Journal of Health and Rehabilitation Research 2791-156X JHRR
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Original Article

Comparative Effects of Core Stability Exercises and Retro-walk on Balance and Coordination in Down Syndrome

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Conflict of Interest: None.
Cheema RUR., et al. (2023). 3(2): DOI: https://doi.org/10.61919/jhrr.v3i2.149

ABSTRACT

Background: Individuals with Down syndrome (DS) often face motor deficits impacting balance and coordination. While core stability exercises are a recognized form of intervention, the potential benefits of Retro walking require further exploration.

Objective: To evaluate and compare the effects of core stability exercises and Retro walking on balance and coordination in individuals with DS.

Methods: This randomized clinical trial included 24 participants with a confirmed diagnosis of DS, aged 8-14 years, and with mild to moderate mental retardation. They were allocated into two groups: Group A, receiving core stability exercises, and Group B, undergoing Retro walking, both over an 8-week period. Inclusion criteria were the ability to stand and walk with a Pediatric Balance Scale (PBS) score of at least 14/56. Exclusion criteria encompassed any orthopedic, cardiac, or uncontrolled cardiovascular conditions. Assessments were conducted using the PBS and Foot Tapping Test, pre- and post-intervention. Data analysis was performed using SPSS version 25.0, employing paired and independent t-tests.

Results: Post-intervention, Group A exhibited an increase in PBS scores from 15.83±2.406 to 32.17±2.209 ($p < .001$), and Group B from 15.08±2.999 to 31.25±1.913 ($p < .001$). Foot Tapping Test scores for the right side improved from 9.92±1.311 to 20.17±2.082 in Group A ($p < .002$), and from 9.67±1.614 to 18.08±2.610 in Group B ($p < .003$).

Conclusion: Both core stability exercises and Retro walking significantly improved balance and coordination in children with DS. These modalities should be considered valuable additions to the therapeutic interventions for this population.

Keywords: Down Syndrome, Motor Deficits, Core Stability, Retro Walking, Randomized Clinical Trial, Pediatric Balance.

INTRODUCTION

Down syndrome (DS), a genetic disorder resulting from the presence of an extra copy of chromosome 21, presents a range of challenges including intellectual disabilities, metabolic, cerebral, biomechanical, perceptive, intellectual, and communicative difficulties (1). These challenges impact the ability of individuals with DS to develop life skills, with variations in the degree of independence achievable (2, 3). The etiology of DS, while not fully understood, is linked to factors such as maternal age over 35 and a higher likelihood in subsequent pregnancies after having a child with DS (4, 5). Some cases involve a rare inherited form, where parental chromosomal translocation leads to the condition in the child. Importantly, DS is diagnosed through cytogenetic testing, and while there's no cure, early intervention with various therapies can significantly improve outcomes (6).

Research in the field of physiotherapy has been instrumental in exploring methods to enhance the balance and coordination in individuals with DS. For instance, Reham Saeed Alsakhaw et al. (2022) compared the effects of core stability exercises and treadmill activities on balance in children with DS, finding significant improvements in functional balance and stability (7). Similarly, a study by Balouchy et al. (2022) highlighted the efficacy of occupational therapy incorporating stability and coordination exercises in enhancing the skills of children with special needs (8). Moreover, Saeed Ghaeeni et al. (2021) demonstrated that an 8-week core stability training program significantly improved proprioception and spinal alignment in children with DS (9).

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In Egypt, Gheitasi et al. (2019) conducted study that underscored the positive impact of core stability exercises on balance and muscle strength in children with DS (10). These findings are consistent with those of Bekhet et al. (2019) in the USA, who emphasized the benefits of aerobic exercise and physical training for this demographic (11). From a different perspective, Doernberg et al. (2021) in Sri Lanka observed that balance abilities in children with DS were considerably lower than their peers, indicating a crucial area for intervention (12, 13). Burkhardt el (2020) also contributed to this area of research by showing how weight lifting and core muscle exercises could aid adolescents with postoperative pain, enhancing physical capacity and quality of life (14).

Additionally, studies have also examined the effectiveness of backward walking training in improving balance and coordination. For example, Ji-Young Choi et al. (2021) found that backward walking training with motor dual tasks was more effective than forward walking training in improving balance and walking functions in children with cerebral palsy (15). Similarly, Elnahhas et al. (2019) concluded that backward walking training is more effective than forward walking training on spatiotemporal gait parameters and gross motor function measures in children with Hemiparetic cerebral palsy (16). However, there is still a lack of comprehensive studies specifically focused on the effects of backward walking combined with whole body vibration in children with cerebral palsy, as noted in a 2021 study (17, 18).

Despite these advances, there remains a gap in the literature regarding the specific effects of retro walking on balance and coordination, particularly in individuals with DS (19, 20). The existing studies, while informative, are often short-term, limiting our understanding of the long-term impacts of these interventions (21). This gap signifies the need for further research, particularly studies of longer duration, to more comprehensively understand the potential benefits of core stability exercises and retro walking on balance and coordination in individuals with Down syndrome (22).

MATERIAL AND METHODS

The study, designed as a randomized clinical trial, aimed to compare the effects of core stability exercises and Retro walk on balance and coordination in individuals with Down syndrome. Conducted at the Department of Physical Therapy at Children's Hospital Lahore, it spanned a duration of six months following the approval from the ethical committee of Riphah College of Rehabilitation Sciences (RCRS). The sample size, comprising 24 participants, was determined using Epitool, referencing the article “Effect of core stability exercise on postural stability in children with Down Syndrome a randomized control study." This size was calculated based on specific mean and variance values with a 0.9 confidence level and 0.8 power, resulting in 12 participants per group.

Participants were recruited using a convenience sampling technique and were then assigned to one of two groups. Group A received conventional treatment coupled with core stability exercises, and Group B underwent conventional treatment along with Retro walk. Both treatments were administered for 30 minutes, five days a week, for a duration of eight weeks. The conventional treatment encompassed speech, physical, occupational, and educational therapies.

Inclusion criteria for the study were children aged between 8 and 14 years with a confirmed diagnosis of Down syndrome and mild to moderate mental retardation, as per the Stanford Binet Intelligence Scale. Furthermore, participants were required to have the ability to stand and walk independently, indicated by a minimum score of 14/56 on the Pediatric Balance Scale. Conversely, children with orthopedic limitations, congenital heart defects, or uncontrolled cardiovascular diseases were excluded from the study.

The Pediatric Balance Scale, a modified version of the Berg Balance Scale, was employed to assess functional balance skills in school-aged children. Additionally, the Foot Tapping Test, involving bilateral toe tapping while seated, was used to measure coordination. The number of taps within a 10-second timeframe was recorded for analysis.

In terms of treatment, the initial visit involved a thorough screening of participants, including medical history and current complaints or symptoms. Conventional physical therapy treatment was administered to both groups, focusing on general strengthening exercises of the upper and lower extremities. Group A additionally engaged in core stability exercises as outlined by Saeed Ghaeeni et al. (2019), while Group B participated in Retro walk exercises on an even surface. Pre and post-intervention assessments were conducted using the Pediatric Balance Scale and Foot Tapping Test, with outcomes measured before and immediately after the 8th week of the treatment session.

Data analysis was performed using SPSS version 22 for Windows software, applying paired t-tests and independent t-tests to interpret the results. Descriptive statistics including bar charts, pie charts, and frequency tables were used for demographic data such as gender, age, and location.

The study adhered to ethical considerations, with approval sought from the ethical committee of Riphah International University, Lahore. Written informed consent was obtained from each participant, ensuring confidentiality of their data. Additionally, permission for the study was granted by the study setting. The study was single-blinded, with participants unaware of the treatment modalities assigned to the other group, although blinding of clinicians and assessors was not possible due to the distinct nature of the interventions in each group.

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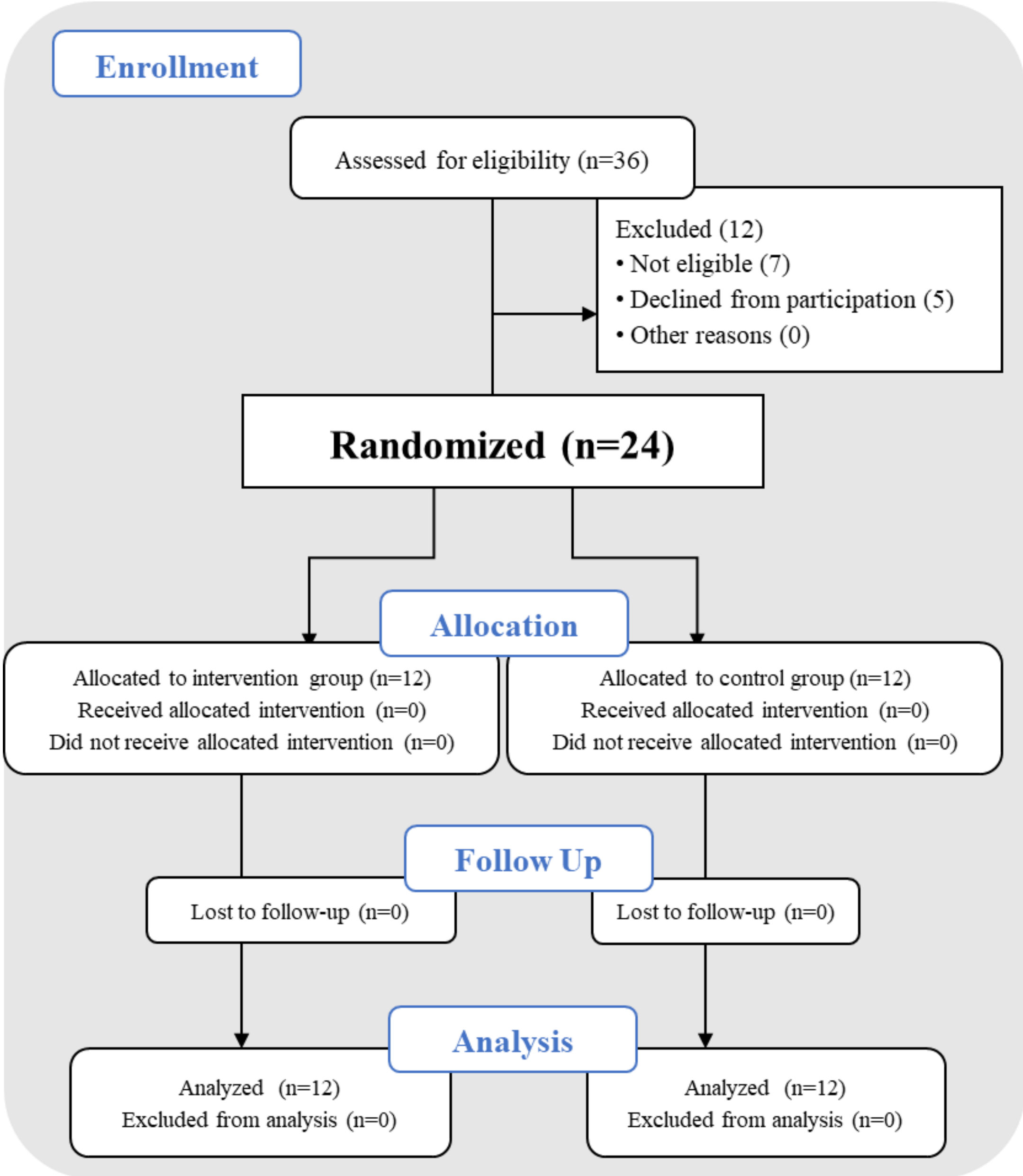

Figure 1 CONSORT Flow Chart

RESULTS

The consolidated participant data for the two groups involved in the study, Group A (Core Stability Exercise) and Group B (Retro Walk), indicates that each group consisted of 12 participants. The average age of participants was similar between the two groups, with Group A having an average age of 10.08 years (SD: 3.728) and Group B with an average age of 10.17 years (SD: 2.98). Body Mass Index (BMI) averages were slightly higher in Group B at 26.46 (SD: 2.611) compared to Group A's average BMI of 25.42 (SD: 3.476). Gender distribution showed a higher percentage of females in Group A (67%) compared to Group B (33%), with the reverse being true for male participants. The majority of participants in both groups were classified as overweight, with Group A at 75% and Group B at 67%.

Characteristics	Group A (Core Stability Exercise)	Group B (Retro Walk)
Number of Participants	12	12
Average Age of Participants (Years)	10.08 (SD: 3.728)	10.17 (SD: 2.98)
Average Body Mass Index (BMI)	25.42 (SD: 3.476)	26.46 (SD: 2.611)
Gender Distribution		
Female	8 (67%)	4 (33%)
Male	4 (33%)	8 (67%)
BMI Distribution		
Normal	3 (25%)	4 (33%)
Overweight	9 (75%)	8 (67%)
Total Participants	12 (100%)	12 (100%)

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The between-group analysis for pre- and post-treatment outcomes demonstrated that both Group A and Group B showed improvements after the interventions. Specifically, in the pre-treatment phase, Group A had an average Pediatric Balance Scale score of 15.83 (SD: 2.406) with a mean difference of 0.75 (SD: 0.593), while Group B scored slightly lower at 15.08 (SD: 2.999). Post-treatment scores improved for both groups, with Group A reaching 32.17 (SD: 2.209) and Group B at 31.25 (SD: 1.913), with Group A showing a mean difference of 0.92 (SD: 0.296) and a t-statistic of 1.087 (p-value: .289). Notable improvements were also seen in the Foot Tapping Test results, with Group A showing a post-treatment mean difference of 2.09 (SD: 0.538) with a t-statistic of 2.162 (p-value: .052), indicating a significant change from pre-treatment scores.

Table: Between-Group Analysis Comparing Pre- and Post-Treatment

Sr. No	Treatment Phase	Group	Mean ± S.D	Mean Difference	t-statistic	p-value
Pediatric balance scale	Pre-Treatment	A	15.83±2.406	0.75±0.593	.676	.507
		B	15.08±2.999			
	Post-Treatment	A	32.17±2.209	0.92±0.296	1.087	.289
		B	31.25±1.913			
Foot tapping test (Right	Pre-Treatment	A	9.92±1.311	0.25±0.303	.416	.681
		B	9.67±1.614			
	Post-Treatment	A	20.17±2.082	2.09±0.538	2.162	.052
		B	18.08±2.610			
Post Foot tapping test (Left)	Pre-Treatment	A	8.42±1.443	0.25±0.14	-.445	.681
		B	8.37±1.303			
	Post-Treatment	A	16.67±1.826	0.08±0.538	-.129	.052
		B	14.75±1.288			
Foot tapping test	Pre-Treatment	A	10.92±1.443	0.16±0.230	-.303	.765
		B	11.08±1.240			
	Post-Treatment	A	19.83±2.209	0.5±0.595	-.633	.533
		B	20.33±1.614	-	-	-

Table: Within-Group Analysis for Group A and Group B

Group	Tool	Pre-treatment Mean ± S.D	Post-Treatment Mean ± S.D	t-value	p-value
A	Pediatric Balance Scale	16.83±2.604	32.17±2.209	-23.167	.001
	Foot Tapping Test (Right)	9.92±1.311	20.17±18.08	-23.788	.002
	Foot Tapping Test (Left)	8.42±1.433	16.67±1.826	-13.606	.003
	Foot Tapping Test (Bilateral)	9.92±1.443	19.83±2.209	-19.800	.001
B	Pediatric Balance Scale	15.08±2.999	31.17±2.209	-23.167	.001
	Foot Tapping Test (Right)	8.67±1.641	18.08±2.610	-23.788	.003
	Foot Tapping Test (Left)	10.37±1.303	14.75±1.288	-13.606	.002
	Foot Tapping Test (Bilateral)	9.08±1.240	20.33±1.614	-19.800	.002

The within-group analysis for both groups revealed statistically significant improvements from pre-treatment to post-treatment measures. In Group A, the Pediatric Balance Scale scores showed a considerable increase from a mean of 16.83 (SD: 2.604) to 32.17 (SD: 2.209) with a t-value of-23.167 (p-value: .001). Similarly, the Foot Tapping Test results for the right, left, and bilateral measures

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all showed significant improvements, with t-values ranging from-13.606 to-23.788 and p-values from .001 to .003. Group B mirrored these positive outcomes, with the Pediatric Balance Scale scores also showing a substantial rise from a mean of 15.08 (SD: 2.999) to 31.17 (SD: 2.209) and Foot Tapping Test results exhibiting significant enhancements with t-values of-13.606 to-19.800 and p-values from .001 to .003. These results indicate that both core stability exercises and Retro walk have a positive impact on balance and coordination in individuals with Down syndrome.

DISCUSSION

The discussion of the study findings aligns with previous research, indicating that core stability exercises and Retro walk are beneficial for improving balance and coordination in individuals with Down syndrome (23). This conclusion is drawn from significant improvements observed in postural balance and coordination measures following the interventions (24). The study's outcomes resonate with the work of Dunsky et al. (2019), which highlighted the efficacy of therapeutic programs that include balance and coordination practice (25). Similarly, Suh et al. (2019) found that core stability training enhanced postural control in this population (26).

The current research further supports the findings of PUNTUMETAKUL et al. (2021) who reported improvements in equilibrium and stabilizer muscle function following core stability exercises (27). These findings are particularly relevant as they substantiate the potential of physiotherapeutic interventions to mitigate some of the motor function challenges faced by individuals with Down syndrome. Furthermore, the research is in line with the studies by Angulo et al. and Jia et al., which emphasize the role of physical activity in improving the overall functioning of individuals with Down syndrome (28, 29).

The study also echoes the findings of Anoop Aggarwa et al. (2019) and Alshimaa Ramadanat el, who investigated the effects of core strengthening on balance, pain reduction, and overall well-being. Moreover, the meta-analysis by Junker and Stöggl and the research by Doğan the evidence that core stability exercises are associated with improved postural coordination and balance (30, 31).

However, the discussion must acknowledge the limitations of the current study. One notable limitation is the exclusion of other factors that may influence function and pain, which could provide a more comprehensive understanding of the impact of the interventions. Moreover, the effect of varying activity levels on the outcomes has not been explored.

Given these considerations, future research should investigate the intrinsic and extrinsic risk factors that may influence the general population. It would also be beneficial to extend this study to rural areas to enhance awareness of appropriate activity levels and the benefits of targeted exercises. Additionally, further research into how core stability exercises influence daily activities and interventions for other symptoms associated with Down syndrome would be valuable.

CONCLUSION

The findings from the current study suggest that both core stability exercises and Retro walking are beneficial interventions for improving balance and coordination in individuals with Down syndrome. These therapeutic modalities have shown to be effective and can be integrated into existing treatment programs to address some of the motor deficits associated with Down syndrome. The positive changes in postural balance and coordination as a result of these interventions provide a compelling case for their adoption in clinical practice.

The implications of this study support the practical inclusion of core stability exercises and Retro walking into therapeutic programs for individuals with Down syndrome, highlighting potential benefits in daily functioning and independence. These findings can guide clinicians in enhancing rehabilitation strategies, offer families evidence-based options for improving the quality of life of their loved ones, and encourage further research into optimizing and tailoring interventions for this population. Moreover, recognizing the broader societal and healthcare system benefits, such as increased social participation and potential cost reductions, underscores the value of these interventions in public health initiatives.

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