Oxygen Cost and Physiologic Responses to Stair Ascending and Descending with Different Assistive Devices in Older Adults – a Paradox

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Background and Purpose

Assistive walking devices (ADs) are frequently used to enhance functional ambulation by providing individuals with various physical impairments a safe and functional means of household and community mobility. During ambulation, clients frequently negotiate various architectural barriers such as stairs and ramps. It is important to understand the metabolic costs and physiologic responses of stair ascending and descending (SAD) with ADs to ensure the individual can safely use the AD.

Given the prevalence of AD use and high likelihood of encountering stairs in homes and communities warrants investigation into the metabolic costs and physiologic responses of stair ascending and descending (SAD) with ADs to ensure the individual can safely use the AD. Previous studies have examined metabolic costs and physiologic responses of ADs on level surfaces, but to our knowledge, there are no studies that describe the metabolic costs and cardiovascular response to these ADs during SAD. Therefore, the purpose of this study was to quantify and compare the metabolic costs and cardiovascular responses to SAD with different ADs in older adults.

Methods

Subjects

- 14 healthy volunteers (10 males, 4 females)
- Age: 63.71 ± 11.73 years
- Inclusion: No use of an AD; physically capable of SAD with an AD
- Exclusion: Current use of AD; cardiac, metabolic, musculoskeletal disorder

Procedure

- Performed four randomized trials of SAD at their own self-selected speed with three ADs: standard walker (SW), wheeled walker (WW), single point cane (C), and unassisted ambulation (UA).
- Each trial consisted of a five-minute steady state session of SAD followed by a two-minute data collection period
- Steady state expired ventilations were collected in Douglas bags for subsequent metabolic analysis
- Heart rate, blood pressure and rate of perceived exertion were also measured during steady state conditions

Results

- SAD using a C, SW, and WW resulted in significantly (p<0.05) greater oxygen cost per meter compared to UA SAD
- Metabolic costs per minute were not significantly increased
- Heart rate cost per meter to SAD with C, SW and WW were significantly (p<0.05) higher when compared to UA SAD, 116%, 126% and 147%, respectively
- No significant (p>0.05) differences were detected for rating of perceived exertion between any of the SAD trials
- Participants SAD at significantly (p<0.05) reduced speeds during trials with the ADs

Conclusion

- When the oxygen cost and cardiovascular responses of SAD with a C, SW or WW are quantified per unit distance there appears to be significant increased demands
- From a physiologic stand point (per minute) older adults can SAD with no significant increase in physiologic demand
- Older adults compensate for the increased physiologic demands per unit distance by slowing down; therefore, skepticism about prescribing an AD based off of increased oxygen cost and cardiovascular demands in terms of per unit distance may not be accurate in terms of safe usage. It is more clinically applicable to base AD prescription from a physiologic stand point (per minute) at self-selected speed.