SWACSM Abstract

Effects of Aerobic Exercise on Individuals with Down Syndrome Via Tele-Rehabilitation

ZEEL K. PATEL[1], ISHA GAUTAMI[2], NAMRATA JAIN[2], & JACOB HINKEL-LIPSKER[1]

[1]California State University, Northridge, Northridge, CA; [2]Veer Narmard South Gujarat University, Surat, Gujarat, India

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Advisor / Mentor: Hinkel-Lipsker, Jacob (jacob.hinkellipsker@csun.edu)

BACKGROUND:
Down's syndrome (DS), also known as 'trisomy 21', is a genetic disorder wherein an extra chromosome is present with the 21st pair of chromosomes [1]. People with DS undergo developmental delays and intellectual disabilities [2]. Cognitive ability is affected in individuals with DS along with limited ability to adapt motor skills, and these individuals are at risk of cardiorespiratory problems [3]. DS is one of the most common chromosomal abnormalities in humans [4], occurring in about 1 in 1,000 babies born each year [5]. While the prevalence of DS in the Indian population may differ from that of the US data, it is markedly associated with maternal age. [6] As adults, people with DS exhibit mental abilities that are typically similar to those of an 8- or 9-year-old [7]. However, DS has been commonly related to obesity and low levels of physical fitness [9].

Researchers have analyzed the effect of aerobic exercise in those with DS on fitness parameters such as aerobic capacity, cardiovascular endurance, VO2 max, and maximum heart rate. They concluded that those with DS who engage in aerobic exercise exhibit improved outcomes on these parameters, highlighting the beneficial impact of aerobic exercises on their ability to perform daily living activities throughout the lifespan [10]. Another study demonstrated the importance of an aerobic exercise in adolescents with DS through improvement of cognitive abilities. They also found a positive correlation between aerobic exercise and cognition of individuals with DS [11]. Other research examining the feasibility of a group exercise session delivered via tele-rehabilitation to individuals with DS demonstrated improvement in cognitive function in adults with DS following a 30-minute group exercise program one to two times per week [12]. Therefore, previous work has shown clear connections between aerobic exercise and improved physical fitness and cognitive abilities in people with DS. However, the impact of aerobic exercise on both physical fitness and cognitive ability in a population of individuals with DS has yet to be examined.

PURPOSE AND HYPOTHESIS
To evaluate the relationship between aerobic exercise and physical fitness as well as cognitive parameters in people with DS, and to examine the efficacy of group exercises

given via telerehabilitation in a population with DS. It was hypothesized that aerobic exercise delivered via telerehabilitation would significantly improve physical fitness and cognitive ability in people with DS.

METHODOLOGY:

The study was conducted among 5 individuals with DS, who met certain inclusion criteria including age range of 10-20 years, having a functional ability sufficient to understand directions, and the ability to communicate through spoken language, as well as the capability to participate in physical activity. Additionally, it was required that prospective participants had a wireless internet connection in their homes. Conversely, individuals with severe cardiovascular conditions or functional inability that hindered their understanding of directions and communication through spoken language were excluded from participating in this study. All potential subjects and their parents gave written informed consent before enrolling in the study.

In this interventional study, prior to engaging in the exercise session, demographic data were recorded along with physical and cognitive parameters (see below). 45-minute exercise sessions were delivered via video-conferencing on alternate days for 10 weeks [12]. Sessions consisted of a 10-minute warm up (i.e., slow pace marching, arm circles, trunk twisting, trunk side bending), 30 minutes of mild-to-moderate intensity aerobic exercises including fast paced marching, heel digs, arm scissors, forward-backward walking with bicep curls, sideways walking (i.e., 3-5 METs), and a five-minute cool down period which included deep breathing exercises, slow pace marching, and gentle full body stretching while standing [15]. Following the 10 weeks of aerobic training, follow up physical and cognitive data were collected from each subjects. These measurements included:

PHYSICAL PARAMETERS: Height, weight, and six-minute walk test (6MWT) performance over 30 meters including resting heart rate (HR), laps covered (in meters), and post HR from which we calculated HR max, Target HR (50%-60%) and VO2 max [14] (Equation 1):

$$\text{VO2 max} = 70.161 + [0.023 * \text{laps covered in 6MWT (cm)}] - [0.276 * \text{weight (kg)}] - [6.79 * \text{sex}] - [0.193 * \text{resting HR (bpm)}] - [0.191 * \text{age (years)}].$$

COGNITIVE PARAMETERS: Cognitive Scale for Down's Syndrome (CS-DS), a 61-item questionnaire which is classified in 3 domains- executive function domain, memory domain, language domain. This questionnaire uses an ordinal scale with options of never/ rarely true, sometimes true, often/always true.

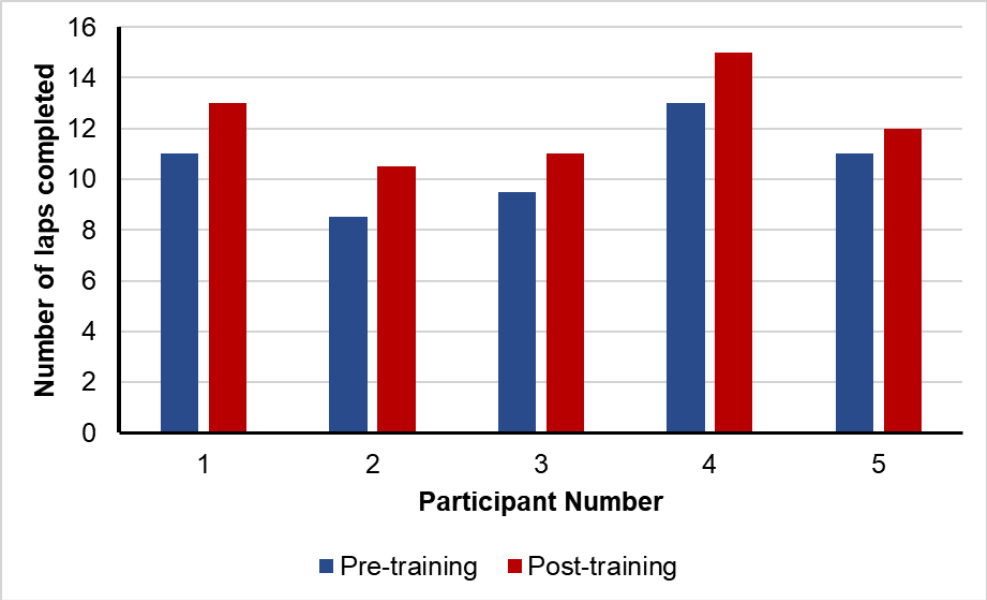

Figure 1. Number of laps completed by participants during the 6MWT.

RESULTS: Paired Sample T-Tests were performed to compare the effect of aerobic exercise training on all physical and cognitive parameters (α = 0.05), and significant increases in pre and post data were found for VO2 max (t =-7.93, p =<0.01), and CS-DS score (t = -3.056, p=0.038).

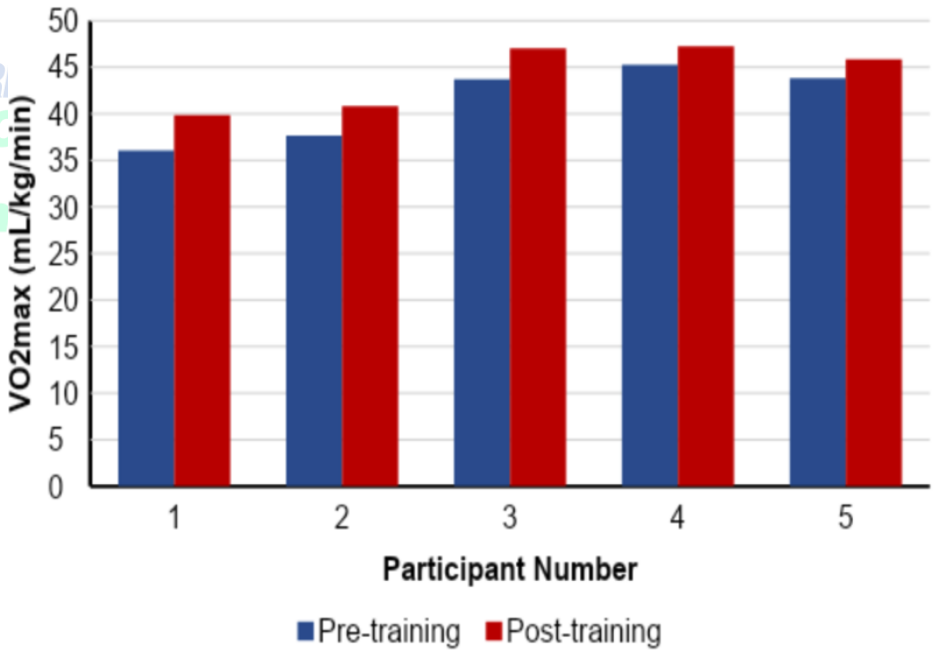

Figure 2. Estimated VO2max before and after training.

DISCUSSION: The purpose of this study was to investigate the effect of aerobic exercise in adolescents with DS on physical fitness and cognitive parameters. Given that low cardiovascular fitness is considered to be a risk factor for cardiopulmonary disorder and can result in a shortened life-span in individuals with DS [13], and that cognitive function is typically low in people with DS, we hypothesized that administering aerobic exercise

through telerehabilitation would result in significant improvements in both the physical fitness and cognitive abilities of individuals with Down Syndrome (DS).

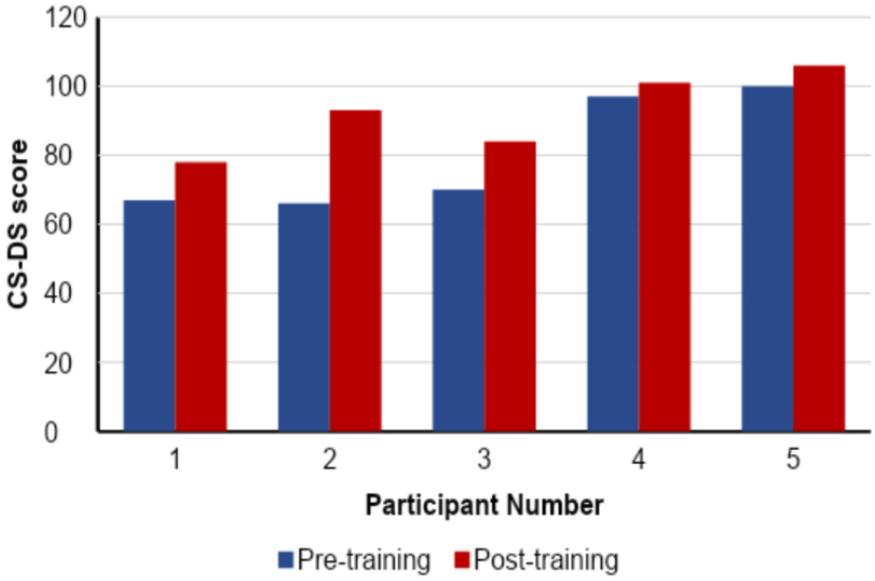

Figure 3. CS-DS score before and after training.

Results from the present study revealed a significant increase in cognitive parameters and physical parameters after 10 weeks of aerobic exercise training. The training program was effective for promoting exercise behavior in subjects that progressively increased their attention and concentration, as well as their distance walked/jogged and speed of walking/jogging during the 6MWT over the course of intervention.

The findings from this study differ from other two studies [8] [11], in which children and adults with DS who performed a 16-week and 12-weeks program, respectively. One of these previous studies study conducted research on the effect of aerobic training on physical fitness and the second study examined the effect of aerobic training on cognitive functions. This study was the first to combine both physical and cognitive parameters in the evaluation of the effect of aerobic exercise.

LIMITATION AND FUTURE SCOPE: Considering the challenges in recruiting a sample of participants with DS and the fact that data collection occurred during the COVID-19 pandemic, a limited number of participants were enrolled for group exercise sessions (n = 5). However, this work has revealed a clear connection between aerobic exercise and improvement in physical and cognitive outcomes, setting the stage for a larger intervention to occur in the future. In addition, the CS-DS questionnaire may not be the most reliable metric for cognitive outcomes; future work should use more formal cognitive assessment (i.e., IQ testing) with the assistance of a trained psychologist.

CONCLUSION: A 10-week aerobic exercise intervention conducted over videoconferencing increases cognition and physical fitness outcomes in a sample of children with DS. In addition, during this intervention there were no reports of withdrawals or negative effects in the recruited sample. Aerobic exercise should be promoted to

improve quality of life in these individuals, particularly in terms of fitness and cognitive abilities. Future work should examine whether these results are consistent with a larger and broader (e.g., adults with DS) population.

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