Original Article

Comparison of Static Cycle and Treadmill Training on Gait Parameters in the Children with Down Syndrome

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ABSTRACT

Objective: To compare the effects of Static Cycle and Treadmill Training on Gait Parameters in the Children with Down syndrome.

Study Design: Randomized Control trial study

Place and Duration of Study: This study was conducted at the Ali Children Clinic Shadman, Lahore from April 2020 to October 2020 for a period of six months.

Materials and Methods: Non-probability sampling technique was used to select a sample of 30 patients from Ali children clinic, Shadman Lahore. Patients randomly allocated into two groups. Group A was given conservative treatment along with static cycle and group B was given conservative treatment with Static cycle and treadmill training 2 days per week. The Pre and Post values of the gait parameters are taken by using the Wisconsin and Dynamic gait index as a tools. Gait can be corrected by using various exercise interventions. Data was analyzed by using SPSS version 25.

Results: Group B showed better outcomes. It has suggested that group B who received both treadmill and static cycle showed significant improvement in the gait parameters.

Conclusion: It was concluded that static cycling along with treadmill intervention showed significant improvement in terms of gait parameters in Down syndrome children.

Key Words: Static Cycle, Treadmill Training, Gait Parameters, Children, Down Syndrome

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INTRODUCTION

Down syndrome is also called the trisomy 21; it is a genetical abnormality that is caused by the presence of all or part of a third copy of chromosome 21. Down syndrome disease affect the children the most effected part of the child is brain because the capacity of the brain to perceive and to respond appropriately will diminished in these child they have some defect in the cognitive function and certain limitation in communication and other social skills. Down syndrome is the chromosomal defect and it is develop in 1 out of 691 babies[1-3]. It is usually related to, delay in physical growth and mild to moderate intellectual disability and other associated characteristic. Down syndrome child are mostly affected by several infection and the prevalence of the infection rate is extremely high. Because poor immunity. The defense system of the body has poor power to fight against the foreign invading infection. To prevent from the recurrent attack of infection the immunization program is recommended by Pediatrician. In first year of the life down syndrome has 62 fold higher ration to develop the pneumonia[4]. In children with Down syndrome compromised function, physical growth delay, affected Lower limb strength, step length, stride length and improper weight shifting during walk are major problems, in down syndrome, Reduced strength in lower limb muscle contributes to the decline in velocity and walking pattern of Down syndrome child. These problems can be minimized by Applying Various Techniques that purely fall under the category of the neuromuscular physical therapy.[5] Moreover, children with Down syndrome also appear to exhibit delayed motor development due to hypotension, ligamentous

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weakness, Frequent history of fall due to poor postural control and balance problem has seen while performing task in the outside enviourment[6].Treadmill device helps to prevent the disuse atrophy in Down syndrome child. Treadmill help to increase the transmission of sensory information (pro-pioceptive sensation) to brain also increase the awareness of body posture and improvement in the balance. If we start the treadmill training in early life it will start helping the child to attain the alternating walking without any delay. Down syndrome child has a major issue of hypotonia and osteoporosis. These problems can be reduce by progressively increasing the speed of the treadmill and time of treadmill training.[7] In infant normal development will have a wider gait pattern in start of the life due to poor balance and joint control. Infant used to walk with wider Stride length or base and small step length. But with the passage of time the gait pattern and the stride width and step length and other parameter has changed. It is very difficult for these children to learn the new task and complete their milestones on time. Static cycle helps to improve the proprioceptive and kinesthetic sensation and this will increase the speed to complete the milestones like walking running sitting standing and weight shifting as well. Sound information about the Static cycling in child also shows many significant results. Some study proved its effect in development of gait parameter in child and increased the speed as well. Increase in lower limb strength will help the children to improve its ambulation.[8]

The gait is consisted of the two major phases the swing phase and the stance phase. The swing phase is further subdivided in the initial swing, pre swing, mid swing and terminal swing. The stance phase is subdivided into heel contact, foot flat, mid stance, heel off and toe off. The 60% of the gait walk is consisted of the stance phase and 40% of the overall gait cycle is consisted of swing phase. Normal gait helps an individual to perform its entire daily task, any issue in the gait will leads to the improper walk, frequent fall, improper weight shifting, slow speed.[9]

MATERIALS AND METHODS

i. Inclusion Criteria

- Children categorized at level I of the Gross Motor Function Classification System.
- Children with Down syndrome with Age group 5-13 years old children were included, Children with normal (BMI) (normal BMI 18.5-24.9)[10]

ii. Exclusion Criteria:

- Those children who could not followed appropriately the guidelines given through the therapist, i.e., that rejected to collaborate with the therapist (even after several attempts.

A. Data Collection Tool:

- **Dynamic Gait Analysis**

(Inter-rated reliability (0.96-0.96) and intra-rated reliability (0.68-0.83)[11]

- **Wisconsin Gait Scale for Child**

Inter-rated reliability (0.81-0.91) and intra-rated reliability (0.75-0.90)[12]

B. **Place and Duration of Study:**

This study was conducted at Ali children clinic Shadman Lahore from April 2020 to October 2020 for a period of six months.

C. Data Collection Procedure:

Firstly, consent was taken. Subjects willing to participate are divided into two groups.

Before the treatment of both groups, detailed gait analysis was assessed by a Wisconsin gait scale and dynamic gait index.

D. Intervention

Static cycle intervention in Group A

Group A received the specific conservative treatment and followed the protocol by receiving the Static cycle training around 10 minute. We had broken the whole treatment protocol in 3 different intervals, with time duration of 3, 3, 4 minute and rest interval was 2 minute in each interval.[13]

E. Treadmill training and Static cycle intervention in Group B

Group B received the conservative treatment along with static cycle also received the specific treatment and follows the protocol by receiving the treadmill training around 10 minute. We break the whole treatment protocol in 3 different intervals, with time duration of 3,3,4 minute and rest interval was around 2 minute in each interval Speed was Around 5-7km/h.[14]

F. Data Analysis Procedure:

Statistical analysis was performed to analyze the effect of the treatment applied to the subjects of both control and experimental groups. It was done by using the IBM SPSS Inc.25.0 version. For this, the data was incorporated in MS excels spreadsheet. Out of 30 subjects 15 were randomized into Group 1 and 15 are randomized into Group 2. All the 30 subjects complete the entire protocol as defined by 6 months of treatment. The outcomes of the study were gait parameters. Statistical tools paired t-test was performed for parameters in between groups and paired sample t-test for parameters within the group. Descriptive measures like mean, the standard deviation was reported along with the p-value.

RESULTS

The mean age of participants in experimental group was 8.11± 2.27 and mean age of conventional group 9.50± 1.78 of. Mean and standard deviation of BMI for experimental group was 19.14 ±0.43 and 19.29±0.45 for conventional group.

The outcomes were assessed by Wisconsin gait scale and dynamic gait index.

The mean and standard deviation of Wisconsin gait scale in pre value was 26.25± 6.75 and the post value of Wisconsin gait within group was 21.68±6.04. The mean difference between pre and post Wisconsin gait value were calculated 4.75±0.71. The P value between pre and post value with in group (<0.05) show significant difference. The mean and standard deviation of Dynamic gait scale in pre value was 11.16± 4.64 and the post value of Dynamic gait within group was 13.76±4.34. The mean difference between pre and post Dynamic gait value were calculated -2.6±0.3. The P value between pre and post value with in group (<0.05) show significant Difference. Between groups comparison was made by using T test and it showed no significant change has seen in both group. but some Gait parameters like Hip hiking, Step length, Stride width show significant difference.

Figure 1: Shows Histogram of Frequency of the mean Age of 8.80 both Group A and Group B. The standard deviation was 2.

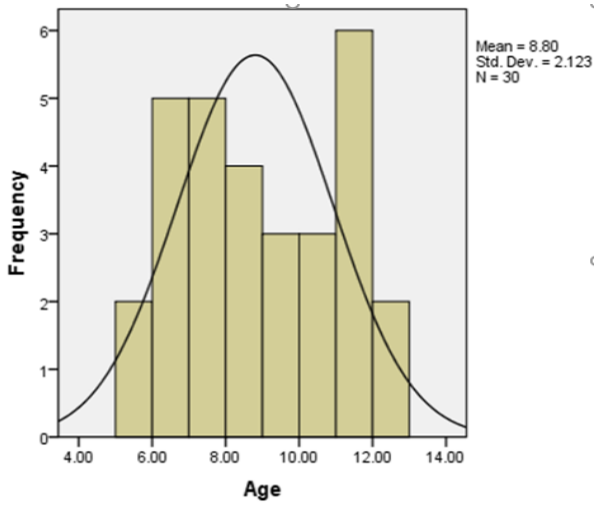

Figure No.1: Age

Figure 2: Shows Histogram of Frequency of Mean BMI 19.22 of both Group A and Group B Combine. The standard deviation was 0.437.

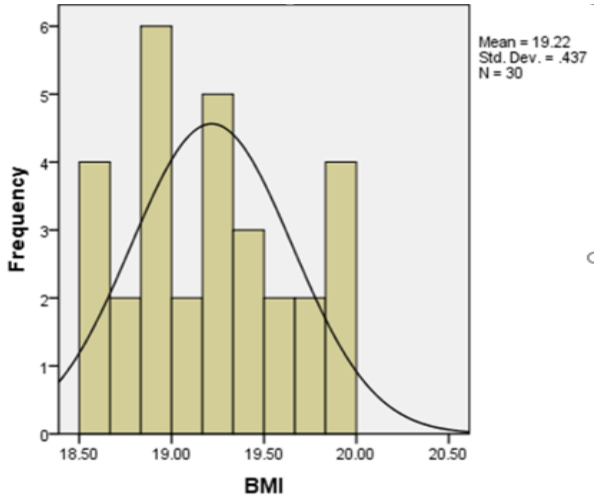

Figure No.2: BMI

Table 1: Shows the descriptive Means and standard deviation of Pre and post Dynamic gait index and pre and post Wisconsin gait scale Separately of Group A and B Overall.

Table No.1: Descriptive Means and standard deviation

	Overall	Treatment	
		Group A	Group B
Pre Wisconsin Gait	26.75 ± 6.62	26.47 ± 7.43	27.03 ± 5.95
Pre Dynamic Gait	10.80 ± 4.54	10.53 ± 5.01	11.07 ± 4.17
Post Wisconsin Gait	21.68 ± 6.06	23.45 ± 7.35	20.04 ± 4.18
Post Dynamic Gait	13.76 ± 4.34	12.33 ± 4.92	15.08 ± 3.40

Table 2: Shows within group comparison in which pre and post mean score of Dynamic and Wisconsin scale among group A and B> There is a significance difference.

Table No.2: Within Group Comparison

		Mean ± SD	P-value
Pair 1	Pre Wisconsin Gait	26.25 ± 6.76	0.001*
	Post Wisconsin Gait	21.68 ± 6.05	
Pair 2	Pre Dynamic Gait	11.16 ± 4.64	0.001*
	Post Dynamic Gait	13.76 ± 4.34	

Table:3 Shows the In between group comparison There was not a significance difference (p<0.05) between Post Wisconsin value of the both groups.

Table No.3: In between group comparison

	Wisconsin Gait scale	Conventional Group	Experimental Group	P value
Mean ± Standard Deviation	Pre Wisconsin	26.47±7.43	27.03±5.95	0.823
	Post Wisconsin	23.45±7.35	20.04±4.18	0.163
	Mean Difference	3.02±0.08	6.99±1.77	

Table:4 Shows the between group comparison There was not a significance difference (p<0.05) between Post dynamic value of the both groups.

Table No.4: The between group comparison

	Dynamic Gait	Conventional Group	Experimental Group	P value
Mean ± Standard Deviation	Pre Dynamic	10.53±5.01	11.07±4.16	0.754
	Post Dynamic	12.33±4.92	15.08±3.40	0.116
	Mean Difference	-1.8±0.09	-4.01±0.76	

DISCUSSION

There was no significant difference between the pretreatment values of two groups according to

Wisconsin gait and Dynamic gait (p value <0.05). Overall the post Wisconsin gait significantly improve in both groups but the P value while comparing the post value of group A and group B was not significant .also the Overall post dynamic gait improved in both groups but the P value had not been significant. This was coherent with the study of Gehan H El-Meniawy, et.al (2012) in which two different exercise interventions given to the groups.[15]

.It had observed that significant improvement had seen because the p value was significant (<0.05) while comparing the post value in the step length and hip hiking, stride width and walking speed of both groups A and B. This result of this study was coherent with the study of Amber Calhoun et al.[16]

The result of our study has showed a significant(<0.05) improvement in the motor development and speed of the walking off Down syndrome child after taking specific static and treadmill training. The values of result in post value of the step length between both groups show a significant improvement in the step length and walking speed. This improved the walking speed and more shift of stance phase toward swing this study is coherent with the study conducted by Matthew beers et al.[17]

The stretching exercises had given a better result in improving the control and flexibility in the body structure. This is coherent with the study of Goncalo V Mendoca et al. (2011) they proved that combined aerobic and resistance exercise increase the exercise capacity if patients with down syndrome.[18]

These findings were also coherent with the study of Christophe Maïano et al. which showed that exercise intervention improve balance and gait pattern in children and adolescents with Down syndrome.[19]

Group B patients was significantly(<0.05) improve as compare to that of patient in Group A, which showed that addition of treadmill training efficiently improve the Wisconsin gait as compare to the static cycling alone. It is coherent with the study of Dale A et al.[20]

CONCLUSION

Static cycles along with treadmill training were more effective and improving the gait parameters as compare to the static cycle alone. The results of our study show a significant improvement in the group B who received the both static cycle and treadmill training along with some conventional treatment protocol (stretching And Isotonic resistance training).

Limitation:

i. Due to pandemic the follow up visit should not have conducted as we have planned.
ii. The behavior of child is major stereotype to break during this treatment protocol.
iii. Wisconsin gait Tool has been used and it was too long having 14 different parameters and children were reluctant during the assessment time.

Recommendation:

i. To reduce the Error, future researchers should use a larger sample size.
ii. Future studies on gait metrics in Down syndrome children will use a sample size of less than ten children. Because as people get older, they have various aberrant synergies associated to gait. This will aid in the development and improvement of the results.
iii. Subsequent research should focus on using visual graphical aid to commence gait in children with severe gait issues.

Author's Contribution:

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Conflict of Interest: The study has no conflict of interest to declare by any author.

REFERENCES

1. Frank K, Esbensen AJ. Fine motor and self-care milestones for individuals with D own syndrome using a Retrospective C hart Review. J Intellectual Disability Research 2015;59(8):719-29.
2. Bull MJ. Health supervision for children with Down syndrome.
3. So S, Urbano R, Hodapp R. Hospitalizations of infants and young children with Down syndrome: evidence from inpatient person-records from a statewide administrative database. J Intellectual Disability Res 2007;51(12):1030-8.
4. Smith DS. Health care management of adults with Down syndrome. Am Family Physician 2001;64 (6):1031.
5. Pangalos C, Avramopoulos D, Blouin JL, Raoul O, DeBlois MC, Prieur M, et al. Understanding the mechanism (s) of mosaic trisomy 21 by using DNA polymorphism analysis. Am J Human Genetics 1994;54(3):473.
6. Palisano RJ, Walter SD, Russell DJ, Rosenbaum PL, Gémus M, Galuppi BE, Cunningham L. Gross motor function of children with Down syndrome: creation of motor growth curves. Archives of Physical Medicine Rehabilitation 2001;82(4): 494-500.
7. Tsimaras V, Giagazoglou P, Fotiadou E, Christoulas K, Angelopoulou N. Jog-walk training in cardiorespiratory fitness of adults with Down

syndrome. Perceptual and motor skills 2003;96 (3_suppl):1239-51.
8. Torfs CP, van den Berg BJ, Oechsli FW, Cummins S. Prenatal and perinatal factors in the etiology of cerebral palsy. J Pediatr 1990;116(4):615-9.
9. Xue D, Sayana A, Darke E, Shen K, Hsieh JT, Luo Z, et al. Vision-based gait analysis for senior care. arXiv Preprint arXiv:181200169. 2018.
10. Bax M, Goldstein M, Rosenbaum P, Leviton A, Paneth N. Proposed definition. Dev Med Child Neurol 2005;8:571-6.
11. Jonsdottir J, Cattaneo D. Reliability and validity of the dynamic gait index in persons with chronic stroke. Archives of Physical Medicine and Rehabilitation 2007;88(11):1410-5.
12. Yaliman A, Kesiktas N, Ozkaya M, Eskiyurt N, Erkan O, Yilmaz E. Evaluation of intrarater and interrater reliability of the Wisconsin Gait Scale with using the video-taped stroke patients in a Turkish sample. Neuro Rehabilitation 2014;34(2): 253-8.
13. Siebert KL, DeMuth SK, Knutson LM, Fowler EG. Stationary cycling and children with cerebral palsy: case reports for two participants. Physical & Occupational Therapy Pediatr 2010;30(2):125-38.
14. Holzapfel SD, Ringenbach SD, Mulvey GM, Sandoval-Menendez AM, Cook MR, Ganger RO, et al. Improvements in manual dexterity relate to improvements in cognitive planning after assisted cycling therapy (ACT) in adolescents with down syndrome. Research in developmental disabilities 2015;45:261-70.
15. Lloyd M, Burghardt A, Ulrich DA, Angulo-Barroso R. Physical activity and walking onset in infants with Down syndrome. Adapted Physical Activity Quarterly 2010;27(1):1-16
16. Calhoun SPT A, Halle SPT S, Looper P. Center-Based Treadmill Training for an Infant with Down Syndrome Not Yet Pulling to Stand 2020.
17. Beerse M, Henderson G, Liang H, Ajisafe T, Wu J. Variability of spatiotemporal gait parameters in children with and without Down syndrome during treadmill walking. Gait Posture 2019;68:207-12.
18. Mendonca GV, Pereira FD, Fernhall B. Effects of combined aerobic and resistance exercise training in adults with and without Down syndrome. Archives Physical Medicine Rehabilitation 2011; 92(1):37-45.
19. Maïano C, Hue O, Lepage G, Morin AJ, Tracey D, Moullec G. Do exercise interventions improve balance for children and adolescents with down syndrome? A systematic review. Physical Therapy 2019;99(5):507-18.
20. Ulrich DA, Lloyd MC, Tiernan CW, Looper JE, Angulo-Barroso RM. Effects of intensity of treadmill training on developmental outcomes and stepping in infants with Down syndrome: a randomized trial. Physical Therapy 2008; 88(1):114-2.