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Research Article

Effect Of Ball Tapping and Jogging on Specific Stereotypical Behaviour in Children with Autism Spectrum Disorder: Experimental Study

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ABSTRACT

Background: Children with Autism Spectrum Disorder (ASD) often exhibit stereotypical behaviors, such as repetitive movements and routines, which can significantly affect their daily functioning. Addressing these behaviors is essential to improving their quality of life. Motor-based interventions like ball tapping and jogging have been shown to help regulate sensory processing and reduce stereotypical behaviors in children with ASD. Understanding the impact of these activities on reducing such behaviors is critical for developing effective therapeutic strategies.

Study Design: Experimental study.

Aim: To assess the effect of ball tapping and jogging on specific stereotypical behaviors in children with autism spectrum disorder.

Objectives:

- To assess self-injurious behavior, stereotypical behavior, and aggressive/destructive behavior in children with ASD.
- To evaluate the impact of ball tapping and jogging on reducing self-injurious behavior, stereotypical behaviors, and aggressive/destructive behavior in children with ASD.
- To compare the experimental and control groups in reducing stereotypical behaviors.

Participants: A total of 28 children (n=28) aged 9-14 years, diagnosed with autism spectrum disorder, participated in the study.

Methods: Children were randomly assigned to two groups: an experimental group (n=14) and a control group (n=14). The experimental group participated in a combination of ball tapping, jogging, and tactile-proprioception activities, while the control group engaged in tactile-proprioception and vestibular activities along with physical exercises. Behavioral data were collected at baseline and after a 2-month intervention.

Results: The experimental group showed significant reductions in self-injurious behavior (SIB), stereotypical behavior (SB), and aggressive/destructive behavior (ADB), with SIB decreasing from 9.21 to 7, SB from 44.93 to 39.64, and ADB from 9.07 to 7.07. Strong Pearson correlations supported these reductions (SIB: 0.910, SB: 0.966, ADB: 0.967). In contrast, the control group showed smaller, less consistent reductions. Statistical analysis confirmed the intervention's effectiveness, with p-values ≤ 0.001.

Conclusion: Ball tapping and jogging interventions were effective in reducing stereotypical behaviors in children with ASD. The experimental group demonstrated more consistent improvements compared to the control group. These findings suggest that ball tapping and jogging may be beneficial in managing challenging behaviors in children with ASD, although the improvements were modest.

Keywords: Autism Spectrum Disorder, Stereotypical Behavior, Physical Activity, Ball Tapping, Jogging.

INTRODUCTION

Autism Spectrum Disorder (ASD) refers to a neurological and developmental disorder that manifests in a variety of characteristic behaviors, including impairments in social interaction and communication[1]. Individuals with ASD often exhibit a broad range of strengths and challenges, which is why the term "spectrum" is used to describe the disorder. This reflects the wide variation in the intensity and type of symptoms across individuals with ASD. The core characteristics of ASD include difficulties in forming social relationships, challenges with communication (both verbal and non-verbal), and repetitive behaviors or restricted interests.[1]

ASD is a neurodevelopmental condition, meaning that it affects the development of the brain, particularly in areas responsible for communication, social interaction, and behavior regulation. Individuals with ASD may demonstrate stereotypical behaviors, such as repetitive actions (e.g., hand-flapping, body rocking), limited focus on particular topics or activities, and a resistance to change in routines. These behaviors are not merely habits but are often coping mechanisms that help individuals deal with environmental stressors, sensory overload, or frustration from difficulties in communication.[1]

In previous editions of the Diagnostic and Statistical Manual of Mental Disorders (DSM), ASD was categorized under pervasive developmental disorders (PDD), which included conditions like PDD-NOS (Pervasive Developmental Disorder – Not Otherwise Specified), Asperger's disorder, childhood disintegrative disorder, and classic autism. However, in the DSM-5, these separate diagnoses were merged under the umbrella term "autism spectrum disorder," reflecting the understanding that these disorders share common features but can vary in severity and presentation. This shift in classification acknowledges the spectrum of developmental challenges faced by individuals with ASD[2].

Stereotypical behaviors are one of the hallmark symptoms of ASD[2]. These behaviors are repetitive and often non-functional, and they can manifest in various forms, such as hand-flapping, body rocking, or repetitive vocalizations. While these actions may seem purposeless to an observer, they often serve an important role for individuals with ASD, particularly in terms of managing stress and sensory overload. Many individuals with ASD struggle with sensory processing, meaning they may be hypersensitive or under-responsive to sensory stimuli like noise, light, or touch. Stereotypical behaviors can help them self-regulate by providing sensory input that is calming or familiar[3].

However, these repetitive behaviors can also interfere with daily functioning, including the ability to participate in social activities, engage in educational tasks, or form meaningful relationships. This presents a challenge not only to the individual with ASD but also to their families, educators, and therapists. As a result, addressing and reducing stereotypical behaviors is often a central goal of therapeutic interventions[3].

A wide range of interventions have been explored to reduce stereotypical behaviors and promote more adaptive functioning in children with ASD. These interventions vary greatly, with some focusing on behavioral strategies, others on environmental modifications, and still others on physical or sensory-based activities. One promising avenue is the use of physical activities, such as ball tapping and jogging, as interventions to reduce repetitive behaviors and improve sensory processing.[4]

Ball tapping and jogging are activities that provide both proprioceptive and vestibular input. The proprioceptive system helps individuals perceive body position and movement, while the vestibular system governs balance and spatial orientation. Both systems play critical roles in regulating sensory processing, motor coordination, and self-regulation. For children with ASD, engaging in activities like ball tapping and jogging may offer sensory input that helps them better manage environmental stimuli and improve motor skills, while also serving as a natural and enjoyable way to reduce stereotypical behaviors[4].

The purpose of this study is to examine the effects of ball tapping and jogging on specific stereotypical behaviors in children with autism spectrum disorder (ASD). While previous research has highlighted the potential benefits of physical activities in reducing stereotypical behaviors, the outcomes have been mixed. Some studies report positive effects, while others find limited or no significant changes. The effectiveness of these interventions may vary based on individual factors such as the child's age, severity of ASD symptoms, and sensory processing needs.

METHODOLOGY

This study was conducted as an experimental study with data collected from OJAS Academy, Ramprastha, Ghaziabad. A total of 28 participants were selected, with the sample size determined by a statistical expert to ensure adequate power for meaningful analysis of the results. To select participants, a convenient sampling technique was used.

INCLUSION CRITERIA:

- Children aged 9–14 years.
- Children diagnosed with autism spectrum disorder (ASD) by a psychologist, neurologist, or pediatrician.
- Children exhibiting behavioral issues.
- Children who have not regularly participated in physical exercise outside of their school physical education classes for the past 6 months.

EXCLUSION CRITERIA:

- Children with one or more comorbid psychiatric disorders.
- Children diagnosed with a complex neurological disorder.
- Children with sensory deficits.
- Children with any musculoskeletal conditions.
- Children with an IQ below 40.

TREATMENT PROTOCOL

The treatment protocol for this study involved dividing the participants into two groups: Group A and Group B. Both groups engaged in a combination of activities aimed at addressing stereotypical behaviors in children with autism spectrum disorder (ASD). Group A participated in a program that included ball tapping, jogging, and additional tactile-proprioceptive and vestibular activities, while Group B engaged in similar tactile-proprioceptive and vestibular activities along with exercise. Each group underwent a 45-minute intervention session that included various exercises targeting sensory regulation and motor coordination. The interventions were conducted over a period of two months to assess the impact of these activities on reducing self-injurious, stereotypical, and aggressive/destructive behaviors in children with ASD.

OUTCOME MEASURE:

Behavior Problems Inventory 01 (BPI-01):

The BPI-01 is a comprehensive tool used to evaluate and quantify problem behaviors in individuals with intellectual and developmental disabilities, particularly those with ASD. It categorizes behaviors into three primary domains:Self-Injurious Behaviors (SIB): Behaviors that cause harm to the individual, Stereotyped Behaviors: Repetitive, non-functional movements or actions, Aggressive/Destructive Behaviors: Harmful actions directed toward others or the environment.

This structure allows for quantitative measurement and tracking of changes over time. The BPI-01 demonstrates strong inter-rater and test-retest reliability (greater than 0.75) and strong concurrent validity, with correlation coefficients ranging from 0.65 to 0.85[20].

DATA COLLECTION

An experimental study was conducted at Ojas Academy, Ramprastha, Ghaziabad, with 28 children aged 9–14 years diagnosed with autism by a psychologist or pediatrician. Children who had participated in regular physical exercise within the past six months, as well as those with comorbid psychiatric disorders, sensory issues, or an IQ below 40, were excluded from the study. The intervention lasted for two months. Data were collected using basic materials (pen, paper, and a table). Participants were selected through randomized sampling using the chit method.

DATA ANALYSIS

Upon completion of the pre- and post-treatment assessments, the data were compiled into a master chart and analyzed using IBM SPSS. Paired t-tests were used to compare motor coordination scores before and after treatment within each group (experimental and control groups).

RESULT

This study evaluates the effect of ball-tapping and jogging interventions on the behavioral patterns of children with autism spectrum disorder (ASD), specifically targeting self-injurious behaviors (SIB), stereotypical behaviors (SB), and aggressive/destructive behaviors (ADB).

Stats	Experimental Group							
	Pre				Post			
	SIB(FREQ)	*SB(FREQ)*	*ADB(FREQ)*	*TOTAL(FREQ)*	*SIB(FREQ)*	*SB(FREQ)*	*ADB(FREQ)*	*TOTAL(FREQ)*
Mean	9.214	43.929	9.071	62.214	7	24.7143	7.0714	38.7857
Standard Error	1.159	3.782	1.506	5.241	0.938	2.1673	1.2156	2.9746
Standard Deviation	4.336	14.150	5.636	19.608	3.508	8.1091	4.5483	11.1299
Sample Variance	18.797	200.225	31.764	384.489	12.308	65.7582	20.6868	123.8736

Table 1.0 Descriptive Statistics of Experimental Group

As presented in Table 1.0 (Descriptive Statistics of Experimental Group), the combined mean frequency of these behaviors in the experimental group decreased significantly from 62.21 pre-intervention to 38.79 post-intervention. Specific reductions were observed in each behavior: SIB reduced from 9.21 to 7, SB from 43.93 to 24.71, and ADB from 9.07 to 7.07. The standard deviation for SB decreased from 14.15 to 8.11, indicating not only a reduction in frequency but also a greater consistency in improvements. These findings underscore the significant impact of the ball-tapping and jogging intervention on reducing these behaviors in the experimental group.

Table 2.0 Descriptive Statistics of Control Group

Control Group								
	Pre				Post			
Stats	*SIB(FREQ)*	*SB(FREQ)*	*ADB(FREQ)*	*TOTAL(FREQ)*	*SIB(FREQ)*	*SB(FREQ)*	*ADB(FREQ)*	*TOTAL(FREQ)*
Mean	9.21	44.93	8.07	62.21	7.93	39.64	7.21	54.79
Standard Error	1.11	2.92	1.36	3.73	1.03	2.62	1.21	3.22
Standard Deviation	4.14	10.93	5.09	13.97	3.85	9.79	4.54	12.05
Sample Variance	17.10	119.46	25.92	195.10	14.84	95.79	20.64	145.26

In contrast, as shown in Table 2.0 (Descriptive Statistics of Control Group), the control group, which did not undergo the same intervention, showed more modest reductions. For SIB, the mean frequency decreased from 9.21 to 7.93, with a reduction in standard deviation (SD) from 4.14 to 3.85. SB decreased from 44.93 to 39.64, with a slight reduction in SD from 10.93 to 9.79, and ADB dropped from 8.07 to 7.21, with SD declining from 5.09 to 4.54. These results indicate some improvement, but the reductions were less significant compared to the experimental group.

Table 3.0 Comparison of Experimental and Control Group

t-Test:PairedTwoSampleforMeans -ExperimentalGroup									**t-Test:PairedTwoSampleforMeans – ControlGroup**							
	Pre	**Post**	**Pre**	**PosT**	**Pre**	**Post**	**Pre**	**Post**	**Pre**	**Post**	**Pre**	**PosT**	**Pre**	**Post**	**Pre**	**Post**
Stats	***SIB(FREQ)***	***SIB(FREQ)***	***SB(FREQ)***	***SB(FREQ)***	***ADB(FREQ)***	***ADB(FREQ)***	***TOTAL(FREQ)***	***TOTAL(FREQ)***	***SIB(FREQ)***	***SIB(FREQ)***	***SB(FREQ)***	***SB(FREQ)***	***ADB(FREQ)***	***ADB(FREQ)***	***TOTAL(FREQ)***	***TOTAL(FREQ)***
Mean	9.214	7	43.93	24.71	9.071	7.071	62.21	38.79	9.214	7.929	44.93	39.64	8.07	7.21	62.21	54.79
Variance	18.797	12.31	2002.3	65.76	31.764	20.687	384.49	123.87	17.104	14.841	119.46	95.79	25.92	20.64	195.10	145.26
Pearson Correlation	0.910		0.80		0.966		0.89		0.967		0.99		0.98		0.99	
P(T<=t) two-tail	0.001		0.00		0.0001		0.00		0.001		1.934E-08		0.0120087		3.27587E-07	
t Critical two-tail	2.160		2.16		2.160		2.16		2.160		2.160		2.160		2.160	

Table 3.0 (Comparison of Experimental and Control Groups) highlights the comparison of the intervention's effectiveness between the two groups. The experimental group demonstrated more pronounced improvements in all behaviors, with the mean frequencies for SIB, SB, and ADB decreasing significantly more than in the control group. For example, SIB in the experimental group decreased from 9.21 to 7, while the control group showed a smaller decrease from 9.21 to 7.93. Statistical analysis, including paired t-tests, revealed highly significant differences in the experimental group ($p \leq 0.001$), and Pearson correlation coefficients were strong across all behaviors (e.g., SIB: 0.910, SB: 0.966, ADB: 0.967), indicating a reliable relationship between pre- and post-intervention values.

These findings suggest that the ball-tapping and jogging interventions are significantly more effective in reducing stereotypical, self-injurious, and aggressive/destructive behaviors compared to the control group. The experimental group experienced consistent and substantial improvements, whereas the control group showed only modest reductions.

DISCUSSION

The study evaluated the effectiveness of ball-tapping and jogging interventions in reducing self-injurious behavior (SIB), stereotypical behavior (SB), and aggressive/destructive behavior (ADB) in children with autism. The results showed significant reductions in SIB (mean from 9.21 to 7), SB (mean from 44.93 to 39.64), and ADB (mean from 8.07 to 7.07) in the experimental group, compared to the control group. Paired t-tests and Pearson correlations confirmed the intervention's impact ($p \leq 0.001$). This study confirms the positive effects of physical interventions like ball tapping and jogging in reducing maladaptive behaviors in children with autism spectrum disorder (ASD). The findings align with previous research suggesting that physical activities can provide sensory regulation and reduce aggressive and stereotypical behaviors. For instance, José Pedro Ferreira (2019) conducted a study on the effects of physical exercise on the stereotyped behavior of children with ASD, concluding that physical exercise is effective in reducing the number of episodes of stereotypical behaviors in children diagnosed with ASD[7]. Similarly, Stefanie Schmitz-Olin (2016) conducted a study on the effects of exercise intensity on stereotypical behavior in children with autism, concluding that although high-intensity aerobic exercise may exacerbate stereotypical behaviors, low- to moderate-intensity exercise produces significant reductions in these behaviors. This provides an easily administered and cost-effective way to positively impact children with ASD[8]. Additionally, Ling Wang (2024) conducted an experimental study on the effect of sports activities on stereotypical behaviors in children with autism, concluding that sports activity interventions may be a promising approach to improving stereotypical behaviors and emphasizing the importance of addressing multiple levels of functioning in autism interventions[18].The significant improvements observed in the experimental group indicate that ball-tapping and jogging interventions are effective in managing challenging behaviors. The lack of change in the control group suggests that the interventions played a crucial role in the observed improvements.

CONCLUSION

In conclusion, this study suggests that ball-tapping and jogging interventions can effectively reduce self-injurious, stereotypical, and aggressive behaviors in children with ASD. While the reductions were modest, they were statistically significant, with less behavioral variability post-intervention. The experimental group showed more consistent improvements compared to the control group, supporting the intervention's effectiveness.

LIMITATIONS OF THE STUDY

- The long-term effects of the interventions were not assessed.
- The study is limited to single Neurodevelopmental disorder

RECOMMENDATIONS

- Assess the long-term effects of ball-tapping and jogging on behaviors in children with ASD.
- Use a larger and more diverse sample to enhance generalizability.
- Consider additional factors, such as parental involvement and environmental influences, in future studies.

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