor behaviour problems using the BOTMP[12]. Guardians of patients who met the eligibility criteria were approached for informed consent before enrolling their children in the study. Following the screening phase, a randomised allocation process was employed to assign each eligible participant to one of two experimental groups: Group A (Experimental Group 1, SPARK) or Group B (Experimental Group 2, FMS). This allocation was achieved using a lottery method without replacement, ensuring a fair and unbiased distribution of participants. Group A received the SPARK program, a research-backed strategy designed to promote holistic well-being, positive social interactions, enjoyment of physical activity, and academic success [13].

The program comprises two primary components: a skill-fitness exercise and a health fitness activity, including activities such as jumping rope, jogging games, and aerobic dancing. For ten weeks, Group A had three sessions per week, each lasting for an hour with CPT. Each session was structured into three parts: warm-up activities (10 minutes), main activity (45 min.), and cool-downs. These sessions were held by two specially trained physiotherapists with more than two years of practical experience in pediatric physical therapy, especially working to treat children with ASD under the supervision of an expert psychologist who is experienced in dealing with adults and children on the autistic spectrum. Group B participated in Fundamental Motor Skill Training (FMS), focusing on fundamental motor skills such as running, jumping, throwing, and kicking, which are considered foundational for more complex gross motor development. This program encompassed 13 activities, including running, jumping, galloping, hopping, side gliding, skipping, leaping, catching, stationary dribbles, kicking, striking a stationary ball, overarm throw, and underarm throw. Group B underwent 30 sessions over ten weeks, with three sessions per week, each lasting 60 minutes and including Conventional Physiotherapy (CPT).

Sessions in Group B followed a similar structure: warm-up activities (10 minutes), the primary FMS activities (45 minutes), and cool-down activities (5 minutes). Two trained sports physiotherapists with a minimum of two years of experience in physical therapy for children and adolescents with developmental disorders, particularly children with ASD, conducted these sessions under the supervision of an expert psychologist familiar with ASD. Motor skills were evaluated using BOTMP at two specific time points: before the intervention

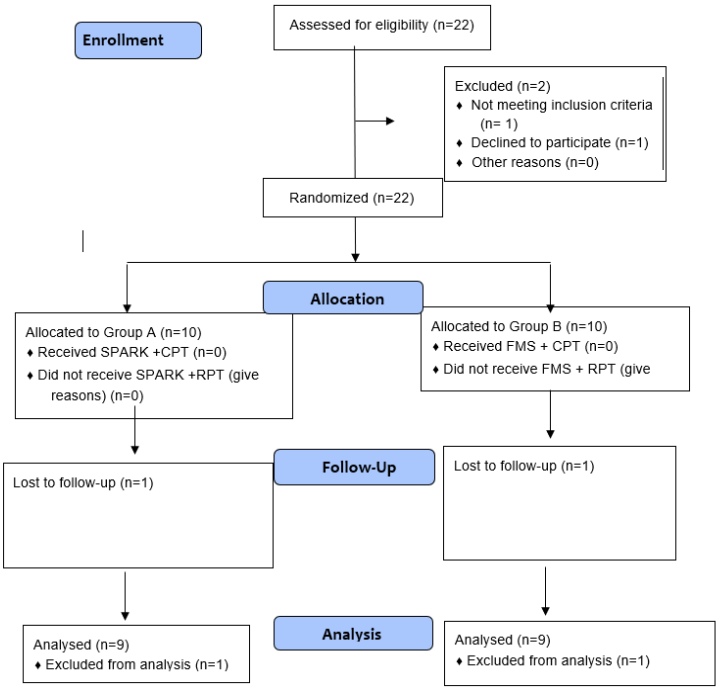


**Figure 1.** CONSORT Flowchart

(baseline or pre-intervention) and after the 10th week of treatment (post-intervention). These assessments were carried out by an assessor who was blinded to the participants' group assignments, ensuring impartial data collection and minimising bias. Distribution of patients is presented in a CONSORT chart as shown in Figure 1.

**Statistical Analysis:** Using SPSS version 27, analysis was done. The means ± standard deviations were used to represent the quantitative variables. On the other hand, frequency and percentage were used to represent qualitative characteristics. The Shapiro-Wilk test of normalcy was used to determine normality. For comparisons within and between groups, the paired t-test and the independent t-test were employed. The significance level was established at $p \leq 0.05$. Initially, 20 participants were recruited in the study, but 2 participants (1 from group A and one from group B) were lost to follow-up, and the sequential deletion method was used to handle the missing data.

## RESULTS

The mean age of the participants in Group A was 7.90±1.66, and in Group B was 7.55± 2.18. Distribution of cases according to gender has shown that among 18 (100%) participants, 10 (55.5 %) were males and 8 (44.44%) were females.

Pre and post-treatment comparison of subcategories of BOTMP scale within group A has shown that there was significant difference in all domains of BOTMP with pre and post-treatment mean difference for running speed and agility was 1.00, for balance was1.80, for coordination 1.30, for strength was 2.40, for upper limb coordination was 1.70, for response speed was 1.60, for visual motor control was 0.90 and for upper limb speed and dexterity was 2.30 with $p < 0.05$ for all, showing that SPARK technique is efficacious in improving fine and gross motor proficiency in children with autism spectrum disorder as shown in Table 1.

**Table 1.** Comparison of Bruininks Oseretsky Test of Motor Proficiency Scale within Group A at baseline and after treatment

| Group A: SPARK | | Mean ±S. D N=9 | Mean Difference | p-value |
|---|---|---|---|---|
| Running speed and agility | Pretreatment | 7.30± 1.70 | 1.00 | <0.05 |
| | Post-treatment | 8.30± 1.70 | | |
| Balance | Pretreatment | 20.90±4.99 | 1.80 | <0.05 |
| | Post-treatment | 22.70±4.44 | | |
| Coordination | Pretreatment | 8.40±3.40 | 1.30 | <0.05 |
| | Post-treatment | 9.70±3.46 | | |
| Strength | Pretreatment | 24.00±6.87 | 2.40 | <0.05 |
| | Post-treatment | 26.40±6.89 | | |
| Upper limb Coordination | Pretreatment | 13.10± 2.07 | 1.70 | <0.05 |
| | Post-treatment | 14.80 ± 2.20 | | |
| Response speed | Pretreatment | 7.20±2.74 | 1.60 | <0.05 |
| | Post-treatment | 8.80±2.97 | | |
| Visual motor control | Pretreatment | 12.90±3.24 | 0.90 | <0.05 |
| | Post-treatment | 13.80±3.22 | | |
| Upper limb speed & dexterity | Pretreatment | 31.80±12.52 | 2.30 | <0.05 |
| | Post-treatment | 34.10±12.19 | | |

Pre- and post-treatment comparison of subcategories of BOTMP within group B has shown that there was a significant difference in all domains of BOTMP, with pre-and post-treatment mean differences in running speed. Agility was 0.55, balance was 1.11, coordination was 0.66, strength was 1.77, upper limb coordination was 1.11, response speed was 1.11, visual motor control was 1.00, and upper limb speed was. Dexterity was 1.66, with p <0.05 for all, showing that the FMS technique is efficacious in improving fine and gross motor proficiency in children with autism spectrum disorder, as shown in Table 2. Baseline comparison of the BOTMP Scale between groups A and B has shown that variables were similar at baseline with p > 0.05, and post-treatment comparison has shown that there was no significant difference between both groups with p>0.05 for all domains of Bruininks Oseretsky Test of Motor Proficiency Scale. Post-treatment agility and speed in Group A was 8.30±1.70 and in Group B was 7.88±2.08, balance in Group A was 22.70±4.44 and in Group B was 21.11±4.42, Coordination in Group A was 9.70±3.46 and in group B was 8.33 ±2.59, strength in Group A was 26.40± 6.89 and in group B was 25.88±6.90, response speed in Group A was 7.20±2.74 and in group B was 8.11 ±2.31, visual motor control in Group A was 13.80±3.22 and in group B was 14.22±3.38, upper limb speed and dexterity in Group A was 34.10±12.19 and in group B was 34.77±12.20 as shown in Table 3.

**Table 2.** Comparison of Bruininks Oseretsky Test of Motor Proficiency Scale within group B at baseline and after treatment

| Group B: FMS | | Mean ±S. D N=9 | Mean Difference | p-value |
|---|---|---|---|---|
| Running speed and agility | Pretreatment | 7.33±1.80 | 0.55 | <0.05 |
| | Post-treatment | 7.88±2.08 | | |
| Balance | Pretreatment | 20.00±4.35 | 1.11 | <0.05 |
| | Post-treatment | 21.11±4.42 | | |
| Coordination | Pretreatment | 7.66±2.64 | 0.66 | <0.05 |
| | Post-treatment | 8.33±2.59 | | |
| Strength | Pretreatment | 24.11±7.28 | 1.77 | <0.05 |
| | Post-treatment | 25.88±6.90 | | |
| Upper limb coordination | Pretreatment | 13.44± 2.06 | 1.11 | <0.05 |
| | Post-treatment | 14.55 ± 2.18 | | |
| Response speed | Pretreatment | 8.11±2.31 | 1.11 | <0.05 |
| | Post-treatment | 9.22±2.81 | | |
| Visual motor control | Pretreatment | 13.22±3.15 | 1.00 | <0.05 |
| | Post-treatment | 14.22±3.38 | | |
| Upper limb speed & dexterity | Pretreatment | 33.11±12.53 | 1.66 | <0.05 |
| | Post-treatment | 34.77±12.20 | | |

**Table 3.** Comparison of Bruininks Oseretsky Test of Motor Proficiency Scale between Group A and Group B at baseline and after treatment

| Bruininks Oseretsky Test of Motor Proficiency Scale | Group A (SPARK) N=9 Mean ±S. D | Group B (FMS) N=9 Mean ±S. D | 95% CI | p-value |
|---|---|---|---|---|
| Pretreatment running speed & agility | 7.30± 1.70 | 7.33±1.80 | -1.73, 1.66 | 0.96 |
| Post-treatment running speed and agility | 8.30± 1.70 | 7.88±2.08 | -1.42, 2.24 | 0.64 |
| Pretreatment balance | 20.90±4.99 | 20.00±4.35 | -3.66, 5.45 | 0.68 |
| Post-Treatment balance | 22.70±4.44 | 21.11±4.42 | -2.71, 5.89 | 0.44 |
| Pretreatment coordination | 8.40±3.40 | 7.66±2.64 | -2.24, 3,71 | 0.61 |
| Post-treatment coordination | 9.70±3.46 | 8.33±2.59 | -1.62, 4.36 | 0.34 |
| Pretreatment Strength | 24.00±6.87 | 24.11±7.28 | -6.96, 6.74 | 0.97 |
| Post-treatment Strength | 26.40±6.89 | 25.88±6.90 | -6.17, 7.19 | 0.87 |
| Pretreatment upper limb Coordination | 13.10± 2.07 | 13.44± 2.06 | -2.32, 1.63 | 0.71 |
| Post-treatment upper limb Coordination | 14.80 ± 2.20 | 14.55 ± 2.18 | -1.88, 2.37 | 0.81 |
| Pretreatment response speed | 7.20±2.74 | 8.11±2.31 | -3.38, 1.56 | 0.44 |
| Post-treatment response speed | 8.80±2.97 | 9.22±2.81 | -3.23, 2.39 | 0.75 |
| Pretreatment visual motor control | 12.90±3.24 | 13.22±3.15 | -3.42, 2.78 | 0.82 |
| Post-treatment visual motor control | 13.80±3.22 | 14.22±3.38 | -3.62, 2.77 | 0.78 |
| Pretreatment upper limb speed and dexterity | 31.80±12.52 | 33.11±12.53 | -13.45, 10.83 | 0.82 |
| Post-treatment upper limb speed and dexterity | 34.10±12.19 | 34.77±12.20 | -12.50, 11.16 | 0.90 |

## DISCUSSION

The purpose of this study was to assess how two different intervention programs—Fundamental Motor Skill Training (FMS) and Sports, Play, and Active Recreation for Kids (SPARK)—affected the motor abilities of kids with autism spectrum disorder (ASD). The results of this study support earlier studies in the field by indicating that both SPARK and FMS therapies were successful in improving fine and gross motor abilities in children with ASD. Several previous studies have explored the role of play and sports-based interventions in improving motor skills and social interaction in autistic children. Ghayour *et al*. (2018) investigated the impact of the SPARK program on motor and behavioural abilities in children with ASD [14]. Their findings demonstrated significant improvements in balance, bilateral coordination, and social interaction, aligning with the results of the current study. These consistent findings indicate the therapeutic potential of SPARK training for motor and social skill development in children with ASD.

Similarly, Hassani *et al*. (2020) conducted a study that evaluated the effects of game-based interventions on motor skills in high-functioning autistic children[15]. Their research highlighted the

effectiveness of programs like SPARK in improving motor skills, particularly gross motor skills, which complements the outcomes observed in the present study.

Additionally, a study by Bremer *et al*. investigated the effects of a fundamental motor skill intervention on young children with ASD. The experimental group in their study exhibited significant motor skill improvements, particularly in object manipulation and overall motor skills, mirroring the positive outcomes observed in our study[16].

Edwards *et al*. (2017) explored the impact of sports-based interventions on fundamental motor skills in autistic children. Although they did not observe significant improvements in skill scores, they noted a substantial enhancement in self-perceived motor skills[17]. This underscores the importance of considering subjective measures and self-perception in assessing motor skill development, which could complement the objective assessments employed in our study.

The study has several limitations, including the short-term duration, limited sample size, single-site setting, and the absence of a control group, which may restrict the generalizability of the findings. Future research should focus on the long-term effects of FMS and SPARK programs, involve more extensive and more diverse samples, and explore the effectiveness of combining these treatments with other therapies and interventions, such as behavioural and occupational therapies. Additionally, studying the personal history and self-image of participants can provide a more holistic understanding of the benefits these programs offer to children with ASD. Addressing these limitations and following these recommendations can help validate and refine the use of FMS and SPARK programs, ultimately contributing to more effective rehabilitation strategies for children with ASD.

## CONCLUSION

This study found that FMS and SPARK programs could significantly improve children with ASD's gross motor skills. These results have profound consequences for the health and motor development of autistic children. Future studies should investigate the long-term outcomes and possible benefits of these interventions in meeting the diverse needs of this group.

## DECLARATION

**Conflict of interest:** The authors declared no conflict of interest.

**Funding support:** No funding source was involved.

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