



Abstract

Purpose: Mobility, stability, and balance play a crucial role in overall postural control, and this is important for all people to live full, active lives. In some populations, such as Down syndrome, this is not easily accomplished. Previous research has proven the challenges in these areas and may possibly be due to the chromosomal differences. The aim of this study is to analyze the effects of a four-week yoga program on mobility, stability, and balance in nine individuals (ages 4-21) with Down syndrome. Improvements in these areas were measured objectively through the seven tests of the Functional Movement Screening (FMS) and the Postural Stability Test (PST) using the Biodex BioSway.

Methods: The nine participants (2M, 7F) in this study, mean age 12.7 \pm 6.9SD, HT-F 48.7in \pm 8.6in, HT-M 60.2in \pm 3.9in, WT-F 87.6lbs \pm 51.7lbs, WT-M 135.3lbs \pm 47.0lbs, were clinically diagnosed with Down syndrome. Subjects completed a pre-testing session for height and weight, seven FMS tests, and the PST test. Prior to the FMS test, the subjects were given scripted explanations of the movements and had twenty seconds of practice on the PST. Data was then collected on subjects during these two protocols. Special adaptations and parent support was used to encourage participation throughout these activities. The study incorporated two, one-hour sessions for four weeks with one week rest before post-testing using the same protocol on the PST and the FMS movements.

Results: Subjects completed 100% of the planned sessions. A paired sample t-test found a significant improvement in the overall FMS scores from 17.0 \pm 4.1 to 25.4 \pm 5.8 ($p=0.018$). No statistical significance was found for the overall PST scores from 2.4 \pm 1.9 to 2.8 \pm 2.9 ($p=0.450$).

Conclusion: The results of this adaptive yoga program suggest that yoga may be beneficial for FMS-tested strength and stability exercise for individuals with Down syndrome. Practicing yoga for four weeks resulted in noticeable improvements in FMS-type mobility, stability, and possibly strength. The ability of children with Down syndrome to progress in these specific areas may aid these individuals to complete activities of daily living in a more efficient manner.

Methods

Subjects completed a pre-testing session one week prior to the first yoga session. Pre-testing involved the Functional Movement Screening and the Postural Stability Test of the BioSway. Prior to each test, the subjects were given scripted explanations and twenty seconds of practice on the BioSway. Following familiarization, data was collected on subjects during these two protocols. Special adaptations and support of parents were used to encourage participation throughout these activities. After a four-week study which incorporated two, one hour yoga sessions per week, the participants were given one week of rest before the post-testing session. The post-testing session followed the exact protocol of the pre-testing session. In addition, each participant was given another twenty second practice period to re-familiarize with the BioSway and the movements of the FMS. Data was taken and recorded in the identical fashion as the pre-testing period.

Introduction

Down syndrome is a genetic disorder attributed to a chromosomal abnormality of Trisomy 21, and is the most common genetic cause of developmental disability. It is estimated that it affects 1 in 1,000 to 1 in 1,200 live births globally. It is characterized by numerous clinical symptoms which include orthopedic, cardiovascular, neuromuscular, visual, cognitive and perceptual impairments (Gupta, 2011).

Down syndrome affects both fine and gross motor skills of children, and they are also affected by lack of hand-eye coordination, visual motor control, reaction time, laterality, strength, and balance. Research has also reported that adolescents with Down syndrome display lack of strength, postural stability, and overall muscle performance. Muscle weakness is very common for individuals with Down syndrome, and is associated with a decrease in cardiovascular fitness, an increased incidence of osteoporosis, and a decreased ability to perform everyday activities, such as walking and remaining balanced while standing (Shields, 2004). Both children and adolescents with Down syndrome are at a higher risk for many physical problems and difficulties that have the potential to interfere with the attainment of major motor milestones and development (Jobling, 2013).

A major concern is that children and adolescents with Down syndrome do not have ample opportunities to learn about being successfully active with their own bodies. In many areas, children with Down syndrome make progress that is slower than their mental age. Their everyday difficulties and differences lead to the necessity of adaptive programs, but they are not always readily available (Jobling, 2013). Physical activity that is catered to the bodies of these children and adolescents with Down syndrome may help lead to better employment opportunities for these individuals in the future (Shields, 2004).

Figure 1: Mean FMS Scores

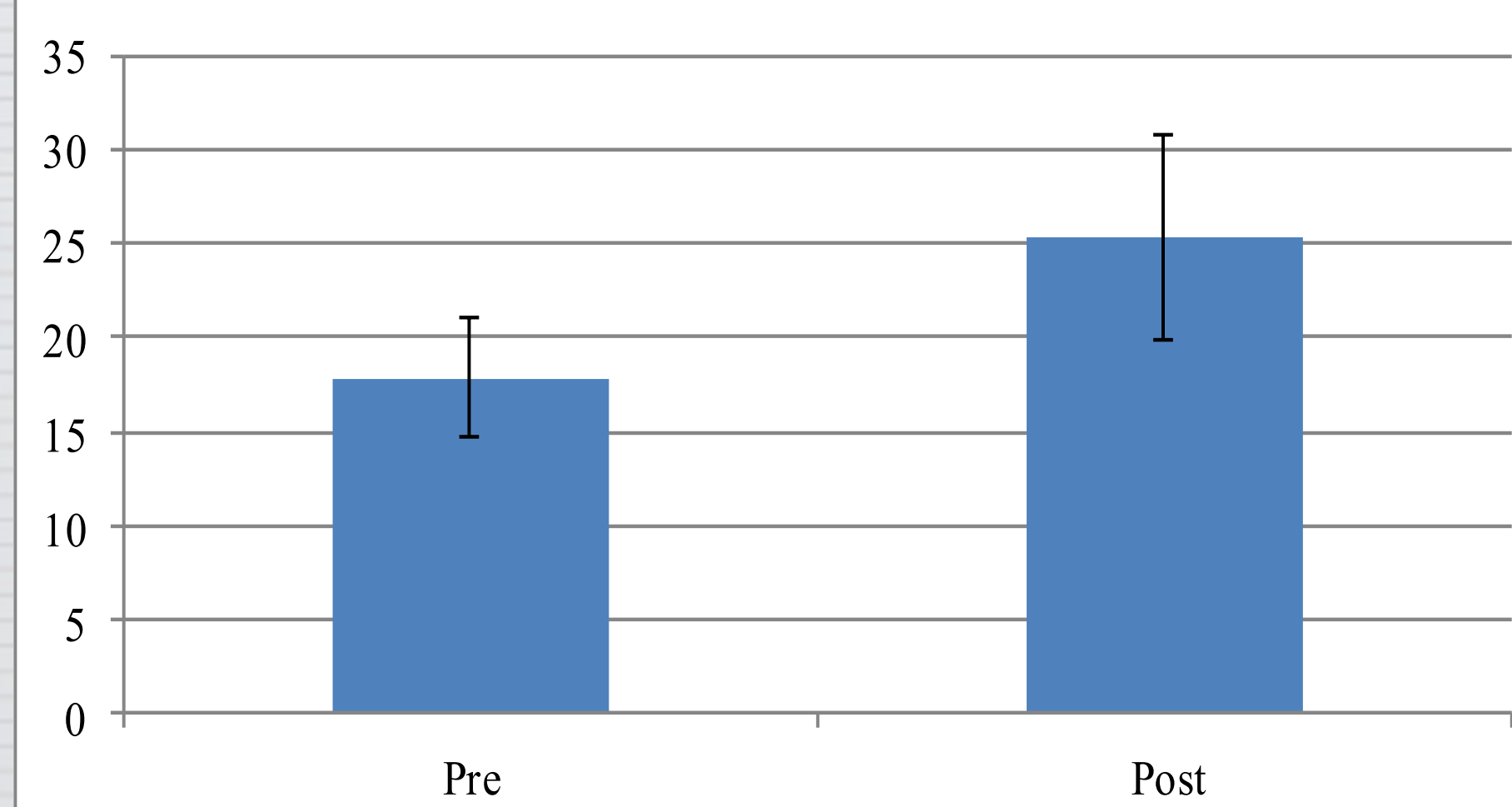
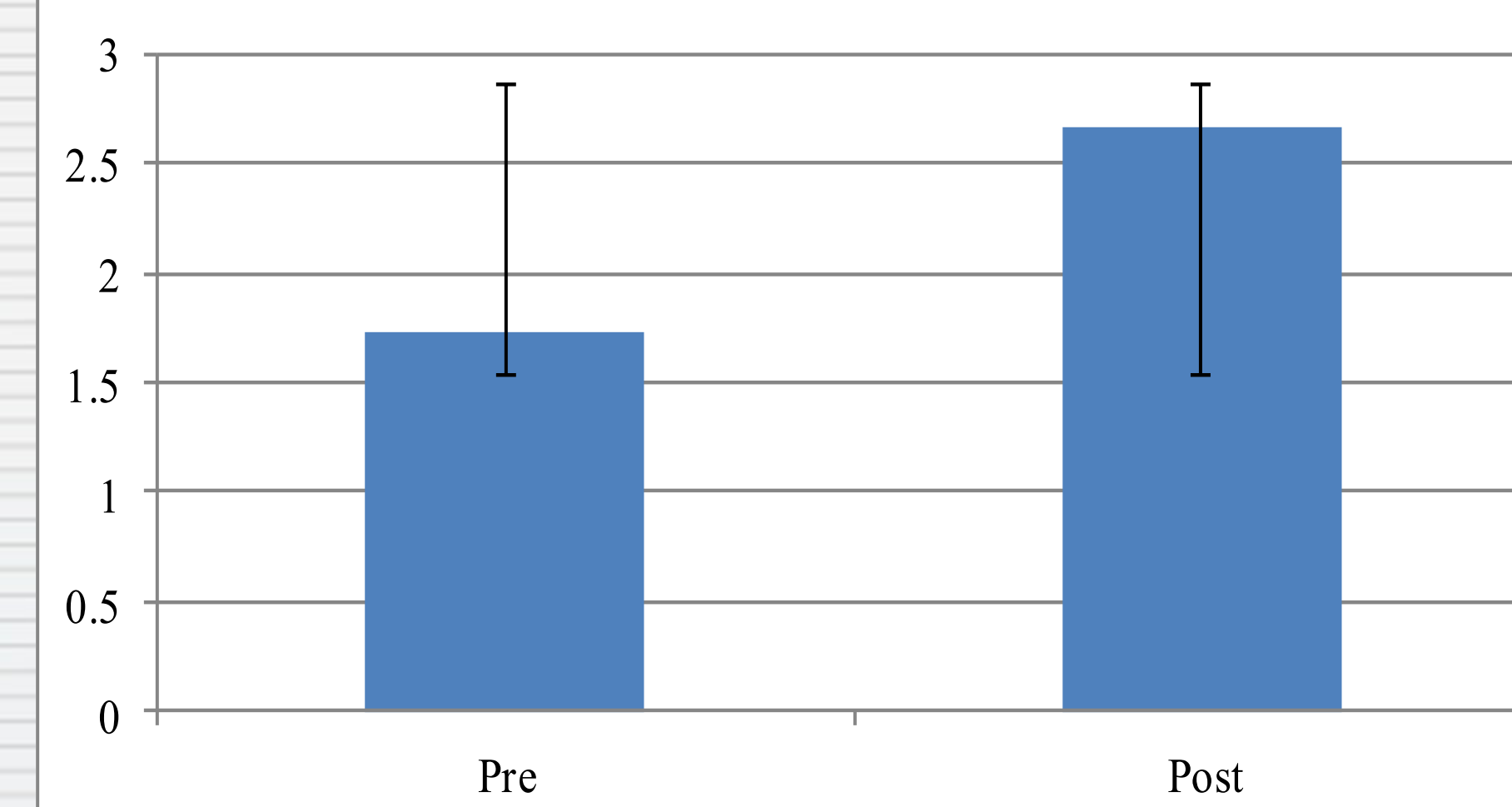


Figure 2: Mean BioSway Scores



Results

The analysis was carried out using a paired sample t-test utilizing the SPSS statistical analysis software. The results indicate a significant improvement in the overall FMS scores from 17.0 \pm 4.1 to 25.4 \pm 5.8 ($p=0.018$). Eight of the nine participants in the study were able to perform the movements. 100% of the participants that performed the FMS tests to completion improved in their overall scores (Figure 1). No statistical significance was found for the overall Postural Stability Test scores from 2.4 \pm 1.9 to 2.8 \pm 2.9 ($p=0.450$). Six of the nine participants were able to perform the test to completion. The results of this test are displayed in Figure 2.

Conclusion

Individuals with Down syndrome live with many added challenges. As they grow both physically and mentally, it is common to engage in sedentary behavior with very low levels of physical fitness (Lin & Wuang, 2012). This sedentary lifestyle can eventually lead to an increased likelihood that an individual will struggle with activities of everyday living, working, and recreation. By finding programs that are exciting and realistic for individuals with Down syndrome to engage in, they will continue to live a healthy life. With this knowledge in mind we created an adaptive yoga program that is fun and practical for children with Down Syndrome. Due to the fact that individuals with Down Syndrome have hyper-flexible muscles, we focused on yoga poses that emphasize increased muscle strength and stability as opposed to flexibility. Our hope is that these kids can use this program throughout their life and will continue to see improvements in muscle tone and balance.



References

- Gupta, S., Rao, B. k., & Sd, K. (2011). Effect of strength and balance training in children with Down's syndrome: A randomized controlled trial. *Clinical Rehabilitation*, 25(5), 425.
- Jobling, A. (2013). Physical education for the person with down syndrome: More than playing games? Retrieved 11/17, 2013, from <http://www.downdysndrome.org/reviews/27/>.
- Lin, H., & Wuang, Y. (2012). Strength and agility training in adolescents with down syndrome: A randomized controlled trial. *Research in Developmental Disabilities*, 6, 2236.
- Shields, N., & Dodd, K. (2004). A systematic review on the effects of exercise programmes designed to improve strength for people with down syndrome. *Physical Therapy Reviews*, 9(2), 109-109-115.

Acknowledgments

A special thank you to all of our participants and their families. We also want to thank the Down Syndrome Society of Minnesota for partnering with us to find participants that would benefit from this study.