THE INFLUENCE OF MAXIMAL VERSUS TRADITIONAL RUNNING SHOES ON RUNNING BIOMECHANICS AND PLANTAR PRESSURE IN RECREATIONALLY ACTIVE ADULTS

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INTRODUCTION

Running is a popular recreational activity that continues to have a high injury rate. Numerous adaptations have been made to footwear over the last 40 years, such as increased cushioning and motion control technology, in an attempt to reduce the incidence of running related injuries (RRIs). More recently, the popularity of maximal running shoes has increased substantially with numerous variations now being offered on the market.

Despite no current agreed upon definition of maximal shoes, they are generally constructed with increased midsole cushioning and a low heel-toe drop. Maximal shoes are intended to improve shock attenuation and reduce impact forces during running, thus reducing the risk of injury (Pollard, 2018). However, previous evidence suggests that maximal shoes may actually increase vertical loading rate (VLR) and vertical impact peak (VIP) compared to traditional shoes (Pollard, 2018; Hannigan, 2019), but no differences in vertical active peak (VAP) were found. Additionally, maximal shoes have been shown to alter running kinematics, particularly increased eversion duration and eversion at toe-off (Hannigan, 2019; Hannigan, 2020). In addition, it has been suggested that greater plantar pressure may increase the risk for RRIs. Prefabricated orthoses have been shown to decrease peak plantar pressure in the forefoot; however, no research has investigated the influence of maximal shoes on plantar pressure (Hahni, 2016).

The purpose of this study was to compare the influence of maximal running shoes on ankle kinematics, ground reaction forces, and plantar pressure as compared to traditional running shoes in recreationally active adults. We hypothesized that running in a maximal shoe would result in a greater VLR and VIP and altered ankle kinematics, including increased eversion duration and eversion at toe-off, compared to the traditional shoe. Additionally, it was hypothesized that the maximal shoe would result in a greater rearfoot plantar pressure compared to the traditional shoe.

METHODS

20 participants (9 male; 11 female) participated in the study. Participants were required to be 18-40 years old, complete at least 150 minutes of moderate intensity physical activity or 75 minutes of vigorous intensity physical activity per week, and be a rearfoot-striker. Exclusion criteria included any neurological or vascular disorders, being currently pregnant, or having suffered an injury within the last six months that limited walking or running for at least one week.

Participants warmed up by running at a self-selected pace on a treadmill for five minutes in two shoe conditions that consisted of a maximal (Hoka Bondi) and a traditional shoe (New Balance Fresh Foam 880). Shoe order was randomized across participants. 21 individual reflective markers and six cluster markers were then applied to the participant's lower extremities to conduct a static calibration in both shoe conditions. Kinematic data were collected with a Qualysis 10-camera motion capture system, ground reaction force data were collected with three embedded force plates, and plantar pressure data were collected using an XSensor pressure imaging system. Following the static calibration, participants performed five practice trials over a 17-meter runway at a self-selected pace to determine average running speed. Participants then completed five successful running trials where their dominant foot contacted the force plate and they ran within ±5% of their average running speed. Participants then switched shoe conditions and completed five successful trials in that shoe condition. Two-tailed paired t-tests were performed for variables of interest, with an alpha level set at 0.05.

Table 1. Participant characteristics

Variable	Mean ± SD
Age (years)	25.1 ± 2.4
Weight (kg)	72.61 ± 12.01
Height (m)	1.72 ± 0.11
Weekly Mileage (miles)	6.13 ± 5.57
Physical Activity Per Week (min)	329 ± 169
Average Trial Speed (m/s)	3.78 ± 0.46

RESULTS

The characteristics of the participants are described in Table 1. The average forefoot plantar pressure in the traditional shoe (40.70 ± 9.10 N/cm^2) was significantly greater than the maximal shoe (36.43 ± 9.11 N/cm^2; p= 0.019). For ground reaction forces, no significant difference was observed between shoe conditions for VIP, VAP, or VLR (p>.05). For ankle kinematics, no significant difference was found between shoe conditions (p > 0.05).

Table 2. Plantar pressure, ground reaction force, and kinematic data

	Maximal	Traditional	p-value
Plantar Pressure			
Forefoot PP (N/cm^2)	36.43 ± 9.07	40.70 ± 9.10	**0.01**
Rearfoot PP (N/cm^2)	27.0 ± 5.76	29.23 ± 6.22	0.11
Ground Reaction Forces			
VIP (BW)	1.89 ± 0.31	1.90 ± 0.36	0.32
VAP (BW)	2.51 ± 0.20	2.54 ± 0.22	0.06
VLR (BW/s)	33.66 ± 8.50	32.2 ± 9.00	0.11
Kinematics			
Peak eversion (°)	10.42 ± 3.80	10.30 ± 4.17	0.84
Eversion excursion (°)	10.56 ± 7.08	10.16 ± 6.68	0.68
Eversion at Toe-Off (°)	4.56 ± 4.27	5.72 ± 5.02	0.15

DISCUSSION AND CONCLUSIONS

This study investigated the difference in running kinematics, ground reaction forces, and plantar pressure between maximal and traditional shoes. Forefoot plantar pressure was significantly greater when running in a traditional shoe compared to a maximal shoe. This increased forefoot plantar pressure may be due to the rocker bottom midsole in the maximal shoe. Previous research has indicated that running with rocker shoes results in decreased work at the ankle and decreased forefoot plantar pressure (Sobhani, 2014; Sobhani, 2016). The rocker sole of the maximal shoe may promote propulsion during gait, thus reducing work at the ankle and forefoot plantar pressure during push-off as compared to the traditional shoe. The decreased forefoot plantar pressure in the maximal shoe may result in the reduced risk of forefoot injuries such as metatarsalgia, metatarsal stress fractures, or for load management in the forefoot.

No significant differences were found in VIP, VAP, or VLR between shoe conditions. Previously conducted research has shown conflicting results in these areas. Two studies reported VIP and VLR to be higher in a maximal shoe (Pollard, 2018; Hannigan, 2019) compared to a traditional shoe, while another found no differences in ground reaction forces (Hannigan, 2020). These inconsistencies are likely related to variations in the models of footwear and populations studied. While participants in the current study were recreationally active, weekly running mileage and running experience was generally lower than previous studies. Additionally, the average running speed was substantially greater in the current study compared to previous studies. Finally, the relatively young age of these participants should also be considered with regard to the generalizability of these results.

Differences in kinematics between shoe conditions were unremarkable. These findings differed from a previous study that demonstrated altered ankle kinematics in the maximal shoe due to differences in footwear design (Hannigan, 2020). The previous study utilized a custom-designed maximal shoe with an increased stack height, while maintaining a narrower heel width. The narrower heel width may have contributed to the altered ankle kinematics to a greater extent than the wider heel width in the Hoka shoe used in the current study.

In conclusion, no differences in ground reaction forces or kinematics were found between a maximal and traditional running shoe in recreationally active adults. Forefoot plantar pressure was greater in the traditional running shoe compared to the maximal shoe, potentially due to the rocker sole of the maximal shoe. Given this finding, maximal shoes may have potential implications for prevention and load management of metatarsalgia and metatarsal stress fractures, but further research is needed to better understand this interaction.

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PROFESSIONAL EXPERIENCES OF PHYSICAL THERAPISTS WHO IDENTIFY AS BLACK, INDIGENOUS, OR PEOPLE OF COLOR (BIPOC)

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INTRODUCTION

Limited research has been conducted to capture the lived experiences of Black, Indigenous, or People of Color (BIPOC) physical therapists (PT) in academic and professional settings. According to the American Physical Therapy Association's most recent *Physical Therapist Member Demographic Profile*, association membership comprised 88.5% White PTs [1]. This fails to reflect the demographic profile of United States, which indicates White individuals comprise 61.6% of the general population, per 2020 US census data [2]. In 2019, Nadoo et al. (2020) studied workforce demographics in healthcare and identified underrepresentation among the larger US population of 13.4% African and 18.3% Hispanic Americans, noting anticipated general growth in these, as well as Asian American and Native American communities [3].

The purpose of this study was to describe the experiences of PTs identifying as BIPOC in academic and professional settings. The research team aimed to identify salient factors that impacted their experience as a BIPOC PT students and professionals. The importance of this study was grounded in gaining a better understanding of the lived experiences of BIPOC people within the predominantly White physical therapy profession. Attention was directed at how their identity molded and influenced daily interactions with patients, peers, colleagues, and organizations.

METHODS

This qualitative research received exempt status by the Oregon State University Institutional Review Board (IRB). Participants were recruited via snowball sampling. Seven participants completed a consent form and demographic form prior to their interview. Semi-structured interviews were conducted between January 2023 and May 2023 via video conference software or phone. Interviews were transcribed using professional transcription services. Interviews were de-identified and coded by five researchers. Themes were identified and organized using a collaborative approach. Any discrepancies were resolved via discussion. See *Figure 1*.

Participants ranged from ages 20 to 39 years old with up to 20 years of experience as a PT. Variations of geographic locations were represented with participants across the United States. Participants identified their race or ethnicity as Asian/SE Asian, Black/African, or Hispanic/Latinx.

RESULTS

Analysis indicated four themes (physical therapy, identity, support, and external influences). These four themes produced subthemes that were protective or limiting in either the academic or professional setting. Subthemes in the academic setting include but are not limited to curriculum and its inclusivity, diverse representation within cohorts, support or lack thereof by peers, family, and faculty, and geographical location. Subthemes identified in the professional setting include but are not limited to diversity training, decreased promotional opportunities, personal boundaries, unsolicited comments, mentorship, and policies. The entirety of subthemes can be identified in *Figure 1.*

Participants shared three common recommendations including: increasing support resources, training conducted by BIPOC leaders, and increased representation of BIPOC PTs in academic and professional settings. Results from this study suggest that the students and professionals from BIPOC backgrounds would benefit from actions that target development of these themes and recommendations.

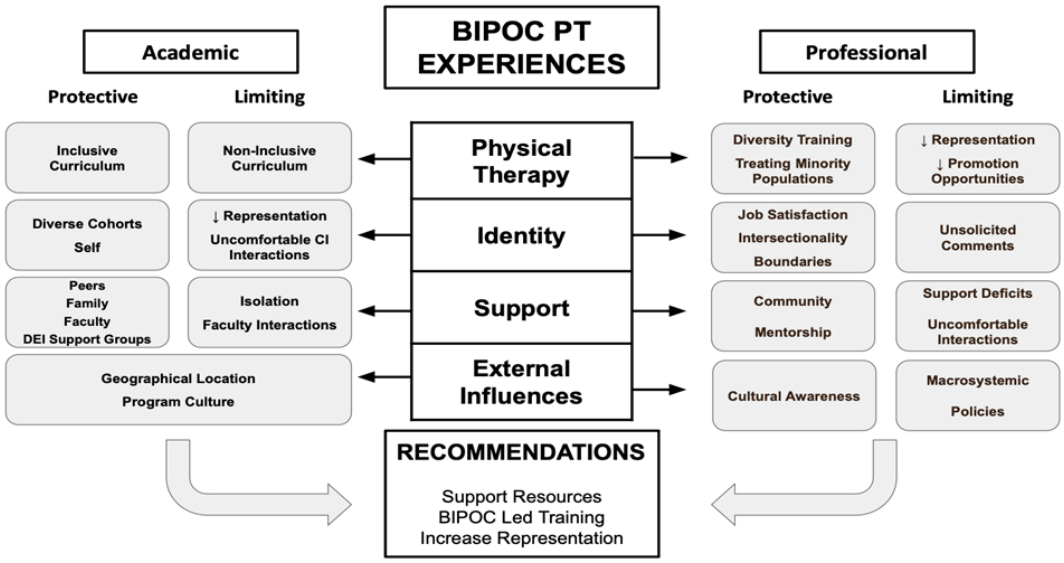

Figure 1: BIPOC Physical Therapist (PT) Experiences - Identified themes, subthemes, and recommendations.

DISCUSSION AND CONCLUSIONS

The physical therapy profession, including academic programs, lacks BIPOC diversity and representation [4]. Given this, the authors sought to obtain greater insight into the lived experiences within this underrepresented population. Participants in this study shared their experiences which include both protective and limiting factors related to the academic and professional setting. Protective factors such as established Diversity, Equity, and Inclusion (DEI) support groups and having a diverse cohort are approaches that academic programs are already taking to support their BIPOC students. This is consistent with recent efforts to implement effective recruitment and retention DPT programs [4].

Participants in this study recommended multiple factors to improve the experience of BIPOC PTs. The most common recommendations included increasing support services, training conducted by BIPOC leaders, and increased representation in the academic and professional setting to increase diversity and inclusion in the physical therapy field. Further research may be helpful in understanding the effects of these interventions. For example, a research study could be done on students enrolled in a 1:1 BIPOC mentorship program before and/or after clinical rotations to measure satisfaction with career and self. This topic could examine what the outlook on career advancement, continuing education, loan repayment, and equity within opportunity might look like when BIPOC students are given resources and mentorship to succeed within these primarily white spaces.

The authors identified small sample size to be a limitation of this study. Further research is recommended to continue to identify factors that impact the experience of BIPOC PTs and opportunities to improve the physical therapy field.

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INTRINSIC FOOT STRENGTH, HIP STRENGTH, AND IMPACTS ON DYNAMIC POSTURAL STABILITY

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INTRODUCTION

For activities and testing requiring gross postural stability, there have been different theories on stability origin including both top down stabilization strategies starting at the core and bottom up strategies leading from the feet. While the majority of research on dynamic lower quadrant alignment centers around the lumbopelvic hip complex [1], more recent works have highlighted the effect of foot intrinsic stability on function and performance [4, 6]

This study's purpose was to identify relationships found between distal intrinsic foot strength and proximal hip strength across the Y-balance test (YBT). Our hypothesis was that individuals with strong foot intrinsics would have better quality movement compared to strong hip strength during the YBT as quantified using center of mass (COM) excursion and acceleration parameters such as sway and jerk.

METHODS

Participants: 20 healthy adults (9 females, 11 males) aged 18-31 years old were recruited with a self-selected convenience sample from the Bend, Oregon area. The inclusion criteria were: Age 18-55 years, independent with community ambulation, and capable of performing a single leg balance test. The exclusion criteria were: no neurological or vascular disorders, not pregnant, no lower extremity injuries within the last 8 weeks. Informed consent was obtained.

Strength & Dynamic Balance Testing: For strength assessment, manual muscle testing (MMT) of the foot (1st ray plantarflexion (PF) strength, and 2-5 ray PF strength respectively) and hip MMT (triplanar) were collected and normalized to bodyweight. YBT was performed while instrumented with IMU sensors (ADPM, Portland OR) to capture center of mass sway (excursion) and jerk (acceleration).

Statistics: MMT data was used to divide the 20 participants into strong, average, and weak groups with cutoff points one standard deviation out from the mean of the entire sample set. Intergroup correlations were assessed using cutoffs 0.5-0.7 as moderate correlation and greater than 0.7 as strong correlation. Comparisons between each group's relationship was evaluated with a single factor analysis of variance (ANOVA) test. A p value less than 0.05 was used as a standard cut off for statistical significance.

RESULTS We found statistically significant (alpha<0.05) negative correlation between weak, average, and strong transverse plane hip strength groups and composite jerk (Figure 1). A moderate negative correlation was found between strength performance in the strong transverse plane group and composite sway. No statistically significant findings were observed amongst the sagittal plane hip strength groups. There was a strong negative correlation found between toe strength and composite sway in the weak group. A strong positive correlation was found between composite jerk and toe strength in the average group. A moderate correlation was found between composite jerk and toe strength in the strong group. No statistical significance was found between foot strength and frontal plane hip strength groups.

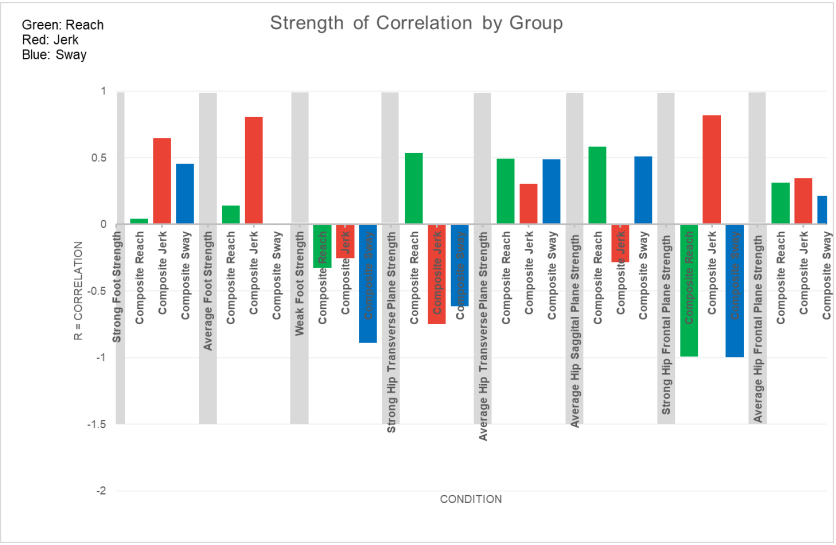

Figure 1. Strength of correlations between groups.

DISCUSSION

The use of IMU's during the YBT provides objective insight on the quality of COM control during a test that is based on an absolute reach score. The results of this study did not support our initial hypothesis, that distal foot strength would have a greater positive effect on whole body stability compared to proximal hip strength. The only single factor ANOVA result that showed statistical significance (p=0.048) between strength groupings was in the transverse plane hip strength. Participants with strong transverse plane capacity at the hip demonstrated a strong, positive correlation (+0.79) with composite reach as attained in the YBT. This group also showed a strong, negative correlation (-0.75) with composite jerk scores. This suggests that those with strong hips are able to reach further with less rapid adjustments and overall improved quality of movement. This is supported by a study [5] in which transverse plane hip kinematics were determined to be an effective indicator of postural stability in dynamic activities. This suggests that a top-down approach in rehabilitation protocols should be considered when an individual participates in activities that require dynamic stability.

Table 1: Between groups statistical significance with a single factor ANOVA (p<0.05)

Group	Variables	P value
Foot Strength	Composite Reach	0.766
	Composite Jerk	0.27
	Composite Sway	0.715
Hip Transverse Plane Strength	Composite Reach	0.288
	Composite Jerk	0.048
	Composite Sway	0.869
Hip Sagittal Plane Strength	Composite Reach	0.703
	Composite Jerk	0.703
	Composite Sway	0.711
Hip Frontal Plane Strength	Composite Reach	0.09
	Composite Jerk	0.484
	Composite Sway	0.605

Numerous studies have asserted that recruitment of intrinsic foot musculature increases with postural demand in order to stabilize during dynamic activities [2,3,6]. In the present study, trends were found indicating that participants categorized as having weaker composite foot strength had a strong, negative correlation (-0.888) between foot strength and sway. This suggests that people with weaker foot intrinsics had less control of their COM during the YBT. When compared with the sway measurements for the strong and average foot strength groupings, we assert that the strength of this trend may offer clinical value despite the limitations of a small study sample size. The average foot strength group presented with a strong, positive correlation (+0.807) between strength and composite jerk scores. In other words, those which have a more mid-range foot strength have some of the fastest acceleration between their points of excursion. Overall, there is evidence supporting a positive relationship between intrinsic foot muscle strength and improved dynamic balance.

CONCLUSION

We hypothesized that individuals with stronger foot intrinsics would have better quantitative movement quality measures during the YBT. However, this research found that transverse hip strength was more influential in keeping the center of mass stabilized within an individual's base of support while performing a dynamic activity. Yet, a limitation of our study was that it was not adequately powered with a non-uniform distribution. These results suggest that while the strength of the foot intrinsic muscles impact dynamic stability, the transverse plane hip musculature also plays a key role during a postural stability test. Future studies with sufficient statistical power could investigate these trends further, and how planar aspects of hip and foot strength relate to an individual's movement strategy to achieve dynamic stability.

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MULTIPLE SCLEROSIS AND HIGH INTENSITY INTERVAL TRAINING: A CASE SERIES

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INTRODUCTION

Multiple sclerosis (MS) is a complex neurodegenerative disease characterized by demyelination and neural inflammation within the central nervous system. The clinical presentation and disease progression of MS are highly individual depending on the location of the demyelination and inflammation. Common symptoms include sensory loss, heat intolerance, fatigue, muscle weakness, pain, spasticity and balance impairments, but vary greatly between individuals [2]. The physical effects of MS, in combination with other psychological factors, lead to various lifestyle impacts, including fatigue, decreased quality of life, decreased mobility and decreased physical activity.

Because many individuals with MS suffer from heat intolerance and intense fatigue, many physical therapists are hesitant to prescribe moderate to high intensity exercise therapy, and many patients are hesitant to participate in such exercise. However, emerging evidence suggests that high intensity interval training (HIIT) may be safe and effective for patients with MS and may potentially result in better outcomes in fewer sessions [3].

HIIT is a method of exercise that utilizes short to long periods of high intensity exercise, alternated with short rest periods of low intensity exercise or rest [4]. In this study, we defined HIIT as a 2:1 ratio of work to rest, while maintaining a rate of perceived exertion (RPE) of at least 8/10 on the Modified Borg Scale. The purpose of this study was to determine the effects of HIIT on walking speed, balance, and quality of life in individuals with MS. We hypothesized that HIIT would improve all outcome measures.

METHODS

Participants consisted of three female physical therapy patients at Destination Rehab. Participants were required to be at least 18 years of age and have a diagnosis of MS. Participants performed each HIIT workout during their physical therapy treatment sessions.

After donning a continuous heart rate monitor, patients then completed a 3–5-minute warm-up, followed by at least 20-30 minutes of HIIT, followed by other physical therapy interventions as indicated. HIIT parameters were as follows: 20-30 minutes per session, with a 2:1 ratio of time “ON” (high intensity exercise) to time “OFF” (low to moderate intensity exercise). Clinicians monitored participants’ RPE via the Modified Borg Scale. Target RPE was at least an 8/10 during the “ON” phase of HIIT. RPE was then compared to objective heart rate data to assist with accuracy. To track participants’ progress, clinicians used the following outcome measures: 60-second sit-to-stand (60STS), MiniBEST, and Modified Fatigue Impact Scale (MFIS). Finally, each participant completed a brief exit survey to collect data about their subjective experience in the HIIT program.

Data were collected by three physical therapists and five student physical therapists. The study was a case series design. We performed no statistical analyses between participants. Due to the real-life clinical setting, exercise types were not standardized, but rather individualized.

RESULTS

Overall, patient outcomes improved between intake and discharge assessments, with the exception of Patient A’s MFIS score, and Patient B’s MiniBEST score, as seen in Table 1 below. Additionally, the subjective exit surveys reflected positive attitudes towards HIIT programs, with Patient C reporting, “HIIT gives you a sense of accomplishment which tends to motivate you to try harder and do better each time.” Patient B reported, “[It] is great for not over fatiguing muscles, and the repetition is perfect for gaining more confidence with each set.” Major themes seen in all the exit surveys were increased self-efficacy with exercise, and appreciation for the adaptability of the program.

	60 Second Sit to Stand		Modified Fatigue Impact Scale		MiniBEST	
	Intake	Discharge	Intake	Discharge	Intake	Discharge
Patient A	21	37	29	29	21	27
Patient B	21	25	30	24	27	24
Patient C	24	33	40	37	24	25

Table 1: Outcome measure scores for each participant at intake and discharge

DISCUSSION AND CONCLUSIONS

Due to the unpredictable nature of the MS disease process, the individual presentation of each participant differed notably. Our exit survey focused on the subjective experience, capturing the holistic impact the exercise program had on our participants. We included an array of exercise options that were catered to each individual performing the workout, which differs from the current literature in which each participant performs a standardized exercise routine [1]. We hypothesized HIIT would improve walking speed, quality of life and balance. While we were not able to draw conclusions about walking speed and endurance, the improvement in the 60STS scores may indicate an increase in functional endurance. There were only two scores that did not improve over the course of treatment. We suspect this was due to situations outside of our control such as illnesses and personal life changes that may have impacted fatigue levels and work ability in those with MS more than in the general population.

Statistical analysis was unable to be performed due to our small sample size. Certain outcome measures such as the MS Walk 12 and 6-Minute Walk Test were used inconsistently among the patients, resulting in us being unable to include pertinent information collected for certain participants. Therefore, we could not fully analyze the data for those outcome measures. The limited nature of a case series does not allow us to make specific recommendations to the larger population. However, we believe that valuable information regarding our participants' perceptions and relevant outcomes may still be applied to clinical practice.

While the small sample size does not allow us to make general recommendations, we believe insights gained regarding this style of exercise program may still be valuable for clinical practice. HIIT exercise prescriptions may be beneficial for patient populations that need flexibility in their programming. HIIT not only helps with balance, functional strengthening and fatigue, but may also help improve self-efficacy and confidence.

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ACL RECONSTRUCTION AND THE RELATION TO CUTTING BIOMECHANICS AND KINESIOPHOBIA

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INTRODUCTION

The anterior cruciate ligament (ACL) is responsible for providing stability to the knee by preventing anterior translation of the tibia relative to the femur. The ACL can withstand forces up to 2000 N [1], yet is the most commonly injured ligament in the knee. ACL injuries account for 100,000-200,000 knee injuries in the United States per year [2]. Due to its prevalence, especially amongst young athletes, surgical interventions are commonly performed to facilitate return to sport. Mounting evidence suggests that individuals with a history of ACL injury are at risk for developing maladaptive behaviors due to fear of movement (kinesiophobia), a limiting factor in return to sport [3].

In a previous study of the ACL, participants demonstrated significantly less peak knee flexion, knee flexion excursion, peak hip extension, and hip extension excursion in the surgical limb compared to the nonsurgical limb during a cutting task [4]. It is currently undetermined if these biomechanical deficits occur due to hamstring or quadricep weakness, kinesiophobia, or both. Therefore, the purpose of this study was to investigate potential relationships between cutting biomechanics, measures of strength and kinesiophobia, and whether a quick motor learning intervention centered around verbal cueing can change cutting biomechanics after ACL reconstruction (ACLR). It was hypothesized that: (1) participants who have decreased quadricep and hamstring strength will demonstrate less knee and hip excursion during cutting, (2) participants who have high self-reported levels of kinesiophobia will have less peak hip and knee flexion angles during cutting, and (3) an internal verbal cue will facilitate greater hip and knee flexion angles during cutting.

METHODS

13 participants partook in this quasi-experimental crossover study (females=6, males=7; average age=32.3 ± 8.1 years; average height= 174.9 ± 9.5 cm; average weight= 73.6 ± 8.5 kg). Participants were included in this study if they were 18-50 years of age, had sustained an ACL injury, had a surgical repair at least 1 year prior, and were cleared by a medical professional for unrestricted activity at least 3 months prior. Participants were excluded if they were pregnant, had neurological or vascular disorders, had prior surgeries or current injuries to the back or lower extremities, or had any injury over the prior 3 months that limited physical activity for 1 week or more. Participants were screened, signed a consent form, and were interviewed prior to data collection. Data about ACL injury and reconstruction was collected. A 5-minute treadmill warm-up at a self-selected pace was performed in a standardized shoe.

All 3D motion capture data was collected with a Qualisys 10-Camera Motion Capture System (Qualisys AB). Participants then had 43 individual markers placed on their pelvis, legs, and feet for static calibration. After calibration, pelvis markers and clusters of thigh, shank and foot remained on the participant while all others were removed. Participants were instructed to run toward the force plates at an 8 ± 0.6 minutes/mile pace before planting their foot on the last force plate and cutting at a 45 ± 10 degree angle toward the opposite side. 5 trials were recorded on each leg, and this was repeated after a cue to “bend more at the hip and the knee” was given. Knee flexor and extensor strength was measured bilaterally using the Biodex Medical System 3 isokinetic dynamometer in a seated position. Data was collected at 60 degrees/second and 180 degrees/second. Each speed was performed for two trials with 5 repetitions each, and a short break between sets. At the end, participants filled out both the Tampa Scale of Kinesiophobia (TSK) and the ACL Return to Sport after Injury (ACL-RSI). Statistical analyses included Pearson’s correlations and paired t-tests performed in Microsoft Excel. The α-level has been set to 0.05.

RESULTS

Peak knee flexion angles, knee flexion at initial contact (IC), peak hip extension, and hip flexion at IC all increased significantly from pre-cue to post-cue on both limbs (Table 1). No significant correlation was found between TSK scores and peak knee flexion angles during cutting on either limb. No significant correlation was found between TSK scores and peak torque of the knee flexors and extensors on either limb. No significant correlation was found between peak knee flexion angles during cutting and peak torque for the knee flexors and extensors on the involved side. No significant

differences between surgical and non-surgical limbs for peak knee flexion, peak hip extension, or knee flexion at initial contact for either the pre-cue or post-cue conditions. A significant difference was found between the surgical and non-surgical limbs for hip flexion at initial contact during the pre-cue condition only (surgical limb hip flexion at IC average = 33.83 ± 10.99 degrees, non-surgical hip flexion at IC average = 37.05 ± 11.28 degrees).

Table 1: Biomechanical data during the cutting maneuver

Limb/Condition	Average Joint Angle (deg)					
	Involved Limbs			Uninvolved Limbs		
	Pre-Cue	Post-Cue	p-value	Pre-Cue	Post-Cue	p-value
Hip						
Peak extension	-13.01 ± 8.01	-11.85 ± 6.79	0.304	-16.81 ± 5.67	-14.67 ± 8.66	0.344
Flexion at IC	34.18 ± 8.38	41.17 ± 9.18	< 0.001*	35.76 ± 11.20	42.04 ± 8.70	0.0104*
Knee						
Peak flexion	46.96 ± 5.51	58.02 ± 6.37	< 0.001*	47.83 ± 6.97	58.73 ± 6.64	< 0.001*
Flexion at IC	18.43 ± 6.92	21.50 ± 7.06	< 0.001*	19.98 ± 6.10	24.03 ± 5.71	0.0337*

*Denotes significant difference, $p \leq 0.05$

DISCUSSION AND CONCLUSIONS

In this study, researchers found that an internal cue provided during cutting tasks significantly increased hip and knee flexion angles at IC, as well as peak knee flexion angles. Prior research has shown that improper jump-landing mechanics is one of the leading causes of non-contact ACL injury due to small knee, hip, and trunk flexion angles [5], and that enhancing this motor skill can lead to a reduction in injury [6]. This study begins to show the effects of augmented information on joint kinematics in participants with ACL reconstructions. Internal cueing can be used during ACLR rehabilitation in order to restore normal joint kinematics during cutting techniques to help reduce the risk of re-injury. Future studies should assess whether or not consistent externally focused cues could provide further improvement during cutting techniques in patients with ACL reconstructions.

This study did not find any significant relationship between kinesiophobia scores and decreased hip and knee flexion angles. In another study that assessed TSK scores and knee flexion post ACLR, a strong negative relationship was found between the two ($r = -.592$, $p = .20$) and it was concluded that the TSK had high reliability at predicting movement alterations in individuals who have a fear of movement post-ACLR [7]. Due to lack of power in this study, these same results were not found to be significant, and thus more research must be done on the relationship of kinesiophobia and peak hip and knee flexion angles in individuals post-ACLR.

This study was not adequately powered and a larger sample size may have led to more significant results. Additionally, most of the participants were young, active individuals with little fear avoidance for cutting activities. Only one of the 13 participants was considered to have kinesiophobia (>37 points on the TSK).

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A Pilot Study Examining Concussion Trends in a Non-Athlete Population

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INTRODUCTION

According to the most recent report to Congress by the Centers for Disease Control and Prevention more than 1.5 million people experience a traumatic brain injury each year in the United States. Up to 75% of these are mild traumatic brain injuries (mTBI), more commonly known as concussions (CDC, 2003). This study examined mTBI patients in the Bend, Oregon area and how different confounding variables may influence performance on concussion-related outcome measures. The confounding variables examined included cervical injury at time of concussion, previous COVID within the last 6 months, and prior concussion history. These subgroups were compared based on performance on the Vestibular Ocular Motor Screening (VOMS), Post-Concussion Symptom Scale (PCSS), and Dual Task Cost (DTC) as estimated by Four Square Step Test (FSST). With the emergence of the recent COVID-19 pandemic, many of the symptoms experienced by patients overlap with symptoms experienced in mTBI. Our research also aimed to examine the possible effects COVID diagnosis may have on mTBI recovery.

METHODS

Participants were referred to Spark Rehab + Wellness for physical or occupational therapy with a diagnosis of concussion or mTBI. In total 24 were included in the final data analysis. The average age was 42 and there were 17 females and 7 males included. Subjects were included if they had a history of previous concussion and excluded if they were not treated at Spark Rehab + Wellness and did not speak English. Consent was obtained from participants if a student was collecting data during their session. Patient names were coded in order to be blinded during data analysis.

Data was collected from each patient chart and included the PCSS, VOMS, FSST using dual task, and Buffalo Concussion Treadmill Test (BCTT). The tests were conducted in the order listed above, but did vary if the patient's symptoms limited them. From the FSST Dual Task Cost (DTC) was calculated. The BCTT was omitted from analysis as not enough patients were able to complete the test. Each of these tests was analyzed using a 2-sided equal variance T-Test and compared with age, gender, time since concussion, cervical injury, loss of consciousness, number of previous concussions, and previous COVID-19 within 6 months of most recent concussion. Correlation analyses were run between scores of the four tests conducted during the initial evaluation. P-value was set to 0.05.

RESULTS

The comparisons made primarily fell into three main outcome measure categories: VOMS, PCSS and DTC. Other information was collected on age, COVID status in the last 6 months (yes or no), cervical injury adjunct to concussion (yes or no), loss of consciousness (yes or no), and BCTT.

Measurement	R	P value
VOMS vs. Time Since Injury	-0.05	0.835
VOMS vs. PCSS Items	0.42	0.09
VOMS vs Age	0.02	0.95
PCSS vs. Time Since Injury	-0.07	0.759
PCSS vs. Age	0.061	0.777
DTC vs. VOMS	0.87	0.0001
PCSS vs VOMS With COVID +	0.705	0.0001
PCSS vs. VOMS With COVID -	0.013	0.81

Measurement	T-test
VOMS vs. COVID (Y/N)	0.055
VOMS vs. Cervical Injury (Y/N)	0.116
PCSS vs. COVID (within 6 months)	0.541
PCSS vs. Cervical injury	0.538
PCSS vs. LOC	0.238
PCSS vs. Male or Female	0.14
DTC vs. LOC	0.02
DTC vs. Age (over or under 40)	0.124
DTC vs. Male or Female	0.729
DTC vs. COVID	0.81
DTC vs. Cervical Injury	0.298
DTV vs. Time Since Injury	0.097

Significant findings were a strong correlation between PCSS and VOMS in patients without COVID (R=0.705, p=0.001), but not with patients with COVID (R=0.0128, p=0.81), VOMS and DTC (R=0.756, p=0.001) and
between LOC and no LOC for DTC (sample size of 2 for LOC).
While some results show a p-value of <.05, this study needed more power to be clinically valid.

DISCUSSION

The outcomes of this study show that adults and children (average age of 42 years old) who had concussion symptoms with time of onset ranging from 2-1095 days with no diagnosis of COVID-19 had a strong correlation between PCSS and VOMS scores. The correlation between PCSS and VOMS for patients with a previous COVID-19 diagnosis was weak. For patients without a COVID-19 diagnosis, as self-reported symptoms of fogginess, sadness, dizziness and emotion worsened on the PCSS, VOMS scores also worsened.

Some of the individual findings were unexpected regarding standard treatment for concussion for patients with a previous COVID-19 diagnosis. These patients had higher averages for self reported symptoms scores with the PCSS as well as higher vestibular-ocular motor functioning scores as measured by the VOMS. DTC scoring was also less predictable with this patient population. One patient with a previous diagnosis of COVID-19 within the last 6 months had a DTC of 166% and a VOMS score of 35.63. Further study in the association between COVID-19 and concussion would be valuable as this is an emerging topic of study. A larger population size would be needed to observe these findings.

Previous studies have outlined the impact of vestibular symptoms after concussion and having multiple post-concussion symptoms and its impact on quality of life. Our correlational analysis found that there is not only an association between vestibulo-ocular function and worsening self-reported symptoms post concussion, but also worsening vestibulo-ocular function and DTC. Of the 24 patients included in this study, 10 had a reported DTC greater than 17%. DTC and VOMS were strongly correlated with an r=0.7561 and p=0.011. Ninety percent of these patients reported feelings of fogginess, 60% reported feelings of sadness, and 60% reported feeling more emotional.

CONCLUSION

While the VOMS scores of patients with a previous diagnosis of COVID-19 were not strongly correlated with PCSS, there was a strong correlation for patients without a previous COVID-19 diagnosis. Worsening DTC was also associated with worsening VOMS scores for all patients that had recorded DTC. Based on previous studies, this information suggests that the persistence of post concussion symptoms are associated with prolonged recovery of vestibulo-ocular function as well as increased dual task cost. Our data also shows a need for more research into the implications of previous diagnosis of COVID-19 and concussion on treatment and recovery for patients experiencing persistent symptoms after concussion.

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WALKING BIOMECHANICS AND PERCEIVED COMFORT IN THREE DIFFERENT SHOES IN ADULTS WITH KNEE OSTEOARTHRITIS

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INTRODUCTION

Knee osteoarthritis (OA) is a degenerative joint disease prevalent in 6% of the adult population in the United States [4]. Various biomechanical factors like increased knee adduction moment (KAM) have long been identified as risk factors for developing knee OA [3]. Current research has demonstrated that footwear can affect these biomechanical variables in healthy populations [1]. It is currently unknown how varying shoe conditions affect the biomechanics, intrinsic perception, and the pain experienced during gait in individuals diagnosed with knee OA. The purpose of this study was to investigate the effect of minimal, traditional, and maximally cushioned shoes on walking biomechanics and individual perception in individuals with knee OA.

METHODS

Inclusion criteria consisted of having a current diagnosis of knee OA, 3/10 pain in the involved knee, and being able to walk without an assistive device. Exclusion criteria consisted of having severe pain or injury in another joint, having a knee replacement or other serious surgeries to the lower extremities or back, or currently undergoing intra-articular joint injections. This project utilized three different shoe types to each serve as a condition: maximal (HOKA Bondi 7), traditional (New Balance Fresh Foam 880v11) and minimal (Xero Prio). 3D markerless motion capture (Qualisys, Theia), plantar pressure (XSENSOR), and three force plates (AMTI) were utilized to obtain data of each subject in each shoe condition. Prior to data collection the participant filled out an initial questionnaire about their knee OA, Oxford Knee Score (OKS), and Knee Injury and Osteoarthritis Outcome Score (KOOS). Participants were asked to perform 5-10 trials of walking along the force plate walkway in each shoe condition. Following each shoe condition, the participant filled out another survey to rate the shoe. The research team utilized SPSS to analyze the data. Repeated measures ANOVAs and Pearson correlations were used to analyze the data. The alpha level was set at .05.

RESULTS

Overall shoe rating was significantly higher in the traditional shoe compared to the minimal shoe (p = .023). The peak KAM was significantly greater in the maximal shoe compared to the traditional shoe (p= .004). Average pressure (p <.001) and peak pressure (p = .007) were significantly higher in the minimal shoe compared to both other shoes. Medial peak pressure was significantly higher in the minimal shoe compared to the maximal shoe (p = .019), while lateral peak pressure was significantly higher in the minimal shoe than both the traditional and maximal shoes (p < .001) (Table 1).

We observed a positive correlation between overall shoe rating and perceived shoe stability (r = 0.69). There was also a positive correlation between KAM and knee adduction at initial contact (r = .84).

Table 1: Perception, Plantar Pressure, and Biomechanical Data

	Maximal	**Minimal**	**Traditional**	***p*-value**
Overall Shoe Rating	75.5(17.19)	42.6 (31.42)	76 (19.10)	**0.023**
Stability	64.3(22.21)	52.2 (35.35)	80.5 (13.69)	0.269
Pain Perception	24.33(31.91)	15.11 (16.23)	14.55 (16.22)	0.121
Knee Adduction Moment	0.521 (0.15)	0.489 (0.13)	0.46 (0.14)	**0.004**
Average Pressure	4.63 (0.38)	5.39 (0.49)	4.54 (0.69)	**<0.001**
Peak Pressure	26.13 (5.15)	31.92 (3.88)	27.18 (5.16)	**0.008**
Peak Medial Pressure	23.57 (4.94)	30.04 (5.40)	25.63 (6.22)	**0.019**
Peak Lateral Pressure	19.01 (4.24)	25.94 (4.27)	15.05 (2.22)	**<0.001**

Data reported in mean (SD), bold indicated significance.

DISCUSSION

The research conducted in this study investigated how different types of shoes affect pain levels and biomechanics in individuals with knee osteoarthritis. Current research supports shoe type having influence on various biomechanical factors like KAM and knee flexion angle on initial contact. However, this research was conducted on healthy individuals and further investigation is needed in order to help understand which specific shoe type may be best for someone with knee OA. The traditional shoe demonstrated the smallest KAM among the shoe types (0.469), as well as lowest average pressure (4.54), both of which were determined to be significant findings. Conversely the maximal shoe was seen to have the largest KAM (.521) while the minimal shoe displayed the largest average pressure (5.39).

Statistical analysis showed that overall shoe rating based on individual perception was significant ($p = 0.023$). The traditional shoe received the highest overall rating from participants (76), with the maximal and minimal shoes being rated (75.5) and (42.6) respectively. Prior research has demonstrated large KAM may result in knee OA progression as well as suggesting the significance of lowering the peak KAM in people with knee OA to make clinical improvements [2]. This study currently lacks the power to assert that people with knee OA should avoid the use of maximal shoes or conversely should opt for a traditionally cushioned shoe. We have, however, demonstrated significance in that those with knee OA who wear maximal shoes do experience a larger peak KAM. This finding was in contrast to the traditional shoe in that it was demonstrated to have the lowest KAM, average pressure, as well as having the highest overall shoe rating among all three shoes tested. A significant limitation of this study was the limited sample from which data was collected. The researchers recognized that a larger sample size would make for a more robust study, however, we were limited by the number of participants willing to participate in this study.

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COMPARISON OF THE EFFECT OF STANDARD OF CARE EXERCISE PROGRAM TO SELF-SELECTED EXERCISE ON COMPLIANCE IN PEOPLE WITH PARKINSON'S DISEASE

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INTRODUCTION

Parkinson's Disease (PD) is a progressive neurodegenerative disorder for which there is no cure [1]. Disease management is purely symptomatic and typically involves dopamine-therapy to manage early motor effects of PD. Pharmacologic approaches are complemented with exercise to further increase the body's natural dopamine production and support movement initiation at the basal ganglia [2,3]**.** The American College of Sports Medicine exercise recommendations for PD include moderate to vigorous intensity aerobic exercise for 150 minutes per week, strength training, balance, agility, flexibility and multitasking for 30 minutes two-three days per week with daily integration if possible [4]. People with PD have challenges complying with home exercise programs (HEP) due to barriers including cost, low self-efficacy, travel, and lack of social support. This study aimed to compare compliance of people with PD with self-selected (SS) HEP versus standard of care (SOC) HEP prescription. Based on the principle of autonomy, we hypothesized that allowing patients to self select exercise programs will improve compliance with the HEP.

METHODS

Participants were recruited from Bend, OR and were initially screened over the phone to identify eligibility. An in-person screen was performed to assess vital signs, aerobic capacity via the Modified Bruce Protocol Treadmill Test, Hoehn and Yahr (HY) stage via administration of the Unified Parkinson's Disease Rating Scale (UPDRS), and cognitive function via the Mini Mental State Exam (MMSE) to confirm safe independent participation in an HEP. Inclusion criteria was ages 18-80, medically stable, safe to participate in moderate intensity exercise, a score of at least 24 on the MMSE, and a medical diagnosis of PD with a HY between I & III on the UPDRS. Exclusion criteria was use of an assistive device for community ambulation, not medically cleared to participate in exercise, presence of other neurological disorders, currently receiving physical therapy treatment, or unwillingness to participate in a structured exercise program.

Baseline testing performed within one month of recruitment and consisted of a Timed Up and Go (TUG) test, TUG cognitive (TUGcog), 4-square step test (4SST), Functional Gait Assessment (FGA), and a 6-minute walk test (6MWT). A total of five participants were randomly assigned to either a SOC HEP (control) or SS HEP (experimental) group. Participants began interventions within five days of baseline testing and had supervised visits to ensure proper and safe HEP compliance. After randomization, there was no further blinding of participants or therapists. Participants were asked to complete the HEP for a total of six weeks for 30-60 minutes four-five times per week. Follow-up testing was performed on week six and 12 to assess the effects and efficacy of interventions. Compliance and Rating of Perceived Exertion (RPE) were self-reported using HEP tracking sheets and the Modified Borg RPE Scale. Percent compliance was calculated based on the minimum exercise requirements of four days per week. Only activities prescribed by our researchers were counted towards compliance rates. Means (M) were calculated for each outcome measure, RPE, percent compliance, and days per week of activity. Between-group differences were then analyzed using a two-tailed unpaired t-test with an alpha level of 0.05. Standard Deviations (SD) were also calculated for the reported means. All data analyses were performed using Microsoft Excel.

RESULTS

Upon computation of the statistical analysis via means, standard deviations, and t-tests there were no significant differences found at baseline for any of the outcome measures. At the six-week follow-up, a significant difference was found that the SS group (M=5.63 ± 0.81) performed better than SOC (M=8.52 ± 0.42), p-value=0.01. We failed to reject the null because a significant difference between the SS and the SOC in compliance was found (SS: M=133.33 ± 27.32) (SOC: M=52.09 ± 2.95) with a p-value of .03. Statistical significance was also found in number of exercise sessions per week (SS: M=35 ± 1.00, SOC: M=22.5 ± 0.71), p-value=0.001, and RPE (SS: M=36.09 ± 0.54, SOC: M=4.36 ± 0.34), p-value=0.02.

Table 1.1 provides group outcome measure, compliance, number exercise sessions per week, and RPE. t-Test P-values, averages, and standard deviations with * indicating a significant result.

Outcome Measure		SOC Mean ± SD	SS Mean ± SD	t-Test P-Value
Baseline	**4SST (Seconds)**	9.26 ± 0.66	7.05 ± 1.65	0.14
	6MWT (Meters)	382.40 ± 252.30	447.74 ± 78.49	0.78
	FGA (Score)	23.50 ± 4.95	22.33 ± 2.52	0.80
	TUG Dual Cost (Seconds)	-26.5 ± 4.4	-18.0 ± 32.3	0.67
Week 6	**4SST (Seconds)**	8.52 ± 0.42	5.63 ± 0.81	0.01*
	6MWT (Meters)	334.9 ± 113.63	507.61 ± 46.21	0.96
	FGA (Score)	24 ± 1.41	28.67 ± 0.2.31	0.07
	TUG Dual Cost (Seconds)	-11.70 ± 18.24	-17.23 ± 8.75	0.74
Compliance (Percentage)		52.09 ± 2.95	133.33 ± 27.32	0.03*
Amount of Exercise (Total Sessions)		22.5 ± 0.71	35 ± 1.00	0.001*
RPE (Modified Borg 0-10)		4.36 ± 0.34	6.09 ± 0.54	0.02*

DISCUSSION AND CONCLUSIONS

There were no significant differences between participants at baseline, so we can assume changes in outcome measures are attributed to our interventions. There were significant differences in self-reported compliance, where the SS group and SOC group were 133.33% and 52.09% compliant, respectively. This aligns with our hypothesis that those who self-selected their activity would be more likely to adhere to their program. There were also significant differences in exercise intensity reported between groups, where the SS group averaged a RPE of 6.09 and the SOC group averaged a RPE of 4.36 on a scale of 0-10. We hypothesize participants in the SS group were more tolerant of higher exertion due to enjoyment of the activity. Regardless, moderate to vigorous intensity exercise (moderate being 4-6 and vigorous being 7-8 on the modified Borg scale) is associated with better outcomes in those with PD [4]. All participants improved in performance of the 6MWT; all but participant 4 (SOC) improved in the FGA, TUG, TUGcog, and 4SST; participant 6 (SS) slightly declined in the 4SST. While there were no significant differences in most outcome measures between groups, the raw scores showed greater improvements in the SS group than the SOC group. PD is a progressive disease; the goal of therapeutic intervention for such conditions is to maintain function and delay functional decline, so significant improvements are not expected in this population.

The purpose of this study was to reveal the relationship between exercise compliance and ability to autonomously select one's exercise program. Our data suggests there may be a positive relationship between self-selection of exercise programs and compliance rates. This study was underpowered with only five participants out of 10 needed for sufficient power, which may have skewed our findings. To decrease the potential for bias, future studies should blind assessors to group allocation during outcome measure testing. It may be beneficial to include the Patient Specific Functional Scale (PSFS) to allow patients to set individual measurable goals. Further research is indicated as there are currently no other studies on self-selected exercise programs or compliance for patients with Parkinson's.

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COMPARING PHYSICAL ACTIVITY AND PHYSICAL PERFORMANCE OF CANCER SURVIVORS BEFORE AND DURING A GLOBAL PANDEMIC

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INTRODUCTION

A cancer diagnosis is commonly accompanied by negative physical and mental health-related symptoms that vary significantly between individuals and can persist beyond the completion of treatment. Evidence suggests exercise is generally safe and should be prescribed to all cancer survivors during and after treatment to combat these cancer-related symptoms. The American College of Sports Medicine (ACSM) Guidelines for Exercise and Cancer suggest that there is robust evidence supporting exercise to improve health-related outcomes in those with cancer [1].

In 2019, St. Charles Cancer Center in Bend, Oregon opened the Ascent Wellness and Prevention Program (Ascent) with the goal of helping cancer survivors meet the ACSM recommendations for physical activity. In 2020, the COVID-19 Pandemic caused the program to shift to remote delivery, hindering the enrollment of new participants and presenting barriers to active ones. This study aimed to determine if there was a difference in physical activity and physical performance among cancer survivors who participated in Ascent before versus during the Pandemic [2].

METHODS

This retrospective cohort study analyzed the physical activity and physical performance of cancer survivors who participated in Ascent before compared to during the COVID-19 pandemic. The data used for this analysis was collected as part of regular clinical care at St. Charles. Participants were included in Ascent if they had completed all cancer treatment and had medical clearance for physical activity. Participants were excluded if they had active cancer, were actively receiving cancer treatment, or were not medically cleared. Enrollment was on a rolling basis from January 2019 to July 2021. Participants completed an initial evaluation followed by re-evaluations at 3 months and 1 year. Data collected included 6-Minute Walk Test (6MWT), 30-Second Sit to Stand (30s STS), Fullerton Advanced Balance Scale (FABS), and the International Physical Activity Questionnaire (IPAQ). Reported weekly time spent walking and intensity level from the IPAQ was converted into MET-minutes using standard conversions.

A correlation comparison was conducted between weekly MET-minutes and 6MWT results, with a linear regression calculated for all participants over the 1 year. Difference in percent improvement of physical performance was also assessed between groups who completed their 3-month re-evaluation either before or during COVID. Percent improvement was calculated for each participant and performance measure. A 2-tailed unpaired t-test was used to compare groups, with an alpha value of 0.05. Microsoft Excel was used for data analysis.

RESULTS

Our results showed both groups improved on the IPAQ between baseline and 3 months, however, no statistically significant difference in percent improvement between groups was found ($p= 0.43$). The correlation comparison between weekly MET-minutes and 6MWT showed a very low positive correlation ($R2 = 0.05$) between self-reported weekly activity and 6MWT performance (p-value= 0.55).

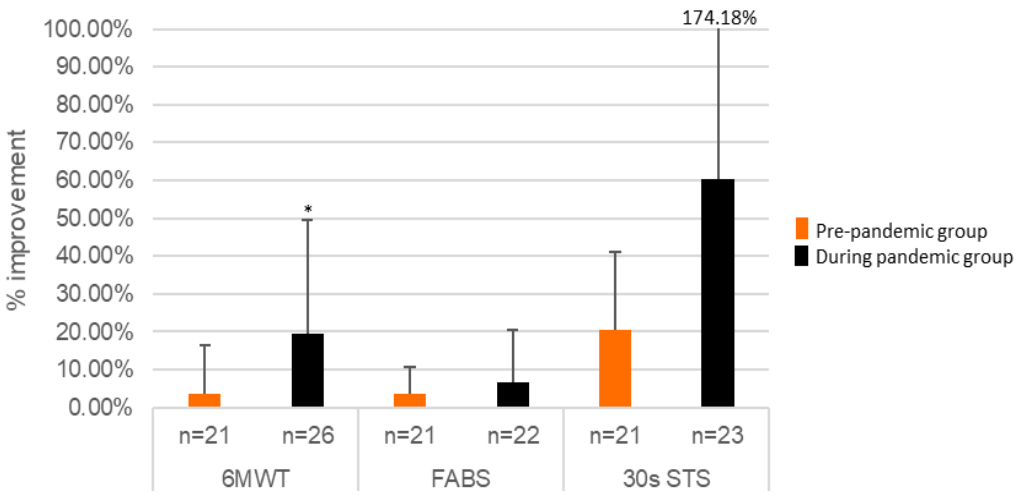

Figure 1. Average percent improvement of the 6MWT, FABS & 30s STS at 3 month-period. Error bars indicate one standard deviation above the mean.

Both groups demonstrated an overall improvement in all performance measures after 3 months, however, there was no significant difference in percent improvement between groups for the FABS (p=0.37) or the 30s STS (p= 0.30). The 6MWT was the only outcome measure that had a significant difference between groups over 3 months (p=0.031).

DISCUSSION AND CONCLUSIONS

The during-pandemic group demonstrated a higher percent improvement in self-reported physical activity and all physical performance measures compared to the pre-pandemic group. This was surprising as we expected that the individuals who had more resources before the pandemic would have been more active. However, this is consistent with another study (n=1361) that found individuals living in rural settings reported being able to maintain physical activity levels during the pandemic [3]. Individuals in rural communities face similar physical activity barriers to those in Ascent including limited access to gyms, exercise equipment, and in-person physical therapy.

Of all performance measures, only the 6MWT showed a statistically significant difference (p=.031) between groups. We believe that survivors were still able to benefit from knowledge and exercise despite being limited in access to gyms and other medical resources during the pandemic. While there was a non-significant and low positive correlation found between 6MWT performance and self-reported weekly MET-minutes (R2 = 0.05), the scatter plot suggests there are outliers, with a high report of physical activity and low 6MWT performance, which may have influenced this analysis.

Study limitations included reliance on self-reported physical activity and barriers to collecting physical performance data from participants during the pandemic due to video-visits instead of in-person visits. This study was underpowered with only 47 participants out of 145 needed for sufficient power.

By implementing strong evidence-based recommendations individuals can combat cancer-related symptoms, like fatigue and decreased function, and improve their quality of life [1]. Findings from this study may be considered when treating populations experiencing a pandemic or rural communities.

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