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Effects of a Remote Exercise Intervention on Aerobic Endurance in Individuals with Down Syndrome

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EFFECTS OF A REMOTE EXERCISE INTERVENTION ON AEROBIC ENDURANCE IN INDIVIDUALS WITH DOWN SYNDROME

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Abstract

Purpose: Down syndrome (Ds) or Trisomy 21 is a common genetic birth condition, and those with Ds typically display decreased cardiorespiratory fitness compared to those without Ds, potentially leading to an increased risk for cardiovascular conditions and mortality. Low cardiorespiratory fitness is partially caused by low physical activity levels in this population. The COVID-19 pandemic caused community-based activity programs to shut down, as individuals with Ds are at increased risk for COVID-19 hospitalization and death. Thus, it was vital to explore alternatives of in-person exercise during the pandemic. The purpose of this study was to investigate the effects of a remote 12-week exercise intervention on aerobic endurance in individuals with Ds.

Subjects: Twenty individuals with a medical diagnosis of Down syndrome were recruited and consented to participate. One participant dropped out for reasons unrelated to this study. Data were collected on 19 participants (5 females, 14 males; age: 25.4±4.8 years; height: 156.9±10.5 cm; weight: 72.5±14.6 kg). The participants needed to be generally healthy and sedentary to be included in this study.

Materials/Methods: Nineteen individuals with Ds completed a structured physical therapist-led 12-week exercise intervention via remote video platform, which consisted of cardiovascular activity, foundational strength exercises targeting core/postural activation and endurance, hip strengthening exercises, and visual-vestibular coordination activities. Using the same platform, aerobic endurance was assessed using the 2 Minute Step Test (2MST). To investigate learning effects of the 2MST, it was performed twice in both the pre- and post-intervention testing sessions. Bland-Altman plots were used to assess learning effects and a paired sample t-test was used to assess the effect of the intervention on cardiorespiratory fitness.

Results: The Bland-Altman plots showed an increase in the number of steps between first and second execution of 2MST in both pre-intervention (mean difference: -8.9±3.9 = 95% CI [-12.8, -5.04]) and post-intervention testing (mean difference: -5.7±4.5 = 95% CI [-10.2,-1.2]) which suggests a learning effect. Therefore, the second execution of the 2MST was used for pre-post intervention comparisons. A paired sample t-test showed a statistically significant improvement of the 2MST between the pre-intervention (67.6±23.6 steps) and post-intervention (79.4±21.8 steps) measurements ($p<0.01$).

Conclusions: There was a statistically significant increase in the number of steps performed during the 2MST between the pre- and post-intervention, with similar peak heart rates, suggesting that there was an improvement in aerobic endurance in this group of individuals with Ds. There was also an observed learning effect between the first and second 2MST executions.

Clinical Relevance: This study shows virtual platforms are an effective mode to deliver an exercise intervention to increase aerobic endurance in those with Ds. The results also support the 2MST as a useful tool to assess aerobic endurance in this population via a virtual platform. It is important to have the participant perform at least 2 trials to account for the learning effect with this test.

Acknowledgments

We would like to acknowledge the work of Dr. Sarah Mann, PT, DPT, MBA who was vital to the development and implementation of the 12-week remote exercise intervention. Her vast experience working with individuals with Ds, her wealth of knowledge, and incredible passion for this population was paramount to the success of this research. We would also like to thank Dr. Thessa Hilgenkamp, PhD and Victor Beck for their support and guidance throughout the completion of this project.

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Introduction

Background

There are approximately 200,000 people with Down syndrome (Ds) in the United States as of 2010, with a prevalence of 1 in 1,328 people nationwide (de Graaf et al., 2017). Ds is a congenital birth condition in which there is a third copy of the 21st chromosome (Howells, 1989). Ds is commonly accompanied by various comorbidities such as hypothyroidism, diabetes mellitus, ligamentous laxity, congenital heart defects, intellectual disabilities, hypotonicity, various hematologic pathologies, and several dermatologic pathologies (Hickey et al., 2012).

Those with Ds (both youth and adults) typically display decreased cardiovascular fitness compared to those without Ds (Fernhall et al., 1996; Guerra et al., 2003), as demonstrated by lower than expected VO_{2peak} levels during exercise testing when compared to those without Ds (Baynard et al., 2008). Low cardiorespiratory fitness is a predictor for cardiovascular risk and mortality in the general population (Ross et al., 2016). Hospitalized individuals with Ds, specifically those under the age of 50, experience a significantly higher prevalence of diabetes, hypotension, pulmonary hypertension, and sleep apnea in addition to an increased risk of a cerebrovascular event (Sobey et al., 2015). Although those seeking hospital care may not represent the Ds population as a whole, this comparison is worth noting because of the increased risk of comorbidities associated with low cardiovascular fitness.

These detrimental effects can possibly be further compounded in the Ds population during the COVID-19 pandemic. Early research indicated that individuals with Ds were at an estimated 4-fold increased risk for COVID-19-related hospitalization and a 10-fold increased risk for COVID-19-related death when compared to individuals without Ds (Clift et al. 2020). Other studies have supported this finding of increased mortality in individuals with Ds who have

contracted COVID-19 in addition to an increased risk of intubation when compared to those without Ds (Hüls et al. 2020; Emami et al. 2021). The increased risks paired with many countries going on lockdown led to severe challenges for individuals with Ds to maintain physical activity. A study that examined physical activity levels of adults with chronic conditions during the COVID-19 quarantine found statistically significant decreases in both moderate and vigorous intensity physical activity when compared to their level of activity before. (López-Sánchez et al., 2020). During a time when services were very limited and a time when it was unsafe for this population to be in public spaces, alternative forms of physical activity needed to be explored to maintain the health of individuals with Ds. Additionally, a recent study found that social isolation measures, such as the widespread lockdown periods, led to significant increases in social withdrawal and depressive symptoms in individuals with Ds when compared to pre-lockdown evaluations (Villani et al. 2020). Using remote exercise interventions may allow participants of these sessions to connect with their peers and develop support networks during this physically and mentally isolating time.

Popular news outlets reported that home-based exercise platforms, such as Peloton, saw significant increases in subscriptions and revenue since the pandemic, with subscriptions increasing 210% and fourth quarter sales increasing 172% (Subscription Insider, 2020; CNBC, 2020). Telehealth has become an emerging alternative to in-person activity, and it has extended into an effective mode of delivering guided exercise into individuals' homes. From May 2019 to May 2020, Google search terms like "high intensity interval training" and "home-based exercise" rose substantially immediately following the respective mandated lockdown and remained higher than levels before (Ding et al., 2020). This further supports the notion that digital mediums have been vital in delivering exercise during the COVID-19 pandemic.

Although the evidence is still scarce, a remote exercise intervention, applied through video conferencing applications, was found to be an effective mode of exercise interventions in the Ds population (Ptomey et al., 2018). Furthermore, attending multiple instructor-led sessions per week was feasible for this population to reach increased levels of physical activity (Ptomey et al., 2018).

With remote exercise interventions, evaluation of aerobic endurance is limited by available equipment and space, making standardized tests with treadmill or track requirements unfeasible. The 2-minute step test (2MST) is a more feasible option because it only requires measuring tape, a stopwatch, and tape. With the added difficulties of COVID-19 restrictions, the 2MST allows for a participant to be tested remotely via telehealth communication methods (Bohannon et al., 2019). The 2MST has been shown to be a reliable aerobic endurance test for older adults (Rikli and Jones, 1999) and although previous studies have utilized the 2MST in both healthy and pathologic populations, there has not been, to our knowledge, any subsequent research on the reliability of the 2MST involving individuals with Ds. Furthermore, improvement in the 2MST performance, as evidenced by an increase in the number of steps performed, has also not been assessed in the Ds population. Additionally, progress may be observed in both step quantity and quality. As the quantity of the steps may be influenced by both aerobic endurance and limitations in movement patterns, it is important to evaluate the quality of the movement patterns as part of the performance. Individuals with Ds generally exhibit increased joint laxity and/or decreased coordination of the pelvis and head, arms, and trunk (Kubo et al., 2006). These impairments may manifest during the 2MST with common compensation patterns such as increased postural sway or excessive hip external rotation.

Improved quality may be demonstrated by a decrease in frequency of compensatory patterns. Both an increase in step quality and quantity may be indicative of increased aerobic endurance.

Aims

The primary aim of this study was to investigate the effects of a 12-week remote exercise intervention on aerobic endurance using the 2MST in individuals with Ds. We hypothesized that participants would demonstrate improved performance (both in quality and quantity) on the 2MST, indicating an improvement in aerobic endurance after the 12-week intervention. The secondary aim of this study was to investigate potential learning effects by administering the 2MST two times in both pre- and post-intervention sessions. We hypothesized that a learning effect would be observed between both 2MST administrations in each session.

Methods

Design

A repeated-measures intervention study was used via a virtual platform comparing aerobic endurance in individuals with Ds using the 2MST pre- and post-12-week exercise intervention.

Participants

Participants included individuals with Ds who were generally healthy, sedentary (defined as less than 30 minutes of moderate/severe exercise per day), and between the ages of 18-35 years old. Participants needed to have a medical diagnosis of trisomy 21 and normal thyroid function for at least 6 months. Individuals were excluded if they had any of the following: unresolved congenital heart disease; atherosclerotic or other vascular disease; asthma or other pulmonary disease; hypertension; blood pressure below 90/60 mmHg; history of presyncope or syncope; diabetes (use of glucose lowering medication); severe obesity (defined as BMI >40); medications affecting heart rate, blood pressure or arterial function; anti-inflammatory medication including NSAIDS; or were currently smoking.

Sample size calculation

Based on differences in VO_2peak for individuals with Ds pre- and post-exercise intervention in the paper of Rimmer et al 2004, the effect size was 0.71. Using a power of 0.8, alpha level set at 0.05, and assumed correlation between pre and post of at least r=0.70, the required sample size to detect a difference in a repeated design is 18 (G*Power software). To account for 10% dropout, 20 participants were included.

Procedure

The 2MST was performed as part of a more extensive testing session including other fitness field tests and two questionnaires on physical activity and attitudes towards exercise. Participants were sent recorded instructional videos detailing the 2MST and appropriate environment and technology set-up to ensure efficient use of time during the measurement sessions. A separate virtual session was conducted to help familiarize the participant and their family members with the materials, setting up the heart rate monitor, and finding a location with sufficient space and lighting in their home. During the pre-intervention and post-intervention measurement session, participants were required to be assisted by a parent/caregiver to ensure the safety of the participant and to assist with the execution of the test. Three test administrators were trained in the specific 2MST protocol and followed a strict order of administration. Participants were paired with the same tester for the pre- and post-intervention assessment. The 2MST protocol was completed twice in each session to determine if there was a learning effect, once at the beginning and again at the end of the testing session to limit the effects of fatigue from test 1 to test 2, while other fitness measurements were collected in between (not involving cardiovascular endurance).

2-Minute Step Test Protocol

Participants were asked to wear a Polar OH1 heart rate monitor that was paired to their phone via Bluetooth and recorded through the Polar Beat application downloaded from the Google Play Store or Apple Store. An assistant (parent or caregiver) was required to be present to ensure safety of the participant throughout testing, as well as assist with proper set-up of each test. Testers provided instruction over Zoom video conferencing (Zoom Video Communications Inc., 2016) to the assistant and participant. The tester instructed the assistant to measure the

distance from the top of the waist at the iliac crest to the superior border of the patella on the right lower extremity and place a piece of blue masking tape on the individual at the halfway point (i.e., measurement = 50cm, tape placed at 25cm). The participant was then instructed to stand with the right lateral aspect of the thigh next to the wall. The assistant was instructed to place a long piece of tape (3-4ft in length) horizontally at the same height on the wall as the tape on the participant's right lower extremity. The assistant was instructed to grab a 6" sensory ball that would be held at the level of the tape on the wall to provide an external visual cue for the participant. The tester then instructed the participant to march in place and touch the ball with their knees as many times as they could in 2 minutes.

Another researcher was on the video call to record the number of repetitions that the right knee elevated above the tape line on the wall. Repetitions were not counted if the right knee failed to rise above the line. If the participant's right knee began to fall beneath the height of the tape for multiple repetitions, the tester encouraged the participant to march higher or keep their knees up. The tester encouraged the participant throughout the test to help maintain motivation and to obtain the maximum performance. The participant was allowed to take standing rest breaks, but the test was terminated (i.e., marked the end of the test with number of steps at that point used as the maximum number of repetitions for the 2MST) if the participant required a seated rest break.

Outcome measures

The quantitative outcome measures were the number of steps completed during the 2MST and the maximal heart rate achieved with the Polar OH1 heart rate monitor. For the qualitative performance of the 2MST, recorded videos of the test were blinded with regards to pre-test and post-test information and were then evaluated for impairments in movement patterns

by two trained observers (different from the test instructor). The following movement impairments were included in the observation protocol: isolated hip flexion strength, forward trunk flexion rather than pure hip flexion, excessive postural sway, loss of balance, decreased accuracy of knee to target, excessive hip external rotation, and widening of base of support. Compensation patterns were only observed from the sagittal plane as this was how the test was administered during the testing sessions. Following unblinding of the recorded videos, the total number of compensatory patterns were compared between the pre- and post-intervention testing sessions to assess for overall improvements of movement quality.

Intervention

Over a period of 12 weeks, participants received 60-minute exercise sessions with an experienced doctor of physical therapy—who has over a decade of experience working with individuals with Ds—over Zoom video conferencing (Zoom Video Communications Inc., 2016) three times per week (Mon, Wed, Sat). Exercise sessions consisted of cardiovascular activity for 20 minutes, foundational strengthening for 15 minutes, hip strengthening activities for 10 minutes, balance activities for 10 minutes, and a 5-minute cool-down. The targeted intensity for the cardiovascular activity was moderate intensity, defined as at least 65% of predicted maximal heart rate, using the specific prediction equation for individuals with Down syndrome by Fernhall et al. (Predicted HR_{max} = 179 - (0.56 age)) (Fernhall et al., 2001). After the 12-week intervention, participants then repeated the testing protocols to obtain post-intervention measurements of the 2MST. Adherence to the intervention was evaluated with participant attendance rates. Fidelity of the planned intervention was evaluated using participants' heart rate measurements of the exercise sessions (Polar OH1 heart rate monitor).

Statistical Analysis

Group characteristics, adherence and fidelity to the intervention were reported with descriptive characteristics. Bland-Altman plots were used to investigate the learning effect between the first and second administration of the 2MST during each of the testing sessions. Based on the results, data was used from either the first or second administration of the 2MST for both the pre- and post-intervention sessions for following analyses. A paired sample t-test was used to assess if the difference in the number of steps taken and a Wilcoxon signed-rank test was used to assess the total number of compensation patterns recorded between pre-intervention and post-intervention were statistically significant.

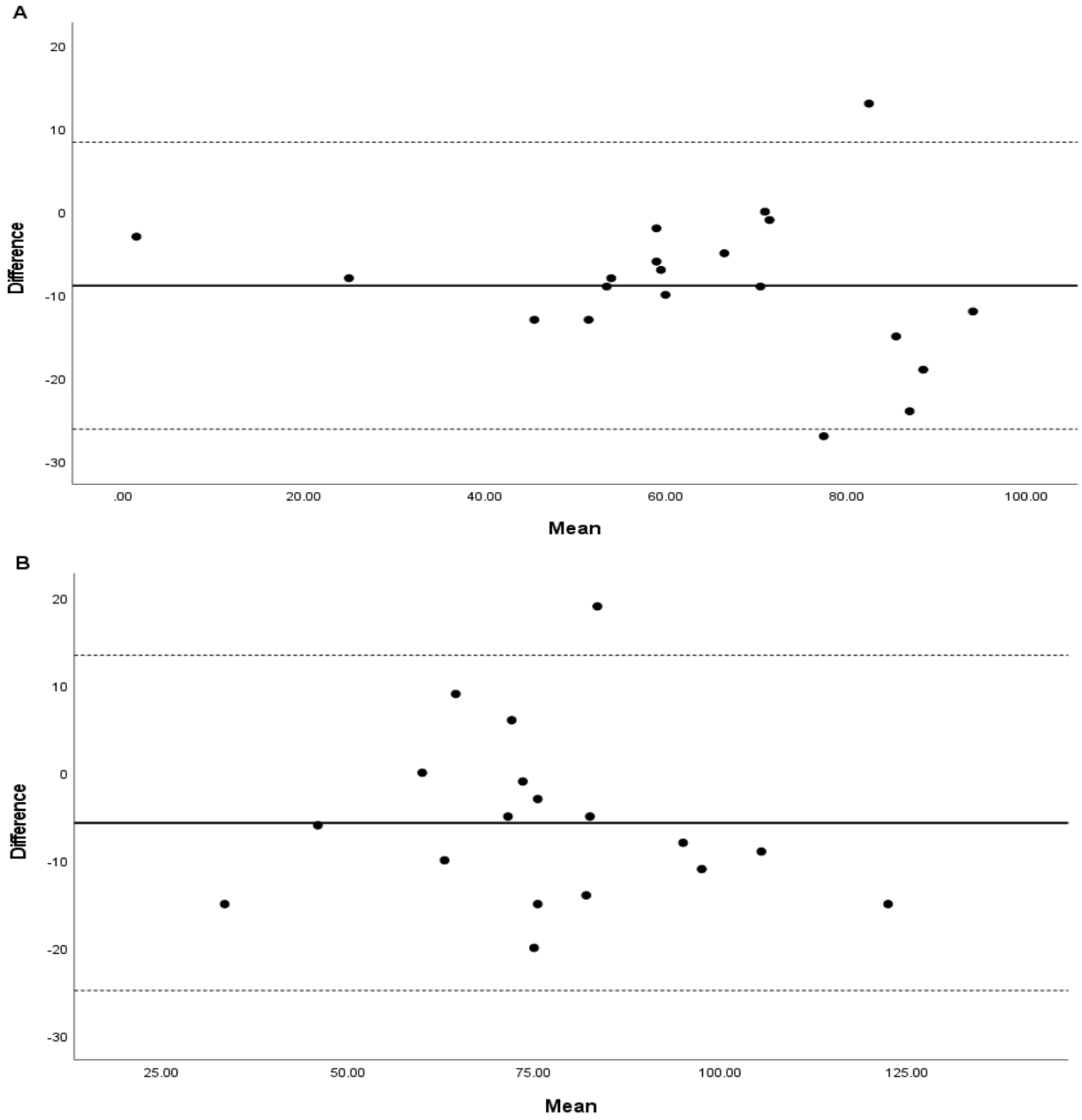
Results

Twenty individuals with Ds were recruited and consented to participate. One participant dropped out for reasons unrelated to this study. Data was recorded in 19 individuals with Ds (5 females and 14 males; age: 25.4±4.8 years; height: 156.9±10.5 cm; weight: 72.5±14.6 kg) participated in this study. Adherence to the protocol was excellent, with an average of 93% attendance across all the sessions of the 12-week program (Table 1). Fidelity of the program was demonstrated by the achieved heart rates of the participants during the exercise sessions; participants spend on average 20 minutes and 5 seconds in the 60-69% HRmax zone and an additional 9 minutes and 43 seconds at 70% of HRmax or higher (Table 1). The Bland-Altman plots (Figure 1) showed an increase in the number of steps between first and second execution of 2MST in both pre-intervention (1A) (mean difference: -8.90±3.9, 95% CI [-12.76, -5.04]) and post-intervention (1B) testing session (mean difference: -5.72±4.5, 95% CI [-10.2-1.21]) which suggests a learning effect. Therefore, the second execution of the 2MST was used for pre-post intervention comparisons (Figure 2). There was a statistically significant improvement of the 2MST between the pre-intervention (68.4±24.8 steps) and post-intervention (79.4±21.8 steps) measurements ($p<0.01$) with similar peak heart rates. Table 2 includes the number of steps each participant completed, heart rate measurements taken before and after administration of the 2MST, as well as the compensation patterns observed. Out of the 18 participants with complete data, 3 had no compensation patterns at the start, 8 participants decreased their compensation patterns, 2 did not increase or decrease, and 5 participants increased their compensation patterns, resulting in a non-significant change from pre- to post-intervention. There was no significant difference in average number of compensations observed between pre- and post-intervention ($p=0.244$). In general, the most common compensation patterns observed during pre-intervention

observations included: forward trunk lean instead of hip flexion, excessive hip external rotation, and excessive postural sway (Table 3). The most common compensation patterns observed during post-intervention observations included: excessive postural sway, decreased isolated hip flexion pattern (Figure 4), and widening base of support. Decreased accuracy of knee to target and widening base of support were observed the same number of times in both the pre- and post-intervention observations (Table 3).

Week	% Attendance	Minutes spent between 60-69% of HRmax (min:sec)	Minutes spent at 70% of HRmax or higher (min:sec)
1	96	14:04	5:32
2	100	17:09	5:12
3	98	17:43	8:58
4	96	19:16	7:28
5	93	16:32	9:51
6	95	17:12	10:41
7	93	22:29	12:54
8	95	22:48	10:23
9	88	23:56	11:23
10	89	25:38	10:35
11	86	19:33	11:32
12	88	24:39	12:12
Average	**93**	**20:05**	**9:43**

Table 1: Adherence and Fidelity of the Exercise Intervention



Figures 1A and 1B: Bland-Altman plots of the two executions of the 2MST pre-intervention (A) and post-intervention (B).

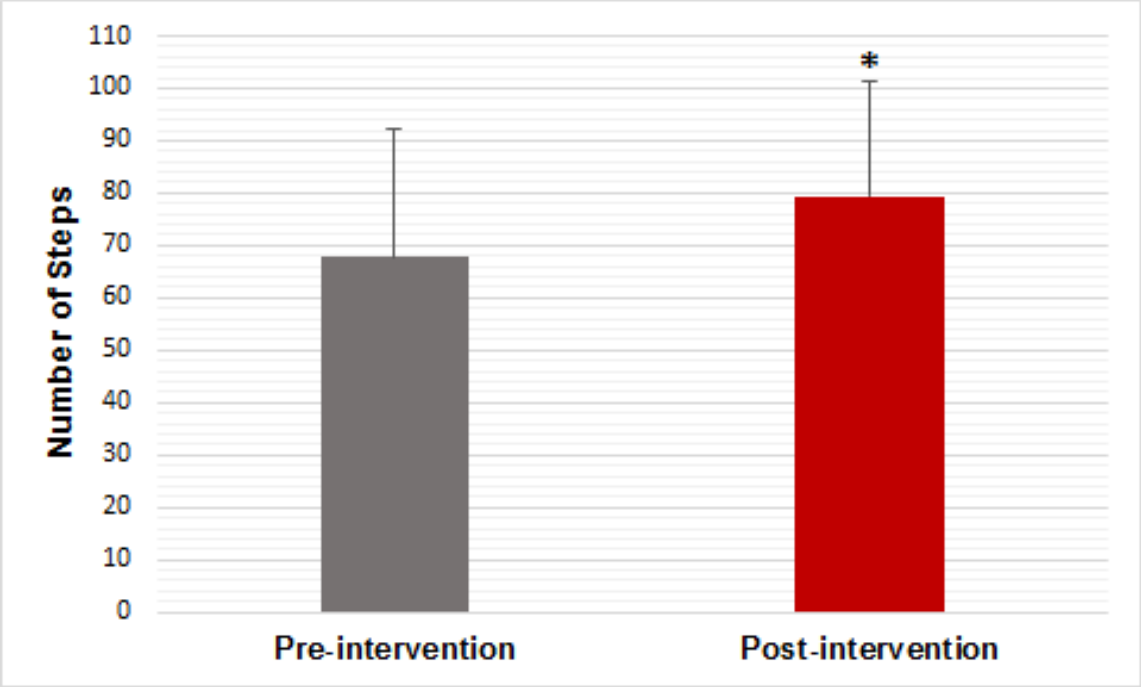


Figure 2: Comparison of the average number of steps performed during the second execution of the 2MST at pre-intervention and post-intervention

* indicates significant difference from pre-intervention

	Pre-intervention	**Post-intervention**	**P-values**
2MST Trial 2 (number of steps)[#]	68.4±24.8	79.4±21.8	0.004*
HR pre-trial 2 (bpm)[†]	80.8±15.1	80.3±10.2	0.909
HR post-trial 2 (bpm)[#]	117.3±21.0	113.8±16.5	0.437
Average number of compensations[#]	2.0±1.6	1.7±1.6	0.244[##]

Table 2: Comparison of second 2MST trial and heart rates (HR) pre- and post-intervention written as mean ± standard deviation.

*denotes significant difference; [†]denotes n=12; [#]denotes n=18, [##]denotes Wilcoxon signed-rank test

	Pre-intervention	Post-intervention
Excessive hip external rotation	6	3
Decreased isolated hip flexion strength (“figure 4”)	5	6
Forward trunk lean rather than hip flexion	7	4
Decreased accuracy of knee to hand	3	3
Loss of balance	4	2
Excessive postural sway	6	7
Widening base of support	5	5

Table 3: Comparison of number of participants who demonstrated observed compensation patterns during 2MST in pre- and post-intervention based on performance during each of their second trials.

Discussion

The purpose of this study was to investigate the effects of a remote 12-week exercise intervention on aerobic endurance in individuals with Ds. Results showed that there was a significant improvement in 2MST performance after the 12-week exercise intervention. Additionally, the 2MST demonstrated a learning effect from the first to the second attempt.

There is limited research available on the effects of remote exercise interventions in the Ds population. However, our findings are comparable to prior research that used traditional in-person exercise programs and demonstrated improvements in the Ds population. One systematic review found that various exercise interventions were effective in improving muscle strength, balance, and cardiovascular fitness in individuals with Ds (Li et al. 2013). Furthermore, previous studies have found that traditional non-remote exercise programs improved cardiovascular fitness in individuals with Ds (Dodd and Shields, 2005; Mendonca et al. 2011; Seron et al. 2015).

The learning effect that we found is consistent with prior research that found a learning effect using the 2MST but with individuals undergoing cardiopulmonary rehabilitation (Haas et al. 2017). Haas et al. suggest that use of the 2MST in an interventional investigation requires a minimum of two executions prior to assessing the intervention which has been corroborated by this study of the Ds population.

When comparing these results to other studies that looked at the efficacy of delivering an exercise intervention using a virtual platform, our study showed similar feasibility. A pilot trial by Ptomey et al. 2018 found it was feasible to implement a remote exercise session twice per week with 89.5% average attendance for group exercise sessions. Our study found similar success in implementing the intervention three times per week with 93% attendance across the 12-week intervention. Moreover, the achieved intensity for the cardiovascular activity was

sufficiently high and lasted long enough to elicit a training response and improve aerobic endurance. This suggests that remote exercise interventions can be an effective means of increasing aerobic endurance in the Ds population. Finding alternative modes of delivering exercise and aerobic endurance assessment during the global pandemic has become increasingly important in vulnerable populations. The results also support the 2MST as a useful tool to assess aerobic endurance in this population via a virtual platform since it requires minimal space and equipment. However, it is important to have the participant perform at least 2 trials to account for the learning effect with this test.

Qualitative analysis of the common compensation patterns during standing marches revealed that although not significantly different, overall, the majority of the participants had decreased compensations observed during the post-intervention measurement of the 2MST when compared to the pre-intervention measurement. However, it should be noted that two of the three observed compensation patterns that were demonstrated by the same number of or more participants during post-intervention testing were excessive postural sway and widening base of support. A recent systematic review discussed multiple studies which found postural instability in Ds with greater center of mass displacement during gait and greater displacement of center of pressure during static standing (Zago et al. 2020). As discussed in this review, previous research has shown that individuals with Ds show greater postural sway in the mediolateral direction leading to increased step width to account for a maintenance of the center of gravity over their base of support (Zago et al. 2020). Due to the repetitive nature of the 2MST task, which requires consistent stepping and intermittent single-limb support, the test likely emphasizes these difficulties with postural stability and balance that individuals with Ds may experience.

Limitations

While this study has shown the potential benefits of a remote exercise intervention on the aerobic endurance of individuals with Ds, the results should be viewed in light of several limitations. Firstly, the lack of control group and randomization may limit the study's impact and thus, further research needs to compare the effects of this intervention on the 2MST to a control group with Ds that did not participate in an exercise intervention versus a group with Ds that did participate in an exercise intervention. Additionally, it should be noted that one participant performed 0 repetitions and 3 repetitions on the two 2MST executions during pre-intervention testing, and 43 and 49 repetitions during the post-test executions. This result may have impacted the results disproportionally; however, the test results were reflective of the participant's ability at the time and the group results were still significant even when this participant was excluded from analysis.

This may highlight one of the drawbacks of remote exercise interventions as all instructions were provided verbally—over video conferencing—in addition to instructional videos and technological virtual visits provided to each participant. Assistance of a parent or caregiver was required for each participant during testing and while this is beneficial to assist with set-up and safety, there could potentially be variability in the execution of how the test was set-up, despite the consistency of the verbal instructions provided.

The use of the consumer-grade Polar OH1 heart rate monitor and Polar Flow software to access the data remotely was very user-friendly while still allowing access to high-quality data. However, the software platform did not allow for customization of heart rate zones, which resulted in aggregated data per 10% of predicted maximal heart rate instead of a total time spent at 65% and higher, as the intervention prescribed.

Conclusion

In this study, we observed a significant increase in the number of steps performed during the 2MST between the pre- and post-intervention testing sessions, with similar peak heart rates, suggesting that there was an overall improvement in aerobic endurance in this group of individuals with Ds. We also observed a significant learning effect between the first and second 2MST executions. Given these results, it is important that those utilizing the 2MST administer the test at least two times per testing session to account for this learning effect.

This study supports the effectiveness of an exercise intervention in the Ds population via virtual platforms for improving aerobic endurance, possibly increasing access for rural or underserved areas. This study has yielded promising results for future research and approaches to improve and assess aerobic endurance through virtual interventions and platforms.

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Curriculum Vitae

Jonathan R. Crimm
Department of Physical Therapy, University of Nevada, Las Vegas
4505 Maryland Parkway, Las Vegas, Nevada 89154
Johnycrimm@gmail.com

Education

DPT University of Nevada Las Vegas – Las Vegas, Nevada 2019 - anticipated graduation (5/15/2022)

BS Utah Valley University – Orem, Utah 2014-2019 Exercise Science

Licensure

Michigan State Board of Physical Therapy Examiners - License Pending Graduation May 2022

Certifications

CPR certification	June 2020
HIPAA certification	June 2019
Blood Born Pathogen certification	June 2019

Employment / Clinical Experience

January 2022 – April 2022	Student Physical Therapist, University of Utah Health Care Nathan Fankhauser PT, DPT – Nate.fankhauser@utah.edu
September 2021 - December 2021	Student Physical Therapist, Sunrise System - Southern Hills Hospital Abbay Dow PT, DPT – Abbay.dow@gmail.com
July 2021 - September 2021	Student Physical Therapist, Concentra Medical Center - Las Vegas Tao Bon PT, DPT – Tao_bon@concentra.com
July 2020 – August 2020	Student Physical Therapist, True Physical Therapy, 3530 E Flamingo Rd #115, Las Vegas, NV 89121
May 2014 – May 2019	Case Manager, Therapy Technician, Medical Transportation, Certified Nursing Assistant – Orem Rehabilitation and Skilled Nursing, 575 E 1400 S, Orem, UT 84097

May 2014 – July 2014	Personal Care Assistant – Courtyard at Jamestown Assisted Living Facility, 3352 N 100 E, Provo, UT 84604

Membership in Professional Organizations

Member of American Physical Therapy Association (2019 to present)
Member of Nevada Physical Therapy Association (2019 to present)
Member of Utah Physical Therapy Association (2019 to present)

Service / Volunteer Activity

CDC STEADI FPAW 2020
Fall Risk Screener

Clean the World Foundation (10/11/2019)
Volunteer

The Lullaby Connection (8/31/2020, 9/8/2020)
Volunteer

The Church of Jesus Christ of Latter-Day Saints (6/2019-present)
Youth Adviser

Honors and Awards

UVU College of Science Excellent Student Award 2019
Magna Cum Laude, Utah Valley University Class of 2019

Current Research Activity

Crimm, J., Wyckoff, K., McCuch, G., Stainbrook, C., Williams, L., Standifird, T. (2018) An analysis of foot to ground interactions while running behind a jogging stroller.

Hilgenkamp T., Wolf L., Lee, B., Murata, A., **Crimm, J.,** Effects of a Remote Exercise Intervention on Aerobic Endurance in Individuals with Down Syndrome. *Presented at CSM 2022*

Language skills

Bilingual: English and Spanish

Benjamin A Lee
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balee5451@gmail.com

Education

Doctor of Physical Therapy (DPT) Estimated May 2022

- University of Nevada, Las Vegas

Bachelor of Science in Community Health Sciences, Magna Cum Laude
May 2019

- University of Nevada, Reno

Licensure

Nevada Physical Therapy Board - License Pending Graduation May 2022

Work Experience

Building Staff | **Fitness & Recreational Sports, Reno (December 2015 – December 2018)**

- Assist drop-in class instructors to ensure timely onset and completion of classes.
- Uphold and enforce gym regulations to promote safety and healthy practices among patrons.
- Build rapport with patrons and reinforce relationships to maintain and improve membership retention.

Physical Therapist Technician | **Five Star Premier Residences, Reno (May 2018 – March 2019)**

- Assist Physical Therapist with creation of ther ex fitness program for residents.
- Manage 2-3 patients an hour to ensure efficient completion of fitness program for the day.
- Maintain rapport with patients to ensure they had the best experience possible.

Clinical Experience

Student Physical Therapist | **Spring Valley Hospital, Las Vegas (Jan-Apr 2022)**

- Educate patients in surgical precautions to promote safety and facilitate return to functional activities.
- Recommend appropriate level of discharge to doctors based on patient progression.
- Evaluate and treat patients of varying complexity in different units such as Orthopedics, IMC, ICU, and neurological.

Student Physical Therapist | **Encompass Health of Desert Canyon, Las Vegas (Sept-Dec 2021)**

- Evaluate and treat patients requiring varying degrees of assistance.
- Utilize interpersonal communication in order to motivate patients to participate in strenuous rehabilitation.
- Participate in team conference to determine best discharge plan for patients.

Student Physical Therapist | **Boulder City Hospital, Las Vegas (July-Aug 2021)**

- Create POCs in an outpatient setting for patients with musculoskeletal and neurological deficits.
- Utilize modalities backed by research to complement POC and effectively treat patients.
- Preparing for evaluations at home to ensure thorough evaluation and maximize patient's time in the clinic.

Student Physical Therapist | **Synergy on Blue Diamond, Las Vegas (July-August 2020)**

- Provide patient education to patients regarding safety and purpose of rehab.
- Create ther ex programs for patients through different stages and types of injury.

Certifications

- **STEADI Certification | Older Adult Fall Prevention Screening (March 2020)**
- **American Heart Association Basic Life Support | CPR & AED (Renewal June 2022)**
- **HIPPA Training Certified (June 2019)**

Membership in Professional Organizations/Clubs

Student Member **| American Physical Therapy Association (APTA) (June 2019 – Present)**
Member **| Diversity, Equity, and Inclusion Club of UNLVPT (August 2020 – Present)**

- Discuss barriers to PT as a result of race, ethnicity, socioeconomic status, etc., allowing me to understand different patient perspectives and how best to communicate and treat them.

Member | Las Vegas Triathlon Club (Feb 2021 – Present)

- Participate in local races and events

Service / Volunteer Activity

Clean the World, Las Vegas **|** PT Day of Service (Oct 11, 2019)

- Volunteer

Student Screening | **Nevada Goes Fall Free Coalition**

- Fall prevention screen (Mar 14, 2020)
- STEADI Fall Risk Screen Training (Sept 15, 2020)
- STEADI Fall Screen (Sept 25, 2020)

Inservice Presentation at Synergy Blue Diamond | *Total Elbow Replacement* (Aug 2020)
Inservice Presentation at Encompass Health of Desert Canyon | *Tai Chi* (December 2021)

Current Research Activity

Graduate Research | University of Nevada, Las Vegas – Physical Therapy Department (Jan 2020 – Present)

- *The Effects of Exercise Training on Central and Peripheral Blood Flow Regulation in Individuals with Down Syndrome*

Graduate Research | University of Nevada, Las Vegas – Physical Therapy Department (Sept 2020 – Present)

- Telehealth – Guide participants with Down Syndrome through a series of tests involving aerobic endurance, strength, gait speed, and balance.

Continuing Education (last 3 years)

University of Nevada, Las Vegas | Brown Bag Lecture

- Dr. Istvan Takacs - *The Emerging Role of Physical Therapists in Bike Fitting* (Mar 2020)
- Dr. Rocky Barret - *COVID-19 and the Associated Pulmonary Dysfunction* (Jun 2020)
- Dr. Lisa VanHoose - *Grief and Loss Felt By All During Social Crises* (Jun 2020)
- Dr. Efosa Guobadia - *Global and Community Health (*Nov 2020)

Observer | Cleveland Clinic Virtual Conference

- Attended Advanced Neurological Therapeutics Presentations presented by Cleveland Clinic (Jun 2020)

Andrew Jonathan Murata
Las Vegas, NV
andyjmurata@gmail.com | www.linkedin.com/in/andrewjmurata

Education

University of Nevada, Las Vegas June 2019 – Present
Doctor of Physical Therapy, Class of 2022
2022 Inductee | American Council of Academic Physical Therapy National Student Honors Society
2022 Recipient | AJ Koval Scholarship Award

University of California, Los Angeles Sept 2012 – July 2016
B.S. in Biology with Departmental Honors

Work Experience

Teaching Assistant – University of Nevada, Las Vegas – PT Dept Sept 2020 – May 2021

- Assisted in teaching Musculoskeletal I – Orthopedic Principles and Neurophysiology
- Hosted individual and group review sessions to facilitate better understanding of material
- Participated in research writing for peer-reviewed publications (see below)

Personal Trainer – Fitness 19 June 2017 – May 2019
6429 Pats Ranch Rd, Mira Loma, CA 91752

Clinical Experience

Student Physical Therapist | *Cleveland Clinic Lou Ruvo Center for Brain Health* Jan – Apr 2022

- Gained extensive experience with 100% caseload with individuals with neurodegenerative disease including: Parkinson disease, Multiple sclerosis, Alzheimer's disease, Huntington disease, cerebellar ataxia, neurosarcoidosis, and Parkinson+ syndromes
- Utilized evidence-based outcome measures for effective goal setting and progression monitoring

Student Physical Therapist | *Encompass Health Rehabilitation Hospital* Sept – Dec 2021

- Utilized multi-disciplinary approach to treatment of patients with various conditions including: cerebrovascular accident, spinal cord injury, orthopedic trauma
- Navigated socio-economic considerations for underserved patient population of Las Vegas, NV
- Implemented 4-Square Step Test and Multidirectional Step Training space in rehabilitation gym based on evidence provided during in-service

Student Physical Therapist | *University Medical Center of Southern Nevada* July – Sept 2021

- Demonstrated entry or beyond entry level PT proficiency by end of affiliation with significant experience with underserved population of Las Vegas, NV
- Engaged in interdisciplinary goal-writing to create effective and safe treatment/discharge plans with OT, SLP
- 6 weeks of experience in UMC Lions Burn Care Center for patients in Med-Surg, IMC, and ICU status

Student Physical Therapist | *Optimal Physical Therapy in Henderson, NV* July – Aug 2020

Research

Peer-Reviewed Publications

Ho K.Y., **Murata A**. Asymmetries in Dynamic Valgus Index After Anterior Cruciate Ligament Reconstruction: A Proof-of-Concept Study. *Int. J. Environ. Res. Public Health.* 2021;18:7047. doi: 10.3390/ijerph18137047.

Ho KY, Barrett T, Clark Z, DuVall C, Fox T, Howden C, **Murata A**. Comparisons of trunk and knee mechanics during various speeds of treadmill running between runners with and without patellofemoral pain: a preliminary study. *J Phys Ther Sci*. 2021;33(10). doi: 10.1589/jpts.33.737.

In Preparation
Hilgenkamp, T., **Murata, A**., Crimm, J., Wolf, E., Lee, B., Mann, S. Effects of a Remote Exercise Intervention on Aerobic Endurance in Individuals with Down Syndrome.
Presentation
2/3/2022 **Murata, A**., Wolf, E., Lee, B., Crimm, J., Mann, S., Hilgenkamp, T. Effects of a Remote Exercise Intervention on Aerobic Endurance in Individuals with Down Syndrome. Platform Presentation at APTA Combined Sections Meeting 2022 - Cardiovascular and Pulmonary Platform: Cardiac Emphasis

Volunteer Experience

Nevada Goes Fall Free Coalition Virtual Fall Risk Screening Sept 23, 2020 – 2 Hours
- Assessed fall risk of two 65+ year old members of Nevada community
- Provided detailed risk based on scree results, follow-up information for community resources, home safety, and recommendations

UNLV Physical Therapy Interview Day Volunteer 2020 and 2021 – 16-20 hours
- Participated as part of current student panel for Q&A with DPT candidates
- Led cadaver lab station in 2020 to discuss Anatomy/Physiology section of UNLV program with DPT candidates

Certifications

The OTAGO Exercise Program: Falls Prevention Training Completed: March 3, 2021
CDC's STEADI Toolkit: Older Adult Fall Prevention Course Completed: Sept 10, 2020
AHA Basic Life Support (CPR and AED) Completed: June 1, 2020
NSCA Certified Personal Trainer Nov 2016 – Dec 2020
- ID: 7248060775

Membership in Professional Organizations

Member | American Physical Therapy Association Aug 2019 – Present
- ID: 867143

Member | International Parkinson and Movement Disorder Society Mar 2022 – Present
Member | National Strength and Conditioning Association Nov 2016 – Nov 2019
Member | UNLV PT Spanish Club Fall 2019 – Spring 2021

Brown Bag Series Lectures/Conferences
- 02/03/2022 – 02/05/2022 - APTA Combined Sections Meeting 2022
- 04/09/2021 – Renee Ostertag, PT, DPT and Robyn Gisbert, PT, DPT: "The Secrets of Becoming a Resilient PT"
- 03/05/2021 – Lisa Copeland, PT, DPT: "Physical Therapists in Case Management"
- 02/19/2021 – Danielle Garcia, PT, DPT and Ron Garcia, PT, DPT: "How Two UNLVPT Alums Paid Off $300,000 in Student Loans in Three Years"
- 12/04/2020 – Stephen Hunter, PT, DPT, OCS, FAPTA: "Standardized Care Processes, Patient Outcomes and Clinical Decision Making"
- 11/19/2020 – Efosa Guobadia, PT, DPT: "Global and Community Health"

- 09/25/2020 – Ashley Reagor, PT, DPT: “Now that I’m a Licensed Therapist, How do I Start My Own Private Practice?”
- 09/18/2020 – Natalie Weeks-O’Neill, PT, DPT: “Native American Health and Cultural Competency”
- 06/27/2020 – Advancing Neurological Therapeutics 2020: Best Practices for a Future of Comprehensive Care; Hosted by Cleveland Clinic Lou Ruvo Center for Brain Health
- 06/19/2020 – Lisa VanHoose, PT, PhD, MPH, Associate Professor and Chair, University of Louisiana Monroe, Board-Certified Clinical Specialist in Oncologic Physical Therapy: “Grief and Loss Felt by All During Social Crises”
- 06/12/2020 – Rocky Barrett, PT, DPT, Certificate of Advanced Competency in Home Health, Southwest Medical Home Health: “COVID 19 and the Associated Pulmonary Dysfunction”
- 03/05/2020 – Istvan Takacs, PT, DPT: “The Emerging Role of Physical Therapists in Bike Fitting
- 11/20/2019 – Brooke Conway Kleven, PT, DPT: "Physical Therapy Service in Haiti"
- 10/02/2019 – Greg Nordfelt: TBI survivor and author of *Ride On: Adventures in Traumatic Brain Injury*
- 09/04/2019 – Elizabeth McGehee, PT, DPT, OCS: “My Journey to Pelvic Health”

Elena Wolf
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Education

Doctor of Physical Therapy (DPT) Estimated May 2022

- University of Nevada, Las Vegas

Bachelor of Science in Community Health Sciences May 2016

- University of Nevada, Reno

Licensure

Nevada Physical Therapy Board - License Pending Graduation May 2022

Service

Professional

- APTA Advocacy Day on the Hill (September 13th and 14th, 2021)
  - Student Physical Therapist Representative
- APTA NV Virtual District Meeting (October 12th, 2021)
  - Presentation titled "Day on Capitol Hill and APTA Advocacy"

Community

- Friends of Parkinson's Funny Bunny Race (April 10th, 2021)
  - Volunteer with event set-up and race registration
- High Rollers Adaptive Sports Foundation (January 25th, 2020) 3 hours
  - Volunteer scorekeeper at the Vegas Vengeance Wheelchair Rugby Tournament
- High Rollers Adaptive Sports Foundation (November 23rd, 2019) 3 hours
  - Volunteer scorekeeper at the Texas Hold'em Wheelchair Rugby Tournament
- Clean The World (October 11th, 2019) 2hours
  - For Global PT Day of Service, we helped sort types of soap and package the recycled soap for shipment.
- Las Vegas: Moving Day, a Walk for Parkinson's (September 28th, 2019) 3 hours
  - Donation based participant in the walk and participated in multiple activities during the event.
- Las Vegas Amputee Clinic (September 14th, 2019) 3 hours
  - Aided and encouraged participants with amputees in various physical activities

Leadership

- **Roles**
  - APTA NV Student Special Interest Group (October 2020- June 2021)
    - President
    - APTA NV SSIG Lecture Series
      - Dr. Carol-Ann Nelsen, PT, DPT (April 22nd, 2021)
      - Dr. Lisa Russell, PT, DPT, C-PS (March 24th, 2021)
  - UNLV DPT Class of 2022 Officer (August 2019- Present)
    - Co- Social Coordinator

Research

- **Create/Participate**

- "Effects of a Remote Exercise Intervention on Aerobic Endurance in individuals with Down syndrome."
    - Advisor: Dr. Thessa Hilgenkamp, PhD
    - 2/3/2022 Murata, A., **Wolf, E.**, Lee, B., Crimm, J., Mann, S., Hilgenkamp, T. Effects of a Remote Exercise Intervention on Aerobic Endurance in Individuals with Down Syndrome.
    - Platform Presentation at APTA Combined Sections Meeting 2022 - Cardiovascular and Pulmonary Platform: Cardiac Emphasis

- **Consume/Share**
    - UNLVPT Brown Bag Lecture:
        - February 19th, 2021: Danielle Garcia, PT, DPT, and Ron Garcia, PT, DPT, Financial Peace University Instructors, – "How Two UNLVPT Alums Paid Off $300,000 in Student Loans In Under 3 years"
        - September 25th, 2020: Ashley Reagor, PT, MSPT, ATC – "Now that I'm a licensed therapist, how do I start my own private practice?"
        - September 18th, 2020: Natalie Weeks-O'Neil, PT, DPT, DrPH – "Native American health and cultural competency"
        - March 5th, 2020: Istvan Takacs, PT, DPT, Portland, Oregon, "The Emerging Role of Physical Therapists in Bike Fitting"
        - February 6th, 2020: Brown Bag Movie Night, Thomas G. McPoil, PT, PhD, FAPTA – "50th Mary McMillan Lecture Award: Is Excellence in the Cards"
        - November 20th, 2019: Brooke Conway Kleven, PT, DPT; "Volunteering and Implementation of Healthcare in Haiti"
        - October 10th, 2019: Greg Nordfelt, Author of "Ride On: Adventures in Traumatic Brain Injury"
        - September 19th, 2019: James Gordon, PT, EdD; "45th Mary McMillan Lecture: If Greatness Is a Goal…"
        - September 4th, 2019: Elizabeth McGehee PT, DPT, OCS; "My journey to pelvic health"
    - Nevada Goes Fall Free Coalition: Fall Prevention Awareness Week
        - September 25th, 2020: Free Virtual Fall Risk Screenings
    - Combined Sections Meeting
        - February 2nd-5th, 2022: Attended meetings, poster presentations, networking events, and presented research
        - February 12th-15th, 2020: Attended meetings, poster presentations, and networking events.
    - UNLV Multidisciplinary Didactics
        - February 24th, 2020: Dr. Kevin Mailland, Shoulder Separations
    - UNLV PT Distinguished Lecture Series:
        - November 5th, 2020: Dr. Catherine Lang, PT, PhD, FAPTA; "Wearable sensors are changing how we think about movement and rehabilitation"
        - September 12th, 2019: Anthony Delitto PT, PhD, FAPTA; "Implementation: Finishing the Job of Evidence Based Practice"

Membership in Professional Organizations

- American Physical Therapy Association (June 2019-present)
    - Student Member, #860523
    - APTA Nevada