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Athul G Sivan
Research Scholar, Department
of Physical Education,
Annamalai University,
Annamalai Nagar,
Chidambaram, Tamil Nadu,
India

Dr. Bupesh S Moorthy
Associate Professor,
Department of Physical
Education, Annamalai
University, Annamalai Nagar,
Chidambaram, Tamil Nadu,
India

Corresponding Author:
Athul G Sivan
Research Scholar, Department
of Physical Education,
Annamalai University,
Annamalai Nagar,
Chidambaram, Tamil Nadu,
India

Assessment and enhancement of static balance in children with ADHD: Impact of physical activity interventions

Athul G Sivan and Bupesh S Moorthy

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Abstract

This study aimed to assess the effect of a structured physical activity intervention on static balance in children diagnosed with attention deficit hyperactivity disorder (ADHD). Static balance, a crucial component of motor development and postural control, is often impaired in children with ADHD due to underlying neurodevelopmental challenges. The participants were divided into two groups: an experimental group that underwent a targeted physical activity program and a control group that did not receive any intervention. The static balance test involved measuring the time each child could maintain balance standing barefoot on a narrow wooden stick without support. Pre- and post-test assessments were conducted to evaluate improvement. Results indicated a significant enhancement in the experimental group, with mean static balance time increasing by 37.2% (from 13.97 to 19.19 seconds), supported by statistically significant t-test and ANCOVA analyses. In contrast, the control group showed only negligible change (2.1%). These findings demonstrate that physical activity interventions can effectively improve postural stability and neuromuscular control in children with ADHD, potentially reducing fall risk and enhancing motor proficiency. The study underscores the importance of incorporating structured exercise programs in clinical and educational settings to support motor development and overall functional abilities in this population.

Keywords: Static balance, postural control, motor development, attention deficit hyperactivity disorder (ADHD), physical activity intervention

Introduction

Static balance is a critical component of motor development and postural control, defined as the ability to maintain the body's center of gravity within its base of support while remaining stationary. This fundamental skill underpins safe mobility, everyday functional activities, and serves as the foundation for more complex dynamic movements required in sports and play. Static balance requires continuous integration of sensory information from the visual, vestibular, and proprioceptive systems, which is then processed by the central nervous system to produce appropriate neuromuscular responses. In children, the development of static balance is essential for normal growth, independence, and participation in physical, academic, and social environments.

For children diagnosed with Attention Deficit Hyperactivity Disorder (ADHD), impairments in balance and postural control are frequently observed, reflecting underlying neurodevelopmental challenges. Difficulty with static balance in this population may contribute to reduced motor coordination, higher risk of falls, and lower self-esteem. Assessing static balance is therefore highly relevant in both clinical and educational settings, as it not only reveals potential motor deficits but also tracks the effectiveness of physical activity interventions designed to remediate these challenges. Research into static balance provides valuable insights for tailoring targeted programs that support overall motor proficiency and enhance the daily functioning of children with ADHD. (Geuze, 2003; Verret *et al.*, 2012; Peterka, 2002; Cerrillo-Urbina *et al.*, 2015) [2, 4, 3, 1].

Methodology

The Static Balance Test was administered to assess the postural stability of children diagnosed with Attention Deficit Hyperactivity Disorder (ADHD). The objective was to measure the ability to maintain balance while standing stationary on a narrow base of support.

Participants: The test involved two groups-an experimental group undergoing a physical activity intervention and a control group with no intervention.

Equipment: A wooden stick for standing, a stopwatch, pencil, and recording sheets were used.

Procedure: Each participant was instructed to stand barefoot on the stick with both feet aligned, maintaining balance without stepping off or using external support. Timing commenced as soon as the participant assumed the position and stopped when either the heel or any part of the body other than the feet touched the ground, or when the participant stepped off the stick. The duration of successful balancing was recorded in seconds.

Physical Activity Intervention

The physical activity intervention is a 12-week circuit training program designed to improve balance and coordination among children with ADHD. Each training session begins with a 7-minute warm-up and includes multiple circuits. The exercises within the circuits focus on single-leg balance exercises such as balance holds, heel-to-toe walks, and balancing on unstable surfaces with eyes

closed. Additionally, dynamic balance and coordination drills like cone zigzags, agility ladder drills, and stork stands on unstable surfaces are incorporated. Strength and sensory integration exercises, including activities with therapy balls and resistance bands, complement the balance training. The duration of each station starts at 30 seconds and progressively increases to 60 seconds over the course of the program. Rest periods are included between stations and circuits to allow for recovery.

Test Administration: Each participant was given a trial to familiarize themselves with the task, followed by two timed attempts. The best time was documented for analysis.

Reliability and Scoring: The test demonstrated a reliability coefficient of 87%, indicating good reproducibility. Scores were used to evaluate baseline balance and monitor improvements post physical activity intervention.

Safety

Supervision ensured participant safety throughout the test to prevent falls or injury.

Results

Table 1: Static Balance

Group	Test	Mean	Standard Deviation	Mean Difference	Standard Mean Error	't' ratio	Percentage of Changes
Experimental	Pre	13.97	1.94	5.21	0.43	11.94	37.2%
	Post	19.19	2.21				
Control	Pre	13.22	1.06	.283	0.27	1.03	2.1%
	Post	13.50	1.18				

*Significant at 0.05 level of confidence (The table value required for significance at 0.05 level with df 1 and 38 and 4.07)

The analysis of static balance among children with ADHD in the experimental and control groups revealed notable differences between pre- and post-test results. In the experimental group, the pre-test mean score was 13.97 with a standard deviation of 1.94. Following the intervention, the post-test mean rose significantly to 19.19 with a slightly higher standard deviation of 2.21. This reflects a substantial mean difference of 5.21. The standard error of the mean difference was 0.43, and the calculated 't' value was 11.94, which is statistically significant at the 0.05 level of confidence. The percentage change for the experimental

group stood at an impressive 37.2%, indicating a marked improvement in static balance performance as a result of the intervention. In contrast, the control group showed minimal change. The pre-test mean was 13.22 with a standard deviation of 1.06, while the post-test mean slightly increased to 13.50 with a standard deviation of 1.18. The mean difference was only 0.28, with a standard error of 0.27 and a 't' value of 1.03, which is not statistically significant. The control group's percentage change was a mere 2.1%, suggesting that without intervention, improvements in static balance were negligible.

Table 2: ANACOVA Analysis for Static Balance

Test	Experimental Group	Control	Source of Variance	Sum of Squares	Df	Mean Squares	Obtained 'F' Ratio
Pre-Test							
Mean	13.97	13.22	Between	5.67	1	5.67	2.30
S.D.	1.94	1.06	Within	93.54	38	2.46	
Post Test							
Mean	19.19	13.50	Between	323.42	1	323.42	102.54
S.D.	2.21	1.18	Within	119.9	38	3.154	
Adjusted Post Test							
Mean	18.96	13.73	Between	258.39	1	258.39	110.97
			Within	2.329	37	2.32	

(The table values of 4.08 and 4.07, respectively, were needed for significance at 0.05 level of significance with df 1 and 38 and 1 and 37)

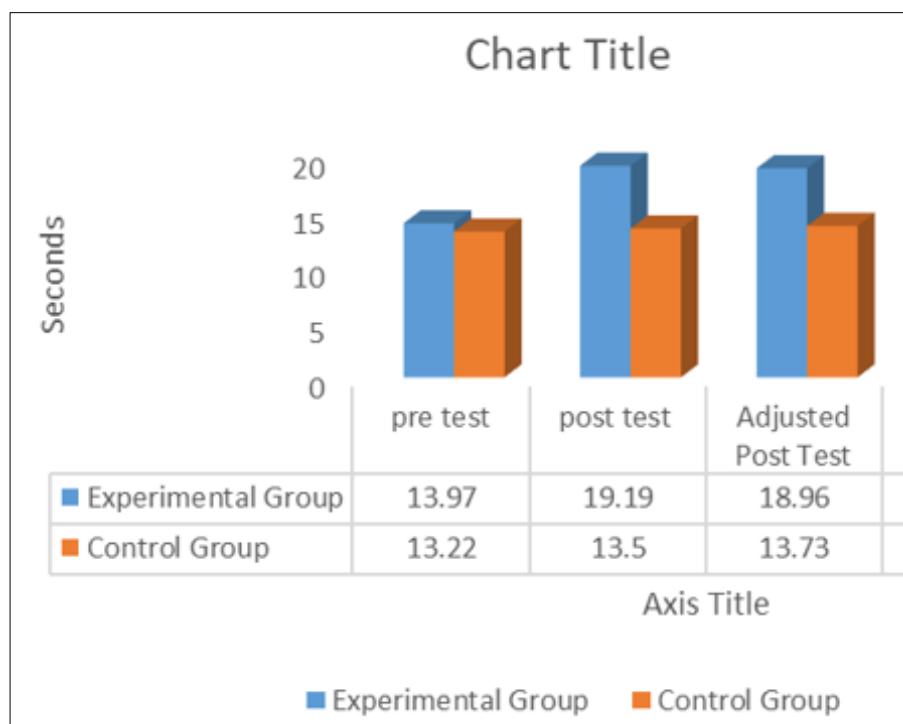


Fig 1: Bar Diagram Showing Pre test Post-Test and Adjusted Post- Test Means on Static Balance

The ANCOVA results for static balance provide a more refined statistical insight by adjusting for any pre-existing differences between the experimental and control groups. During the pre-test phase, both groups had relatively similar means: 13.97 for the experimental group and 13.22 for the control group. The between-group sum of squares was 5.67, with a corresponding F-ratio of 2.30, indicating no significant differences at the baseline. After the intervention, the post-test mean of the experimental group increased to 19.19 compared to 13.50 in the control group. The between-group sum of squares for the post-test was 323.42, yielding an F-ratio of 102.54, which is highly significant and well above the critical value of 4.07 required at the 0.05 level. More importantly, the adjusted post-test means, which account for initial differences, were 18.96 for the experimental group and 13.73 for the control group. The ANCOVA revealed a sum of squares of 258.39 and an F-ratio of 110.97, again significantly exceeding the critical threshold.

Discussion on Findings

The findings of this study demonstrate a significant improvement in static balance among children with ADHD who participated in the physical activity intervention. The experimental group showed a remarkable increase in mean static balance time from 13.97 seconds in the pre-test to 19.19 seconds in the post-test, representing a 37.2% enhancement. This improvement was statistically significant, as confirmed by a high 't' ratio (11.94) and supported by ANCOVA results with an obtained F ratio of 110.97 for the adjusted post-test scores. In contrast, the control group exhibited only a marginal increase of 2.1%, from 13.22 to 13.50 seconds, which was not statistically significant.

These results indicate that targeted physical activity interventions can effectively enhance postural stability and neuromuscular control in children with ADHD. The substantial improvement in static balance suggests that motor coordination-often compromised in this population due to neurodevelopmental differences-can be positively influenced through structured exercise programs. This aligns with

previous research emphasizing the benefits of physical activity in improving motor skills and decreasing fall risk in children facing similar challenges (Verret *et al.*, 2012; Cerrillo-Urbina *et al.*, 2015; Jia *et al.*, 2020) [4, 1, 6].

The lack of significant change in the control group highlights the necessity of specific intervention rather than natural developmental progression alone for improving postural control in children with ADHD. These findings have important clinical and educational implications, underscoring the role of physical activity as a practical and accessible means to enhance motor function and potentially support broader aspects of daily living and academic participation in children with ADHD. Future studies might explore the long-term effects of such interventions and their impact on dynamic balance and functional mobility (Chang *et al.*, 2025; Sun *et al.*, 2025; Martin-Rodriguez *et al.*, 2025) [5, 8, 7].

Conclusion

The present study conclusively demonstrates that targeted physical activity interventions significantly enhance static balance in children diagnosed with Attention Deficit Hyperactivity Disorder (ADHD). The experimental group exhibited a substantial improvement, with static balance time increasing by 37.2% from pre-test to post-test, a change that was statistically significant. Conversely, the control group showed minimal, non-significant changes, underscoring the effectiveness of specific intervention over natural development alone.

These findings highlight the pivotal role of structured physical activity in improving postural stability and neuromuscular coordination within this population, who often experience motor control difficulties due to neurodevelopmental factors. Improved static balance not only supports safe mobility and reduces the risk of falls but may also augment children's overall motor proficiency, self-confidence, and participation in daily and academic activities. Moreover, the static balance test proved to be a reliable and practical assessment tool for evaluating motor improvements resulting from intervention programs. This underscores its

value in both clinical and educational settings for monitoring progress.

Future research should consider long-term follow-up to assess the sustainability of these improvements and extend investigations into dynamic balance and functional motor tasks. Overall, the study reinforces the significance of physical activity as an accessible and impactful component of comprehensive care and support for children with ADHD.

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