THE EFFECT OF 8 WEEKS OF RESISTANCE TRAINING ON GAIT KINEMATICS DURING A "TIMED UP AND GO" TEST AND NORMAL WALKING

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Background

Cancer-related Fatigue (CRF) is one of the most untreated symptoms of cancer. CRF is defined as the feeling of tiredness or exhaustion that is not proportionate with their level of activity. Rest does little to relieve symptoms, so simple tasks such as showering or getting out of bed interferes with their quality of life. Another common side effect is cachexia, which is the wasting away of muscle and fat. Cancer patients are also at a high risk for falling.

Studies have shown that exercise training, in a variety of forms, can improve postural balance, which effectively decreases the risk of falls (Wolfson, et al., 1996; Seidler & Martin, 1997; Lee & Park, 2013). Exercise training has shown to decrease the effects of certain neurological disorders, particularly in stroke patients who are experiencing balance impairments. Such studies showed a correlation between pelvic displacements and balance (Kong, Jeong, & Kim, 2015; Suruliraj, Mahabala, Sailakshmi, & Ratnavalli, 2016), which was improvable with an exercise intervention in place (Jung, Kim, Chung, & Hwang, 2014).

The purpose of this study was to determine if a specific exercise regime can improve measurable factors that contribute to postural instability. Overall, our aim was to decrease fall risk and increase quality of life.

Jung, K., Kim , Y., Chung, Y., & Hwang, S. (2014). Weight-shift training improves trunk control, proprioception, and balance in patients with chronic hemiparetic stroke. The Tohoku Journal of Experimental Medicine, 195-9.

Kong, S., Jeong, Y., & Kim, J. (2015). Correlation between balance and gait according to pelvic displacement in stroke patients. Journal of Physical Therapy Science, 2171-2174.

Lee, I.-H., & Park, S.-y. (2013). Balance Improvement by Strength Training for the Elderly. Journal of Physical Theraphy Science, 1591-1593.

Seidler, R. D., & Martin, P. E. (1997). The effects of short term balance training on the postural control of older adults. Gait and Posture, 224-236.

Suruliraj, K., Mahabala, C., Sailakshmi, G., & Ratnavalli, E. (2016). Relationship between Pelvic Alignment and Weight bearing Asymmetry in Community dwelling Chronic Stroke Survivors. Journal of Neurosciences in Rural Practice, s37-s40.

Wolfson, L., Whipple, R., Derby , C., Judge , J., King , M., Amerman, P., Smyers, D. (1996). Balance and Strength Training in Older Adults: Intervention Gains and Tai Chi Maintenance. Journal of the American Geriatrics Society, 498-506.

Conclusion

- CRF subjects exhibited increased acceleration from a seated position and improved stride velocity during walking in this study.
- CRF subjects did not exhibit any significant changes in most measures of gait kinetics and symmetry.
- A sample size and large variations in data, likely due to variables related to cancer treatment, affected these results.
- A greater emphasis on gait-specific training may also yield more significant results.

Methods & Materials

Training Program

Twelve Subjects underwent an 8 week training program (3 days/week), involving lower extremity cardio (walking and elliptical) warm-up along with lower-extremity resistance training. A 5 min cardio warm-up was used, increasing by 5 min a week, with a max of 30 minutes. Lower-extremity resistance training was composed of leg press, calf raises, knee extension, hip adduction, and hip abduction.

Before (PRE) and after (POST) training, a Timed Up and GO test and 7m Walk test were performed. A paired t test (α = 0.05) assessed differences between PRE v POST means for all variables.

Timed Up and Go (TUG) Test

Proactive balance was measured with TUG. Measurement of phase duration (s), anterior/ posterior (A/P), lateral, and vertical acceleration (m/s^2), as well as flexion and extension peak (°) of both phases were taken. A G-Sensor (BTS BioEngineering, Milan, IT) was placed on S1 vertebrae. Participants started in a seated position, stood up, walked a pre-measured distance of 3m (9ft. 10in.) towards a cone, went around the cone (180 degree turn), and walked back to the chair, and returned to a seated position.

7 meter walk test

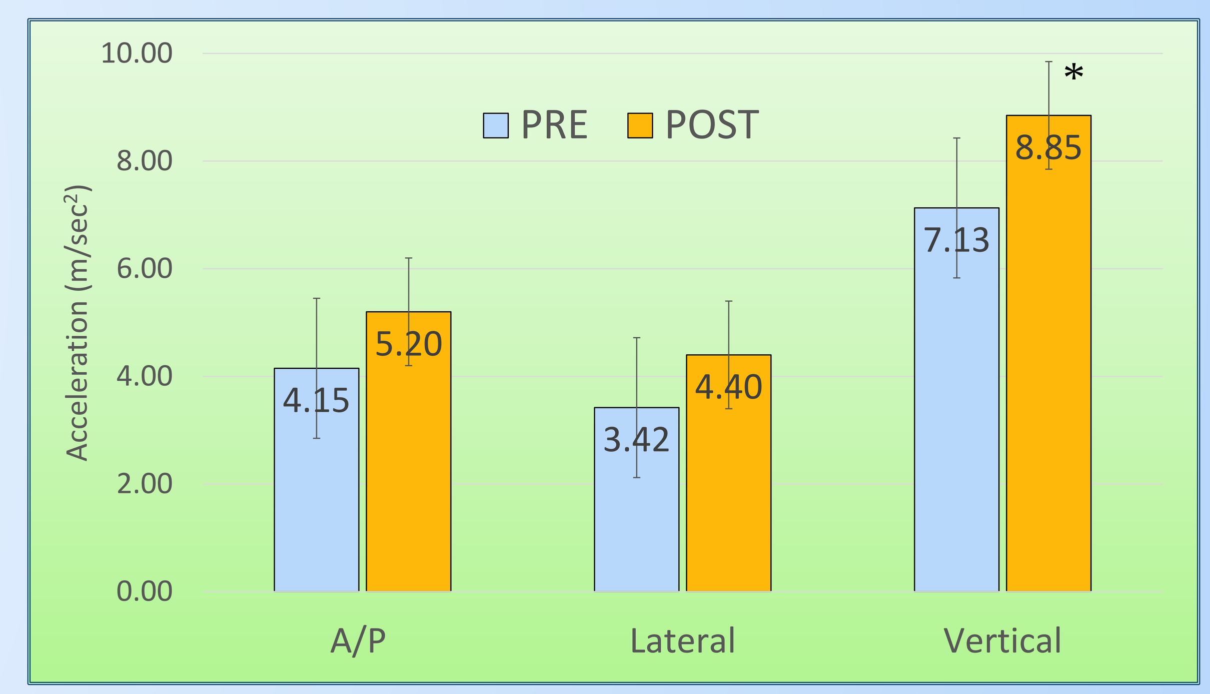
From a standing position, participants walked 7m in a straight line, made a 180 degree turn and then walked 7 m back to their starting position. The G-Sensor (BTS BioEngineering, Milan, IT) allowed measures to be obtained, including: time spent in double-support (%), symmetry index (%), pelvic tilt, obliquity, and rotation, as well as left and right measurements of quality (%), propulsion (°), stride length (m), and stride velocity (m/s). Subjects were instructed to walk at "normal walking speed during the test.

Results

Table 1. Timed Up and Go Test – PRE v POST

	Sit to Stand			Stand to Sit		
Variables (n=12)	Pre Mean ±SD	Post Mean ±SD	p value	Pre Mean ±SD	Post Mean ±SD	p value
Phase Duration (s)	1.327 ±0.387	1.330 ±0.451	0.97	1.336 ±0.320	1.363 ±0.475	0.89
A/P Accel (m/s^2)	4.145 ±1.859	5.200 ±1.859	0.09	3.218 ±1.489	4.372 ±2.183	0.13
Lateral Accel (m/s^2)	3.418 ±1.368	4.400 ±1.766	0.09	4.581 ±1.304	4.459 ±1.456	0.72
Vert Accel (m/s^2)	7.127 ±2.241	8.854 ±2.443	0.008	7.472 ±2.773	6.909 ±3.409	0.59
Flexion Peak (°)	44.22 ±10.01	46.91 ±13.00	0.33	37.87 ±12.79	42.01 ±13.49	0.37
Ext Peak (°)	29.61 ±13.88	29.15 ±14.61	0.84	6.354 ±4.694	5.627 ±4.553	0.69

Sit to Stand Test Acceleration – PRE v POST



* Differences between PRE v POST Vertical Acceleration were statistically significant (p<0.05)

Table 2. 7m walk test – PRE v POST

Variables (n=12)	Pre Mean ±SD	Post Mean ±SD	p value
Double-Support (%)	11.45 ±2.314	10.44 ±2.968	0.31
Symmetry Index (%)	91.66 ±5.195	93.12 ±3.687	0.33
Pelvic Tilt	75.89 ±18.06	65.82 ±25.69	0.19
Pelvic Obliquity	89.46 ±23.43	97.36 ±0.977	0.28
Pelvic Rotation	83.60 ±26.98	89.90 ±15.01	0.32
Left Quality Index (%)	94.05 ±4.752	95.41 ±5.045	0.53
Right Quality Index (%)	96.89 ±1.617	96.30 ±2.392	0.56
Left Propulsion (°)	7.745 ±2.070	7.718 ±2.449	0.94
Right Propulsion (°)	7.918 ±1.995	7.763 ±2.361	0.75
Left Stride l (m)	1.266 ±0.348	1.307 ±0.318	0.21
Right Stride l (m)	1.259 ±0.343	1.298 ±0.312	0.25
Left Stride Velocity (m/s)	1.255 ±0.337	1.313 ±0.334	0.04
Right Stride Velocity (m/s)	1.244 ±0.327	1.304 ±0.330	0.03

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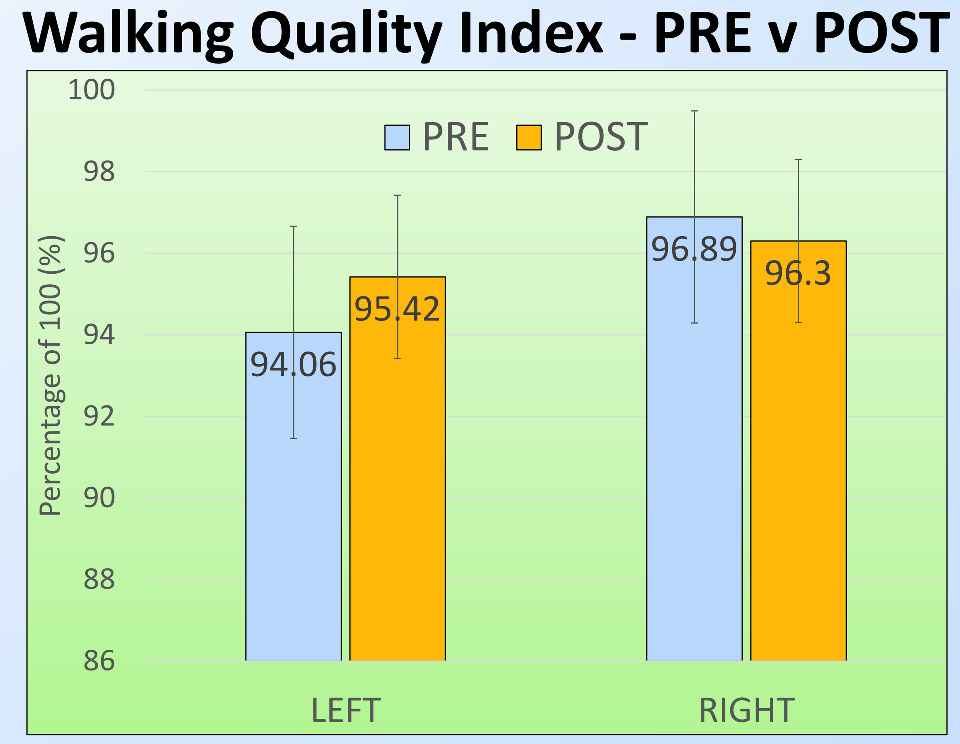
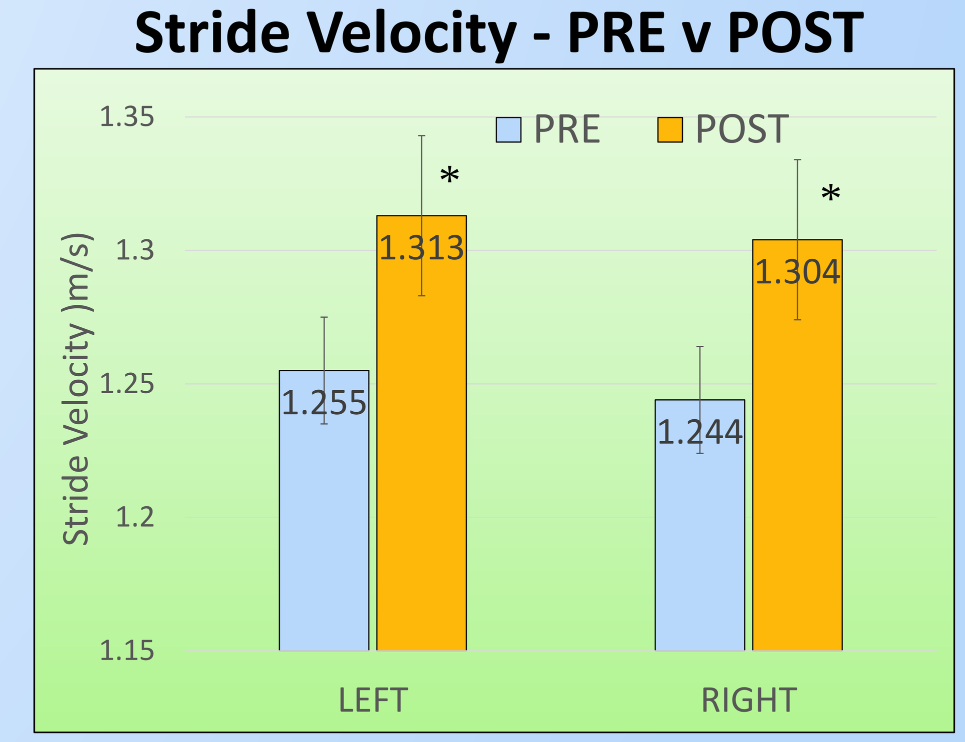
Walking Quality Index - PRE v POST



Stride Velocity - PRE v POST



* Differences between PRE v POST Stride Velocity are statistically significant (p<0.05)

Symmetry Indicies - PRE v POST