Heart Rate Response and Changes in Walking Velocity during the 12-Minute Walk Test in People with Multiple Sclerosis

Cohen, E.T.,[1] Muth, S.,[2] Dekerlegand, R.L.,[2] Ferraro, R.[1], Meyer, L.[1], Chen, D.[1]
[1] Rutgers, The State University of New Jersey, - School of Health Professions, New Jersey, USA;
[2] Thomas Jefferson University, Pennsylvania, USA

Background

- People with multiple sclerosis (MS) commonly experience a decline in walking performance evidenced by decreased walking velocity (WV) during the 6-minute walk test (6MWT).
- In addition, increases in heart rate (HR) and the rate of oxygen consumption (VO_2) have been observed during the initial three minutes of the 6MWT which is followed by an apparent steady-state.
- However, the direct relationship between HR and WV during prolonged walking has not been well studied.

Objective

- To explore the relationship between changes in HR (i.e. cardiovascular demand) and WV during prolonged walking in people with moderate MS-related disability.

Methods

- Nineteen participants with MS (Table 1) completed a 12-minute walk test (12MWT) on an oval track with an embedded instrumented walkway.
- WV data was collected with PKMAS Gait Analysis Software (Protokinetics, Havertown, PA) and parsed into 12, 1-minute time increments.
- HR was continuously measured with a Polar H7 wireless sensor (Polar Electro, Inc., Lake Success, NY) and average HR was calculated for each 1-minute interval.
- Per-minute HR and WV data were first analyzed visually to identify gross patterns of change.
- Pearson correlation coefficients were used to evaluate the relationship between HR and time, WV and time, and the ratio of mean HR to mean WV (HR:WV) and time.

Acknowledgements

This study was funded by a grant from the New Jersey Health Foundation

Results

Table 1. Participant Characteristics

Sex	14 women, 5 men
Age	57 (Range 35-65, SD 6.7)
Years since diagnosis	13.8 (Range 4-31, SD 8.7)
Disease Steps	3 (Range 1-3, IQR = 1)
Patient-Determined Disease Steps	3 (Range 1-5, IQR 1.5)
12-Item MS Walking Scale	63.1 (Range 35-90, SD 16.6)
Modified Fatigue Impact Scale (Total)	41.9 (Range 3-58, SD 12.3)

Figure 1. Walking Velocity x Time

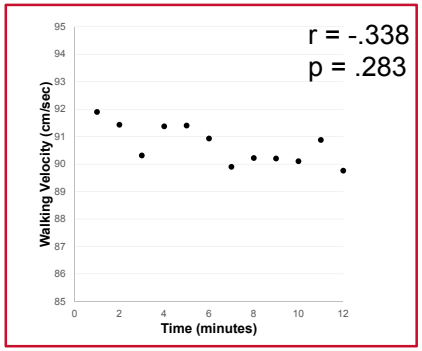


Figure 2. Heart Rate x Time

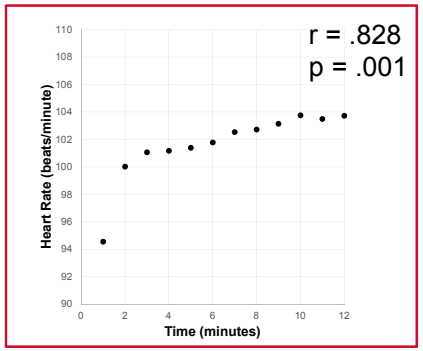
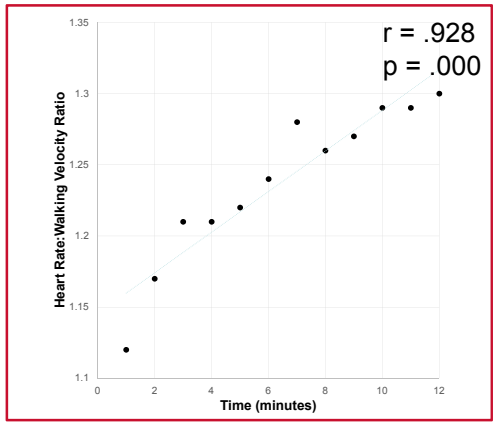


Figure 3. Heart Rate : Walking Velocity Ratio x Time



Results

- No significant correlation was found between WV and time (figure 1). Visual analysis indicates that WV during the 12MWT followed an attenuated U-shaped pattern, similar to that found during 6MWT in people with MS.
- A significant linear correlation between HR and Time ($r(10) = .828$, $p = .001$) was found as illustrated in figure 2.
- A significant linear correlation between HR:WV and time (r= .928, p=.000) was found as illustrated in figure 3.

Conclusions

- A combination of decreasing WV in the presence of steady-state HR appears to have resulted in a significant positive correlation of HR:WV ratio over time in our sample of people with MS during the prolonged walking.
- The observation that a concomitant decline in HR did not accompany the decline in WV suggests that cardiovascular demand may have remained consistent at a lower work rate.
- The negative effect of fatigue on physical performance in people with MS is well-known; however, this data suggests the decline in performance during prolonged walking activity may also increase the cardiovascular demand.
- Further study is warranted to fully evaluate the effect of fatigue-related changes on the metabolic cost of walking using objective physiologic measurements to assess the metabolic cost of prolonged walking.
- A clearer understanding of these effects will enable rehabilitation professionals to better target the multiple contributors to the decline in performance during prolonged activities observed in people with MS.