Effects of Gluteal Muscle Focused Exercise Regimen on Functional Movement and Posture in Children with Down Syndrome: Pilot Study

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Abstract

**Background:** This article emphasizes the importance of the gluteal muscles in children with Down syndrome, revealing their impact on posture and functional movement.

**Purpose:** The motive of this study was to assess the remedial effects of the gluteal muscle exercise regimen as compared to the conventional protocol for Down syndrome and develop the most efficient treatment protocol for children with down syndrome.

**Materials and Methods:** Twelve children with Down syndrome received 8 weeks of continuous therapy, divided into conventional and Gluteal muscle exercise regimen groups using randomization. Pre and post-treatment levels of functional movement and posture were recorded and analyzed using GMFM and Posture Screen Mobile Posture Assessment.

**Results:** The Glutes group showed higher mean GMFM scores and better improvement in posture in 67% of the 6 comparisons, while the remaining subjects didn’t show any notable difference.

**Conclusion:** The gluteal muscle exercise regimen group demonstrated more remarkable improvement than the conventional exercise group in both functional movement and posture in children with downs syndrome in a 8 week protocol.

**Keywords:** Rehabilitation, Mobility, Motor Development, Down Syndrome, Gluteal Complex

Introduction

Down syndrome or Down’s Syndrome is associated with intellectual disability and characterized by a variety of additional clinical findings. It is the most common chromosomal condition with these features ¹. Worldwide DS occurs in approximately 1 of 800 births. It has been recognized that the extra copy of chromosome 21 is the root cause of DS². The variations in the clinical manifestations are also seen due to the various genes on chromosome 21 such as the polymorphisms of the Down Syndrome cell-adhesion molecule (DSCAM). Down syndrome is connected with substantial musculoskeletal sequelae, including laxity of the ligaments³ weakness of the muscles, hypermobility and deformities of the skeletal structure.

These musculoskeletal abnormalities are often debilitating for children with this syndrome³, and it
prevents them from having a normal life. Not being able to keep up physically with your counterparts can be very challenging to understand\(^5\).

The gluteal complexes are the most underrated muscles of the human body. The gluteal muscle complex is the powerhouse of the body. Lower extremity injury prevention and rehabilitation programs often target the glutes using exercises of varying difficulty\(^6\). However, there are many other workouts that can be used for these goals, and there is a dearth of concrete evidence about which exercises work the gluteal muscles the best. The idea that high levels of muscular activity indicated by electromyography (EMG) signal amplitudes result in effects that strengthen muscles is universally accepted by researchers.\(^7\). The literature on gluteal muscle activity during exercise therapy is limited. Improved glute strength means improved balance\(^8\), and improved balance means improved quality of life even into old age. Strong glutes ensure a strong base in your core\(^9\) and a higher quality of life. This justifies why we need to lay more importance to simulating and strengthening the gluteal complex. The gross motor function measure (GMFM) is a clinical tool that is used in the observation and evaluation of the changes of the child’s gross motor function abilities with cerebral palsy.\(^10\) Even though the GMFM 88 was developed for children with CP, advances and deeper research\(^11\) with this scoring system it is now also validated for other populations. These include all the children with acquired brain damage and Downs Syndrome.

The use of mHealth is a priority in healthcare models in countries where life expectancy is increasing and patients require continuous long-term monitoring\(^12\). Recently mobile posture analyzing applications have gained popularity for their reliability and their ease of use. One such application is PostureScreen. It is one of the most recent and uses relatively advanced technology for its analysis\(^13\). The posture will be tracked by advanced posture tracking mobile applications. The front, back, and sides of the body will be analyzed using this application\(^14\).

**Aim**

To determine the effectiveness of Gluteal Muscle Focused Exercise Regimen on Functional Movement and Posture in Children with Downs Syndrome

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**Materials and method**

A randomized clinical trial, by non-probability sampling, with a target population of both male and female children diagnosed with downs syndrome between the age group of 3-7 years.

Opaque Envelope Method was used to randomly allocate the participants into different groups.

Sample Size of 12 was selected for the purpose of this pilot study. There will be 6 respondents in each group and overall sample size will be 12 6x2 for the study based on the probability systematic sampling method. The study was conducted from June 2022 to February 2023.

Inclusion criteria were as follows, Both gender, Ages between 3 and 7 years, Children diagnosed with Down Syndrome, GMFCS Level I, II, III, a score of at least 38-42 in component C in GMFM-88, Mini mental State examination score greater than 24 and stable vital signs. Exclusion criteria were as follows Uncontrollable seizure, had received nerve block or orthopedic surgery, having hip and knee flexion contracture.

**Outcome measures:**

Assessment was performed at baseline (before starting of treatment) and after eight weeks of study.

- Gross Motor Function Scale (GMFM)
- PostureScreen Mobile posture analysis application

**Procedure**

Participants were included considering the inclusion and exclusion criteria. Procedure was explained to the participant & participant’s parents after which the participants’ parents were asked to sign the consent form. Assessment of all the included participants was done according to the assessment form. Participants were randomly divided into two groups i.e. Glutes group and Conventional group. Assessment was performed at baseline and after 8 weeks of study.

Glute focused exercise: The children in this group were subjected to glute specific exercises along with
core strengthening and the conventional treatment for down syndrome. The exercises were performed on an exercise mat. The instructions were given by the therapist and if necessary, assistance was provided.

<table>
<thead>
<tr>
<th>Exercise</th>
<th>Description</th>
</tr>
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<tbody>
<tr>
<td>Glute Bridges</td>
<td>Lie on your back with knees bent, lift hips off the floor, squeezing glutes, and hold for a few seconds before lowering.</td>
</tr>
<tr>
<td>Clamshells</td>
<td>Lie on your side with knees bent, open and close top knee like a clam, engaging glutes.</td>
</tr>
<tr>
<td>Lunges</td>
<td>Step forward, bending both knees, lower into a lunge, push back to starting position.</td>
</tr>
<tr>
<td>Squats</td>
<td>Stand with feet shoulder-width apart, bend knees, lowering into a squat position, rise back up, engaging glutes throughout.</td>
</tr>
<tr>
<td>Hip Abduction</td>
<td>Use a resistance band, lift leg sideways against band tension, engaging glutes.</td>
</tr>
<tr>
<td>Standing Glute Kicks</td>
<td>Stand on one leg, kick the other leg backward, engaging glutes, and lower down.</td>
</tr>
</tbody>
</table>

The intervention was started with stretching and warming up of the muscles\textsuperscript{15}. The proposed protocol consisted of Bridging with single leg, squats, lunges, stepping up, clam, prone hip knee extension, Standing Glute kicks\textsuperscript{16} and straight leg extension in supine at an angle of about 20-30 degrees. Quadruped kicks, one leg bridge, opposite arm/leg raise, 3- direction leg lift was incorporated into the protocol as the subject progresses. The intervention was administered for 1 hour/day for 6 days a week, along with instructions on home care and maintenance. The intervention was administered for 1 hour/day for 6 days a week, along with instructions on home care and maintenance.

Conventional exercise: The children in this group were subjected to the conventional protocol, the exercises were performed on the exercise mat. The exercises are inspired from the Invited Topical Review titled ‘Physiotherapy management of Down syndrome’ by Nora Shields, published in the Australian Journal of Physiotherapy. The instructions were given by the therapist with assistance given when necessary. The intervention started with the stretching and warming up of the muscles. The protocol would include aerobic training, massage, progressive resistive training, and balance training\textsuperscript{17}. Various evidence-based exercises were incorporated into this protocol, tailored to the needs of the individual subject. Glute focused exercises were avoided until absolutely unavoidable. The intervention was given for 1 hour/day for 6 days a week, along with instructions on home care and maintenance. The intervention was administered for 1 hour/day for 6 days a week, along with instructions on home care and maintenance.

Data analysis

The gathered data was entered into an excel spreadsheet, tallied, and statistical analysis was performed on it. The tests of normality were performed and the data set was found to be NOT normally distributed. So, the researcher shall apply a non-parametric test (Wilcoxon test). The ‘Mann Whitney’ test for paired data was used to test for statistical significance. Other statistical metrics included mean, standard deviation, and others.

Data was obtained using the outcome measures among both the glutes group and the conventional group, and were analyzed using the Wilcoxon test. Further comparison of pre-post intervention outcomes within the groups were done for all the outcome measures.

Result

The postural deviations were recorded and compared with the normal values. The normal values for the front view are: Head-0\degree, Acromion-0\degree, ASIS-0\degree, Alignment-0\degree and the normal values for the lateral view are: Head 25\degree, Shoulders-15\degree, Pelvis-3\degree, Femur-4\degree, Alignment-0\degree.
The experimental group showed considerable improvements in head, shoulder, pelvic, and femur locations in the lateral and frontal view. It was found that for GMFM scores and the postural changes showed significant changes in both the groups; but the glutes group was found to be more effective than the conventional group.

The Post Test Dimension E score for the experimental group was 5.15 points higher than the post test dimension E score of the control group.

The postural angles demonstrated in the glutes group were closer to the normal values of posture when compared to the control group.

The GMFM scores and pre and post intervention postural angles comparison is shown in Tables 1 and 2. Figures 1 and 2 show the comparison between the groups before and after the intervention.

**Discussion**

In the present study the glutes group showed a statistically greater difference in functional movement through GMFM scores and posture through the Posture Screen application when compared to the conventional group. In the study we demonstrated that gluteal muscle exercises provoked better posture and functional movement than the conventional exercises. The children in the gluteal muscle group also had a visible improvement in balance and speed. This is in line with what Reiman Bolgla and Loudon reported in 2012 where they proved the importance of the gluteal muscle in rehabilitation.

Barr and Shields (2021) reported that there are physical barriers in various real life situations in children with down syndrome that need to be addressed. This is in agreement with a study done by Gupta and Kabra (2014) where they also found that the children required assistance in some activities that children of the same age without DS wouldn’t have a problem with.

In a study done in 2015 by Mourcou et al., the use of mobile posture analysis applications was found to be unreliable. This was contradictory to the findings of Ahmed., Othman, Sabet and Salwa (2021) where they proved that the PostureScreen Mobile application had excellent inter rater and intra rater validity. A study by L Ruiz G., explored the relationship between physical therapy and the potential benefits in children with down syndrome and found that physiotherapy and its interventions have a significant impact in terms of strength and balance. This provides a useful and convenient way to easily monitor changes in posture and functional mobility throughout the course of a workout programme. A mobile posture
analysis tool integrated into the intervention may give healthcare practitioners real-time feedback, enabling customized changes and guaranteeing that the exercises are catered to each child’s requirements and ability.

During the post test data collection phase, we were able to see that the children looked a lot more toned physically. The body looked firm and aligned and did not look like the usual DS presentation where the children are usually stopped and floppy. It is also to be noted that this was a minimal change and could have only been noted by a keen observer. There was also no significant change in weight.

Additionally, Daly et al.’s (2019) study looks at gluteal muscle activation activities that are useful for children with cerebral palsy, which may be relevant for children with DS given their motor problems. The activities mentioned were similar to the types of exercises used in this study. In Daly’s studies these activities were labeled to be useful in the betterment of movement and posture in children with DS. This is in agreement with our study as we found a similar result.

In contrast to the current investigation, which seeks to determine the effects of a focused exercise programme on functional movement and posture in the same group, Russell et al. (1998) evaluated the validity of the Gross Motor Function Measure (GMFM) as an evaluation tool for children with DS. The work by Russell et al. gives us a fundamental knowledge of the validity and precision of the GMFM in evaluating motor function in DS children. Their study adds to the body of knowledge by demonstrating the reliability of the GMFM, which has subsequently gained acceptance as a frequently used and reliable tool for evaluating gross motor function in this group in both clinical and research contexts. This justifies the use of GMFM in our study.

In our study we were able to produce proof that exercise approaches that involve strengthening, postural balance and mobility are able to help in the management of postural imbalances and gait problems.

The gluteal muscle training programme for kids with DS thus offers a potential chance to address their functional mobility and posture difficulties, building on the data and ideas from this research to create efficient and unique exercise programmes. Adopting a carefully planned and scientifically supported exercise programme may improve the general motor function, balance, and physical wellbeing of kids with DS, encouraging more independence and quality of life. However, in order to guarantee that the exercise programme is suitable and safe and to get the best results, it is crucial to take into account each child’s particular skills and consult with healthcare specialists. Utilising mobile posture analysis tools to provide real-time feedback and individualised modifications might help therapy sessions be even more successful.

Hence the results of our study are concurrent with the studies mentioned above.

**Conclusion**

The current study has provided sufficient evidence that the protocols used have shown a significant improvement in Posture, functional movement and in increasing the strength in subjects with down syndrome. Both the groups had improvement with treatment protocol administered but in this 8-week intervention, we found that the group that had the glute focused exercise had overall better improvement in posture through the assessment application and in the GMFM scores. The subjects in this group were also visually more pleased and relaxed after every treatment session. A deeper study needs to be done into both these methods with a higher sample size and a longer intervention period to provide a better understanding of these methods.

**Ethical Clearance:** Taken from institutional ethical committee.

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