The effect of first-time 4-wheeled walker use on the gait of younger and older adults

Running title: Walker use in younger and older adults

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Patient Consent

All participants provided informed written consent prior to participating. This study was approved by the Health Sciences Ethics Review Board of The University of Western Ontario, London, Canada (HSREB#108430).

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ABSTRACT

Introduction: The 4-wheeled walker is intended to enhance balance and gait for older adults. Yet, some research suggests that walking aids increase falls risk. An understanding of the influence of age with walker use on gait performance is required.

Objective: To examine the effect of initial 4-wheeled walker use on spatiotemporal gait parameters between younger and older adults.

Design: Cross-sectional, repeated-measures.

Setting: Community-dwelling.

Participants: Twenty-five younger (age: 26.5 ± 4.1 years) and 24 older (age: 68.5 ± 10.5 years) adults participated. Younger adults were aged 18-35 years, while older adults were 50 years or older. Included were people not requiring the use of a walking aid, and those able to converse in English.

Interventions: Not applicable.

Main Outcome Measure(s): Gait velocity and stride time variability were recorded using accelerometers. Gait was examined under three conditions: unassisted walking; walking with a 4-wheeled walker; and walking with a 4-wheeled walker while completing a secondary task. Conditions were performed across two walking paths: straight and figure of eight. Separate mixed-methods ANOVAs (within-subject: condition/path; between-subject: group) were used for statistical analyses.

Results: Velocity was lower when walking using a walker while completing a cognitive task ($p<0.001$), in the figure of eight ($p<0.001$), and in older adults ($p=0.001$). Stride time variability increased with walking path and condition difficulty ($p<0.001$) for the straight path versus the figure of eight.

Conclusions: Using a 4-wheeled walker resulted in a slower and more inconsistent gait pattern across both age groups. Walking more complex configurations resulted in the prioritization of gait over the cognitive task while performing the dual-task conditions. No evidence of an age-related difference in the effect of initial walker use on gait was observed. Nonetheless, walkers are cognitively demanding and their introduction should warrant a clinical follow-up.

Keywords: Aging, gait, assistive devices, walkers, multitasking behavior.

INTRODUCTION

Falls in older adults are common and can result in serious physical and psychological consequences, and therefore pose a public health challenge.[1] Notable age-related falls risk factors include impairments in walking, balance, cognition and sensorimotor integration.[2] One strategy recommended by prominent falls prevention guidelines to reduce falls risk is the introduction of a walking aid to compensate for walking and balance deficits.[3] Walking aids allow for a larger base-of-support, haptic feedback, and some even permit the ability to sit and rest.[4]

An upward trend in the prevalence of walking aid use among older adults has been observed.[5] However, despite their popularity and proposed benefits, evidence suggests walking aid use is independently associated with an increased falls risk in older adults.[6] Importantly, older adults who fall using a walker have higher injury rates than cane users.[7] Most older adults start to use walking aids without consulting a healthcare professional, and improper sizing and unsafe techniques are common.[8] These associations are important for healthcare professionals to be aware of as it can inform the implementation of falls prevention strategies.

Walking is a complex task that requires higher-order cognitive processes for even simple routine activities, in particular executive function which allows for continuous sensorimotor planning, monitoring, and adjustments.[9] In older adults, a link between executive function decline, gait decline and falls has been described.[10] The graded executive function decline that accompanies the aging process is believed to limit the capacity of some to successfully adapt to situations requiring greater cognitive resources.[9] Research has demonstrated that the use of a walking aid is an additional cognitively demanding activity superimposed on the task of walking.[11] Compared to cognitively healthy older adults, cognitively impaired older adults showed a significantly increased cognitive load while using a cane or walker, alongside a higher stride time variability which is considered a proxy for gait instability.[12–14] This increased cognitive burden with gait instability may explain the higher risk of falls with walking aid use.

Five studies have evaluated gait with initial wheeled walker use.[11,12,15–17] The use of such a walker was associated with reduced velocity,[15,17] cadence,[11] and stride length[17] in younger adults. Gait variability was not evaluated so there was no instability measure assessed in these studies. For older adults, using a 4-wheeled walker reduced velocity,[12,15,16] cadence,[16] and stride length,[16] and increased stance time[16] and stride time variability.[12] Few studies have examined more ecologically valid conditions, such as walking while completing a secondary task (i.e., dual-task testing).[12,15,16] The relative change in gait or cognitive performance between single-task and dual-task conditions is known as the task cost.[18] These examinations are important as dual-task is considered a capacity test and is part of most everyday activities.[19] Only until recently has it been established that the initial use of a single-point cane is cognitively demanding and increases stride time variability in younger and older adults; although a difference in the effect of the use of the device was not observed between the two age groups.[20] No study has yet directly compared younger and older adults to determine if similar results would be observed with the initial use of a walker.

A better understanding of the difference in the influence of first-time walker use on gait between younger and older adults is needed to inform clinical practice on the role of age-related changes in the safe use of walking aids. Therefore, the primary objective of this study was to evaluate if initial 4-wheeled walker use paired with a secondary cognitive task resulted in different gait velocity and stride time variability responses between younger and older adults. Secondary objectives were to describe gait cost, cognitive cost, and the prioritization of tasks across different walking paths of increasing difficulty during dual-task testing. It was hypothesized that initial walker use would reduce velocity and increase stride time variability, with the greatest magnitude of change being observed in complex walking paths, in dual-task, and in older adults.

METHODS

Participants

The present dataset was part of a larger observational study examining the effect of mobility aid use on the gait of older adults with Alzheimer's disease.[12–14] Younger adults aged 18-35 years who were university students and older adults aged ≥50 years who were members of a local health centre were recruited using e-newsletter postings. Those not requiring a walking aid and who had the ability to converse in English were included. Screening for any musculoskeletal or neurological conditions (e.g., Parkinson's disease, etc.) that may have affected the ability to walk 30 meters without the need for assistance took place first over the phone prior to any collections, followed by subsequent standardized questions at the day of testing. Those who reported medical issues affecting balance and/or gait were excluded. Each participant provided written informed consent prior to data collections. Informed by previous research in cognitively healthy older adults on dual-task gait testing,[21] and walking performance using a 4-wheeled walker,[22] a minimum sample size of 12 participants per group was deemed necessary assuming α=0.05, β=0.20, and a 15% dual-task effect size. This study was approved by the Health Sciences Ethics Review Board of The University of Western Ontario, London, Canada (HSREB#108430).

Participant characteristics

Age, sex, height and weight to calculate body mass index, years of education, falls history (12-months) as defined by Lamb et al.[23], prescription medications, and comorbidities were recorded using a standardized questionnaire. Subsequently, participants underwent a battery of visual and cognitive testing that was administered in-person by a trained research assistant prior to gait testing.

The Mars Contrast Sensitivity Test (Perceptrix®)[24] and the Stereo Fly Test (Stereo Optical Company®) were completed to assess visual contrast sensitivity and binocularity (3D perception), respectively. Participants were asked to identify out loud a series of letters of decreasing size using a Colenbrander Mixed Contrast Visual Acuity chart at both high (black on white) and low (grey on white) contrasts. Visual contrast sensitivity is reported as the logarithm of the minimum angle of resolution (logMAR) with values closest to 0 being indicative of better performance (i.e., 20/20 vision). For binocularity, and using a pair of polarized lenses, participants were asked to look at a series of squares containing four circles or a series of animals lined in rows. Each test demanded for individuals to correctly identify which of the four circles, or which animal in a given row, appeared to come forward and out of the reference plane in order to assess depth perception. Performance is reported in seconds of arc, whereby smaller values indicate better stereopsis. All testing was performed at a 40 cm viewing distance. Visual contrast sensitivity and proper depth perception are critical for safe mobility as they allow for the identification of distances and edges of objects/obstacles that may pose a hazard and therefore increase the risk for falls.[25]

The Mini-Mental State Examination assessed cognitive function,[26] while the Trail Making Test A and B were used as proxy for executive function.[27] Using a standardized set of instructions, the Mini-Mental State Examination separately evaluates: 1) orientation to time and place (10 points), 2) registration (3 points), 3) attention and calculation (5 points), 4) memory recall (3 points), and 5) language and praxis (9 points).[26] The Mini-Mental State Examination scores range from 0-30, with scores between 24-30 depicting a normal cognitive status, 18-23 being regarded as evidence of mild cognitive impairment, and ≤17 being indicative of severe cognitive impairment.[26] For executive function testing, the first part of the Trail Making Test (TMT-A) required participants to connect a series of numbers in ascending order as quickly as possible.[27] The second part (TMT-B) involved the more difficult task of alternating between numbers and letters in ascending order which requires memory and mental flexibility.[27] Both parts of the Trail Making Test were completed using a pencil. Time to complete these tests was recorded to the nearest hundredth of a second using a stopwatch, whereby a lower time is indicative of better performance.

Gait assessment

Velocity and stride time variability were collected using two tri-axial accelerometers (LEGSys™, BioSensics, Cambridge, MA) attached to the lower limbs of each participant at the level of the tibial tuberosity with a frontal plane orientation. The LEGSys™ has been previously validated[28] and observed to be reliable in older adults.[29] Stride time variability was calculated using the coefficient of variation (CoV). Velocity and stride time variability are proxies for the pace and variability gait domains.[30] A relationship exists between these gait domains and changes in age and cognitive function.[30] Stride time variability is considered a measure of motor task automaticity that relies on higher-order cortical control.[31,32] Currently, increased gait variability is believed to be indicative of gait instability due to its association with falls risk in older adults.[33,34]

Procedures

The gait assessment consisted of three conditions: single-task (ST)– unassisted walking; walking with a 4-wheeled walker (4WW); and dual-task (DT)– walking with a 4-wheeled walker while counting backwards from 100 by ones. Each condition was performed under different walking configurations of increasing cognitive challenge used to approximate real-life walking.[35] Using floor templates, a 6-meter straight path (SP) and the Figure-of-8 Walk Test (F8)[36] were performed.

For dual-task trials, no task prioritization instructions were given, and the total number and accuracy of responses were recorded. A cognitive secondary task allowed for the calculation of cognitive cost and for the assessment of task prioritization during dual-task testing. The use of a walker demands two hands; thus, a motor secondary task was deemed inappropriate. Importantly, the selection of the secondary task of counting backwards by ones underwent pilot testing and was compared to counting backwards by threes and reciting the days of the week. Counting backwards by ones was the only cognitive task that was able to be consistently performed without stopping across the different walking paths.

A research assistant provided each participant with a 4-wheeled walker and adjusted the height of the handles so that they were in line with the wrist crease. Each research assistant underwent training for the use and adjustment of walking aids as per clinical standards.[37] Participants were also instructed on the safe use of the device and given a cued 5-minute practice period using the device. Unassisted walking was performed first, followed by the 4WW and dual-task conditions for the straight and F8 paths. One practice trial and two recorded trials were performed at a self-selected, usual walking speed for each condition. Both recorded trials were averaged for data analysis. Seated rest was provided when requested.

Secondary task baseline performance

A seated baseline assessment of the secondary task was recorded in order to examine task prioritization and the relative change in performance associated with dual-task gait testing.

Participants were instructed to subtract ones from 100 ten consecutive times. The time, total responses and number of correct responses were recorded. Time was recorded to the nearest hundredth of a second using a stopwatch.

Data analysis

Continuous variables for clinical and demographic information were not normally distributed as per Q-Q plots and Shapiro-Wilk tests. Therefore, continuous variables were examined for group differences using Kruskal-Wallis H tests; sex proportion differences between groups were assessed using a chi-square test of homogeneity; and Fisher's exact tests were used to examine between group differences in falls history and comorbidities reported. Multiple comparison bias was addressed using Holm-Bonferroni corrections.

Objective #1: As stride time variability did not meet assumptions for normality, statistical analysis was carried out using $\log_{10}$ transformed data. Means and standard deviations were used to summarize velocity, while medians and interquartile ranges were used for the untransformed stride time variability. To examine the effect of walker use and dual-task testing on gait parameters, two separate three-way mixed methods ANOVAs were used: within-subject factors (walking path: SP, F8; condition: ST, 4WW, DT) and between-subject factor (group: younger adults, older adults). If statistically significant, interaction effects were interpreted from plots; otherwise, main effects were explored using post-hoc testing. Cohen's d and omega squared (ω^2) were used to represent effect sizes.[38] Statistical analyses were performed using SPSS version 25.0 (SPSS, Inc., Chicago, IL) and R version 4.0.2[39] with an experiment-wise alpha of 0.05.

Objective #2: The relative change between single-task and dual-task conditions for gait velocity was calculated as:

$$\text{Gait Cost} = \left[\frac{\text{DT} - \text{ST}}{\text{ST}}\right] \text{x}(100)$$

Cognitive cost was also calculated and defined as the relative change in performance from the single-task, seated recording to dual-task. To account for the speed and accuracy of responses, the correct response rate (CRR),[40] was first calculated from the seated baseline assessment:

Correct response rate (CRR) = responses per second x percentage of correct responses

$$\text{Cognitive Cost} = \left[\frac{\text{CRR walking in DT} - \text{CRR seated}}{\text{CRR seated}}\right] x(100)$$

For both gait cost and cognitive cost, negative values represent poorer relative performance between single-task and dual-task conditions, while positive values are representative of improved performance.

A performance-resource operating characteristic (POC) graph was created to evaluate the trade-offs in gait and cognitive task performance upon dual-task. Each POC graph plots cognitive (x-axis) versus gait (y-axis) cost. A POC graph contains four sections: upper left– improved gait but decreased cognitive performance; upper right– improved gait and cognitive performance; lower left– declined gait and cognitive performance; and lower right– declined gait but improved cognitive performance. A reference line divides the second and third sections. Data on the left side of the reference line indicate gait prioritization and those on the right indicate cognitive task prioritization. No changes between conditions are considered for points directly on the reference line.

RESULTS

A total of 49 people participated: 25 were younger and 24 were older adults (Table 1). One participant had missing information regarding their body mass index and education, while another did not perform the Animals Stereo Fly Test. The median age and interquartile ranges for younger and older adults was 26.0 [23.0-30.5] and 68.0 [59.3-76.5] years old, respectively. Older adults demonstrated statistically significant differences to younger adults in body mass index (p=0.001, d=1.29), high visual contrast sensitivity (p=0.001, d=2.00), low visual contrast sensitivity (p=0.001, d=2.29), number of prescription medications (p=0.001, d=1.41), number of comorbidities (p=0.001, d=1.84), and Trail Making Test A (p=0.001, d=1.50) and Trail Making Test B (p=0.001, d=1.13) performance.

Absolute changes in velocity and stride time variability

The three-way interaction term (path/condition/group) was not statistically significant for either velocity or stride time variability (Figures 1-2).

No statistically significant two-way interactions were observed for velocity. There was a significant main effect of walking path configuration ($p<0.001$, $\omega^2=0.37$), condition ($p<0.001$, $\omega^2=0.06$), and group ($p=0.001$, $\omega^2=0.10$). Velocity was lower for the F8 and significantly different from straight path walking (p<0.001, d=2.53). Additionally, velocity was highest for the single-task condition and statistically different between single-task and dual-task (adjusted p<0.001, d=1.44), 4WW and dual-task (adjusted p=0.03, d=0.34), and between single-task and 4WW (adjusted p<0.001, d=1.10). Compared to younger counterparts, older adults had an overall lower gait velocity (p=0.001, d=0.49).

For stride time variability, a statistically significant two-way interaction between walking path and condition ($p<0.001$, $\omega^2=0.53$) was observed. Stride time variability was highest for the F8 walking path. However, stride time variability increased in the straight path with walking condition difficulty, while a slight decrease was observed in the F8.

Gait cost, cognitive cost and task prioritization

Gait cost was -7.10% ± 7.69 in the straight path and -2.31% ± 6.92 in the F8 for younger adults, while for older adults this was -11.95% ± 13.54 and -1.64% ± 6.54, respectively.

Cognitive cost was -22.81% ± 14.84 and -29.01% ± 15.30 for younger adults and -13.63% ± 19.61 and -18.24% ± 22.16 for older adults in the straight and F8 paths, respectively.

Across groups, gait prioritization was highest in the complex walking path configuration of F8 (Figure 3). For older adults, 50% (n=12) prioritized gait over secondary task performance in the straight path and 71% (n=17) in the F8 path. For younger adults, 76% (n=19) prioritized gait in the straight path and 88% (n=22) in the F8.

DISCUSSION

Initial 4-wheeled walker use reduced velocity and increased stride time variability in both younger and older adults. An increased stride time variability is concerning as this is an established marker for falls risk.[32] Velocity was lowest and stride time variability was highest in the more complex walking path and upon dual-task testing while using a walker. As hypothesized, walking more complex configurations resulted in the prioritization of gait over the cognitive task, a posture-first response, by both groups during the dual-task conditions. However, our results indicate that the effect of initial walker use on gait velocity and stride time variability was not dependent on the age of the group (i.e., the interaction between condition and group).

The results of the present manuscript are consistent with previous literature in younger[11,15,17] and older adults,[12,15,16] whereby the use of a walker was associated with spatiotemporal gait parameter changes. Interestingly, the magnitude of change associated with the use of a walker, even upon dual-task, was not disproportionally larger in older adults compared to younger adults. While our sample groups did not differ on global cognitive scores, older adults did demonstrate: a higher body mass index; to be taking more medications; to have reported more comorbidities; and to have a poorer performance in visual and executive function. As those with significant health issues that affected mobility were excluded, a requirement of the screening protocol, the observed clinical differences between age groups would be consistent with age-related changes in several systems (e.g., visual, musculoskeletal, etc.). However, other clinical factors related to age, such as balance control, joint mobility, and sensorimotor integrity were not assessed, and subtle differences may have been observed in these between the two age groups. In the absence of clinically relevant cognitive impairment, the changes seen in executive function among our sample of older adults did not result in gait or cognitive cost performance that differed from younger adults. Moreover, it is important note that older adults self-selected a slower walking speed, and that gait velocity decreased across conditions and walking paths for both groups. A non-linear (quadratic) relationship exists between gait velocity and stride time variability.[41] Gait velocity can act as a confounder in the relationship between the effect of initial walking aid use and stride time variability. However, stride time variability has been reported to be highest at very low (0.2-0.6 m/s) walking speeds compared to moderate (0.8-1.4 m/s) walking speeds.[42] As per the results, gait velocity for both younger and older adults across all conditions (ST, 4WW and DT) and walking paths (SP, F8) remained within this moderate range (0.8-1.33 m/s). Moreover, previous research in older adults has further explained that the increased stride time variability observed upon dual-task testing is not solely related to a biomechanical effect, but also to the increased attentional demands of completing two tasks at once.[43] Nonetheless, and regardless of age, the present study demonstrates walking aid use is associated with increased cognitive demands and may negatively affect gait parameters in the initial phase of using the device.

Our understanding of the factors in the relationship between walking aid use and falls remains in its infancy.[6] Currently, prominent falls prevention guidelines offer no direction regarding gait aid prescription, training, or follow-up care for older adults at risk for falls.[3]

Future research should prioritize longitudinal studies evaluating the learning related to walking aid use and the timelines for automaticity across various adult subpopulations. The results of the present study indicate that training related to the provision of a walking aid should be further investigated as a way to enhance motor learning, and decrease the gait variability and cognitive load associated with the use of these devices. Moreover, future studies should also seek to understand what regimen is most optimal for motor proficiency and what factors (e.g., familiarity with mobility aids, etc.) best predict the safe use of a walking aid. A call for clinical guidance has been made based on some of the negative effects that these types of gait aids can have.[44] Evidence-based guidelines can assist healthcare professionals to standardize their approach for the introduction and follow-up of walking aids, and may also seek to correct other factors related to walking aid use that can increase falls risk such as inappropriate and unsafe use.[8] This is important, knowing that 61% of older adults do not receive a walker from a healthcare professional, and close to 80% are not provided with instructions, education or demonstrations on the safe use of these devices.[8] Guidance should also include the many ways in which older adults interact with their environments using their gait aids. For example, 26.7% regularly use more than one walking aid, such as the use of a cane indoors while using a walker only when outdoors.[5]

There are certain limitations to the present study. A convenience sample was recruited and our results may not be generalizable to all community-dwelling adults. Specifically, older adults within our sample varied in age, were engaged in weekly physical activity programs, and had a lower prevalence of falls than is typically observed.[1] Although walking aids may be provided to healthy individuals for various reasons on a short-term basis, the majority of walking aids are provided to older adults with chronic health issues. As a result, the influence of first-time walker use on gait reported can be considered a conservative estimate. Additionally, most of the sample was composed of females and differences in mobility and dual-task performance have been previously reported based on sex.[45,46] Differences between groups were considered to be indicative of age-related changes in sensorimotor function; however, an assessment of other factors not related to healthy aging that may have affected ambulation with a walker, such as in postural control, were not part of the present protocol and should be further explored. Lastly, and even though data collection took place after a period of cued training and practice trials, the evaluation of the stability of gait parameters on a trial-to-trial basis (i.e., a practice effect) was not examined. The protocol used also did not allow for the randomization of the order of conditions for participants, and this could have influenced the presented results. Future research therefore stands to take steps towards exploring when and how certain factors (e.g., different comorbidities, sex, fear of falling, different surfaces, etc.) may affect the learning associated with initial use of a walking aid.

CONCLUSION

For both younger and older adults, the use of a 4-wheeled walker resulted in decreased walking velocity and increased gait variability. Importantly, the magnitude of change associated with walking with a walker, or walking with a walker while completing a secondary cognitive task, on gait relative to unassisted walking was not dependent on age. The present study demonstrates that the cognitive load related with initial walker use is comparable regardless of age. Future research should aim to establish if clinical follow-up and training in response to the provision of 4-wheeled walker would result in a reduction of the cognitive load and an attenuation of the gait instability observed with the use of these devices.

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Table 1: Demographic and clinical characteristics of the sample of healthy younger and older adults.

Variable	Medians [IQR] or n (%) Younger Adults (n=25)	Medians [IQR] or n (%) Older Adults (n=24)	p-value
Age (years)†	26.0 [23.0-30.5]	68.0 [59.3-76.5]	**0.001**
Female Sex (%)‡	21 (84.0%)	18 (75.0%)	1.00
Body Mass Index (kg/m^2)†	23.2 [20.2-26.1]	29.5 [23.6-33.6] ¶	**0.001**
High Visual Contrast sensitivity (log minimum angle of resolution)†	-0.01 [-0.01-0.00]	0.10 [0.10-0.20]	**0.001**
Low Visual Contrast sensitivity (log minimum angle of resolution)†	0.00 [0.00-0.10]	0.35 [0.20-0.48]	**0.001**
Circles Stereo Fly Test (seconds of arc)†	40.00 [40.00-45.00]	40.00 [40.00-60.00]	0.23
Animals Stereo Fly Test (seconds of arc)†	100.00 [100.00-100.00]	100.00 [100.00-100.00] ¶	1.00
Education (years)†	17.0 [16.0-19.0]	15.0 [13.0-19.0] ¶	0.14
History of Any Falls in the Past 12 Months (yes)§	4 (16.0%)	5 (20.8%)	1.00
Mini-Mental State Examination†	30.0 [30.0-30.0]	30.0 [29.0-30.0]	0.23
Trail Making Test A†	26.1 [19.8-29.4]	47.3 [38.4-64.1]	**0.001**
Trail Making Test B†	42.5 [32.4-49.7]	71.5 [59.1-103.8]	**0.001**
Number of Prescription Medications†	0.0 [0.0-1.0]	2.0 [1.0-4.8]	**0.001**

Number of Comorbidities[†]	0.0 [0.0-0.0]	1.0 [1.0-2.8]	**0.001**
Summary of Comorbidities[§]			
Hypertension	0 (0.0%)	5 (20.8%)	0.13
Diabetes	0 (0.0%)	6 (25.0%)	0.07
Osteoarthritis	0 (0.0%)	10 (41.7%)	**0.001**
Cancer	1 (4.0%)	5 (20.8%)	0.39
Cataract[‖]	1 (4.0%)	7 (29.2%)	0.13
Macular Degeneration	0 (0.0%)	0 (0.0%)	1.00
Other	0 (0.0%)	14 (58.3%)	**0.001**

Footnote: IQR: 25th, 75th Interquartile range. Statistical significance was $p < 0.05$ for the results of: [†] Mann-Whitney U test, [‡] chi-square test of homogeneity, [§] Fisher's exact test, [¶] participant information is missing for one individual (n=23), [‖] All older adults who reported cataracts also reported having received corrective surgery. All presented p-values were adjusted using a Holm-Bonferroni correction.

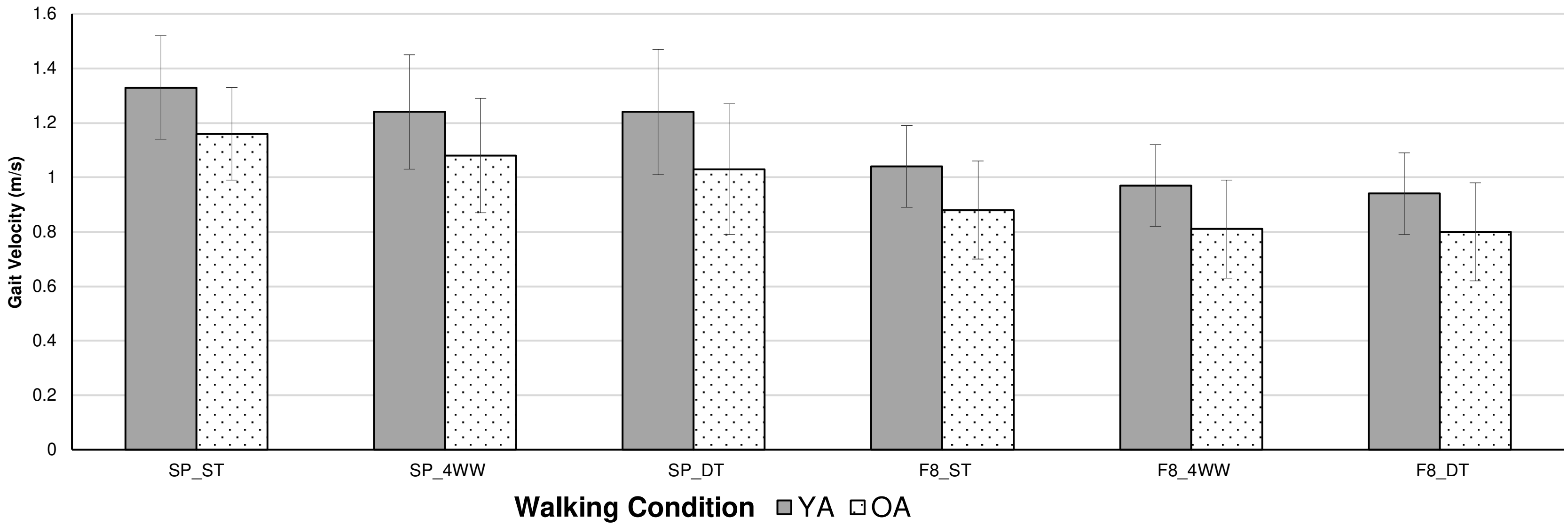
FIGURE LEGENDS

Figure 1: Results of a three-way mixed ANOVA assessing velocity in unassisted walking, walking with a 4-wheeled walker, and walking with a 4-wheeled walker while completing a secondary cognitive task in younger and older adults.

Figure 2: Results of a three-way mixed ANOVA assessing stride time variability in unassisted walking, walking with a 4-wheeled walker, and walking with a 4-wheeled walker while completing a secondary cognitive task in younger and older adults.

Figure 3: Performance-resource operating characteristic graphs comparing gait and cognitive performance upon dual-task while walking A) a straight path (SP) and B) the Figure-of-8 Walk Test (F8) in younger and older adults.

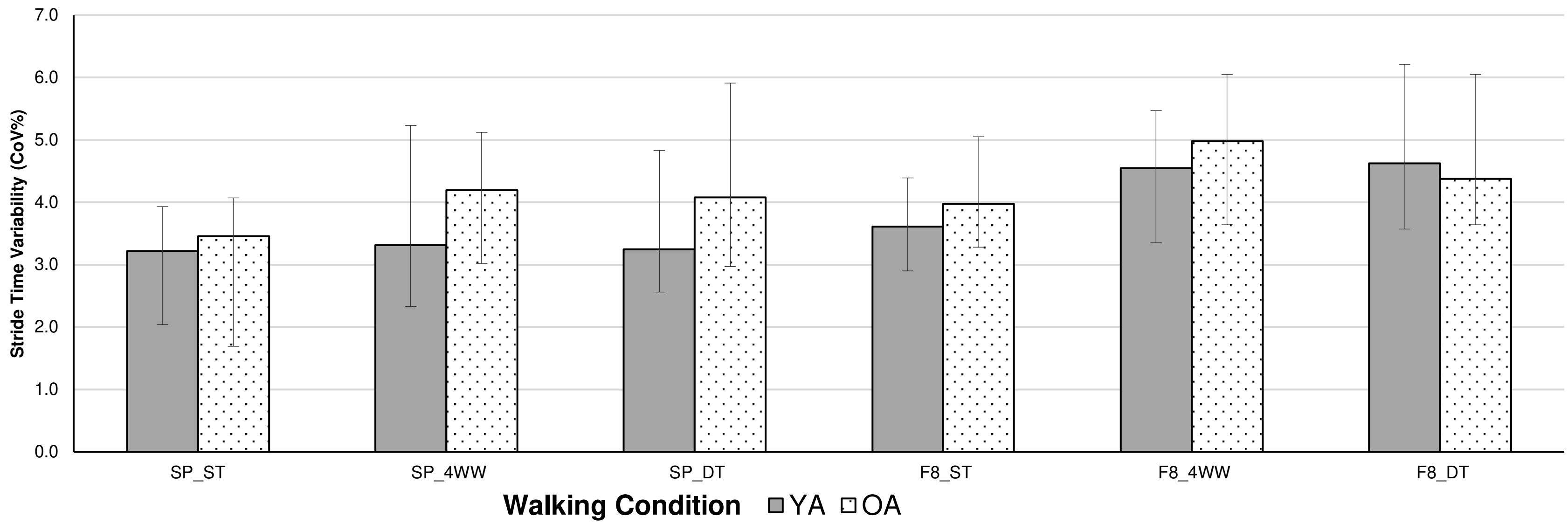
Figure 1.



Velocity (m/s)							
Walking Path Configuration	**Younger Adults (n=25)**			**Older Adults (n=24)**			**Three-way Mixed ANOVA**
	ST	**4WW**	**DT**	**ST**	**4WW**	**DT**	
Straight Path	1.33 ± 0.19	1.24 ± 0.21	1.24 ± 0.23	1.16 ± 0.17	1.08 ± 0.21	1.03 ± 0.24	**Main effects:** Path: **p<0.001** Condition: **p<0.001** Group: **p=0.001** **Interaction terms:**
Figure-of-8 Walk Test	1.04 ± 0.15	0.97 ± 0.15	0.94 ± 0.15	0.88 ± 0.18	0.81 ± 0.18	0.80 ± 0.18	Path x Condition: p=0.60 Path x Group: p=0.33 Condition x Group: p=0.55 Path x Condition x Group: p=0.11

Footnote: 4WW = walking with a 4-wheeled walker, DT = dual-task (walking with a 4-wheeled walker while completing a secondary cognitive task), F8 = Figure-of-8 Walk Test, OA = older adult, SP = straight path, ST = single-task (unassisted walking), YA = younger adult. Statistical significance was $p < 0.05$ for the results of the three-way ANOVA. Means ± standard deviation displayed.

Figure 2.

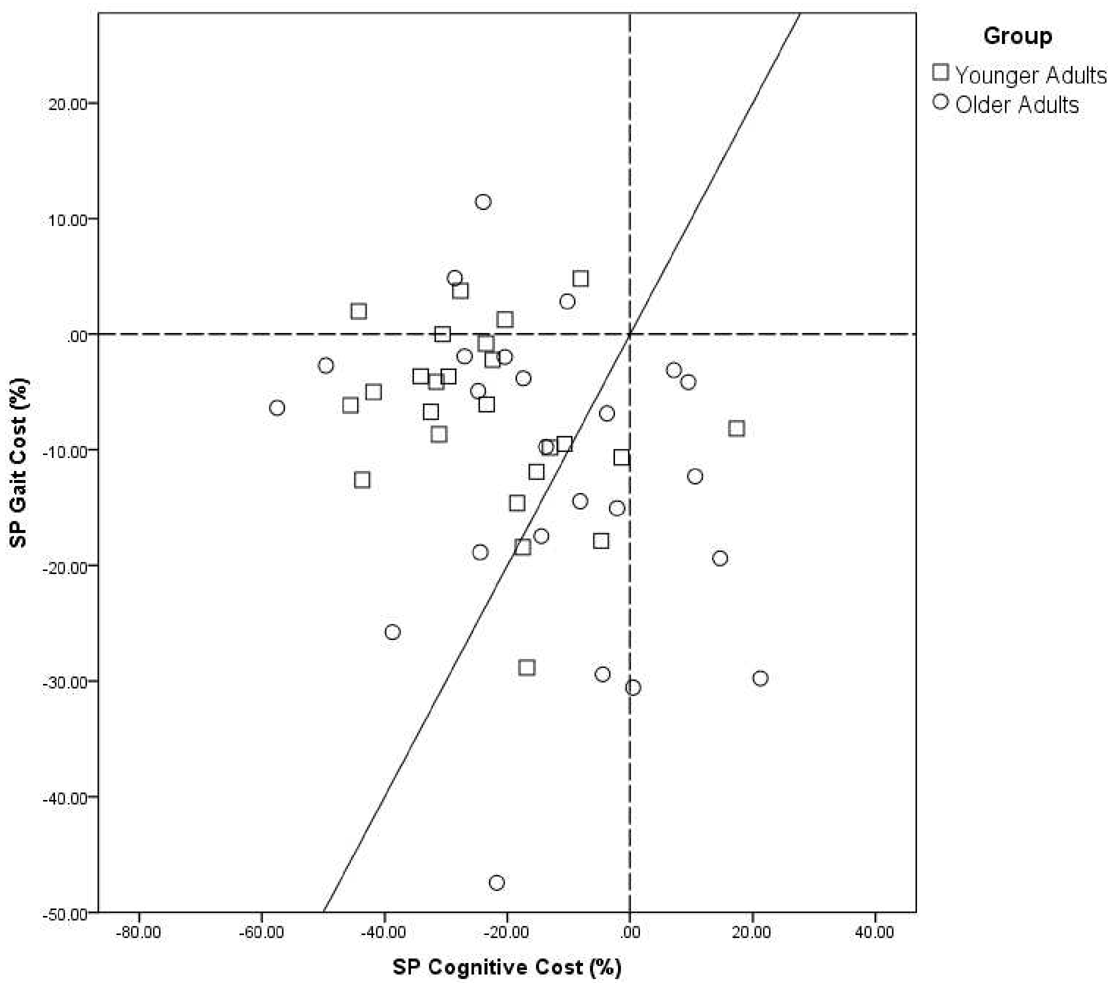


Stride Time Variability (CoV%)							
Walking Path Configuration	**Younger Adults (n=25)**			**Older Adults (n=24)**			**Three-way Mixed ANOVA**
	ST	**4WW**	**DT**	**ST**	**4WW**	**DT**	
Straight Path	3.22 [2.04-3.93]	3.31 [2.33-5.23]	3.25 [2.56-4.83]	3.46 [1.69-4.07]	4.19 [3.02-5.12]	4.08 [2.97-5.91]	**Main effects:** Path: **p<0.001** Condition: **p<0.001** Group: p=0.29 **Interaction terms:**
Figure-of-8 Walk Test	3.61 [2.90-4.39]	4.55 [3.35-5.47]	4.62 [3.57-6.21]	3.97 [3.28-5.05]	4.98 [3.64-6.05]	4.37 [3.64-6.05]	Path x Condition: **p<0.001** Path x Group: p=0.92 Condition x Group: p=0.92 Path x Condition x Group: p=0.34

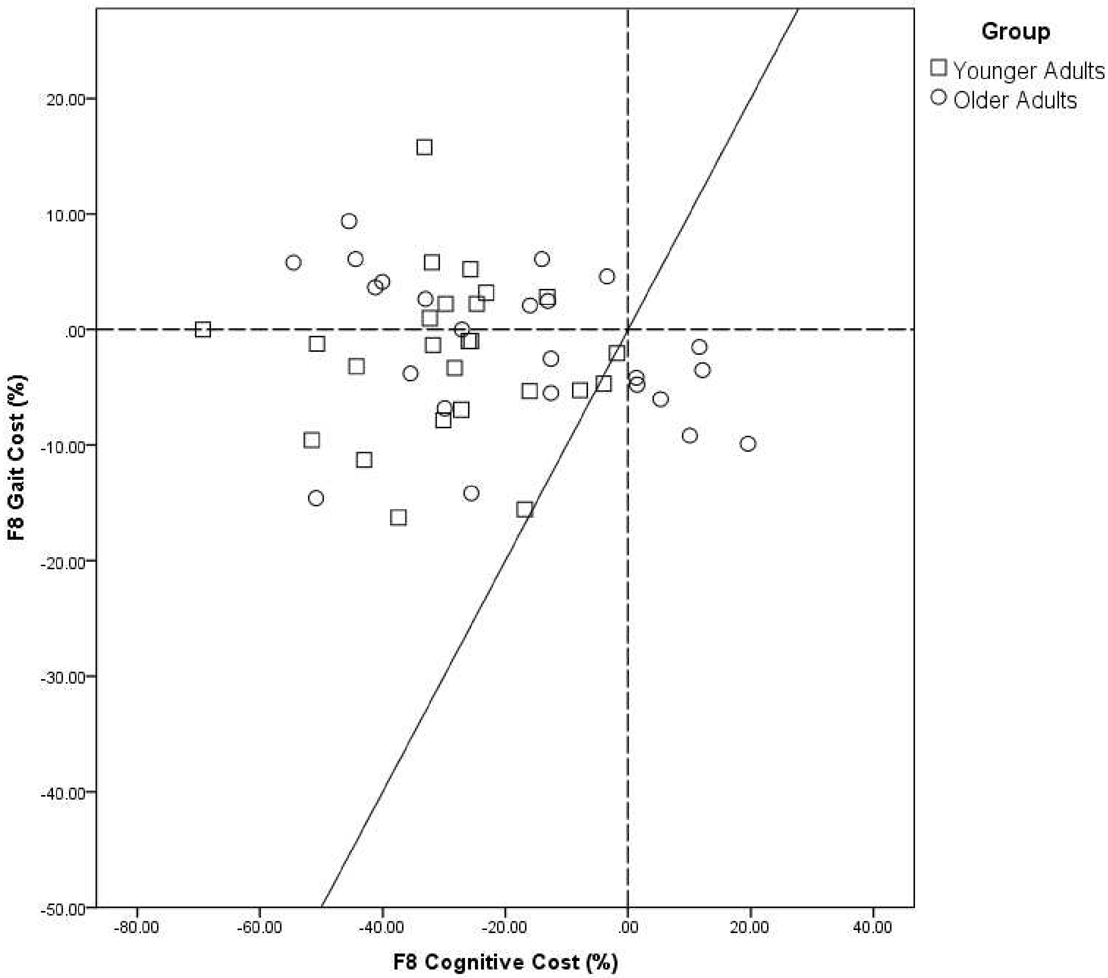
Footnote: 4WW = walking with a 4-wheeled walker, DT = dual-task (walking with a 4-wheeled walker while completing a secondary cognitive task), F8 = Figure-of-8 Walk Test, OA = older adult, SP = straight path, ST = single-task (unassisted walking), YA = younger adult. Statistical significance was $p < 0.05$ for the results of the three-way ANOVA. Medians [25th, 75th Interquartile range] displayed.

Figure 3.

A)


Group
Younger Adults
Older Adults
SP Gait Cost (%)
20.00
10.00
.00
-10.00
-20.00
-30.00
-40.00
-50.00
-80.00
-60.00
-40.00
-20.00
.00
20.00
40.00
SP Cognitive Cost (%)

B)



Footnote: F8 = Figure-of-8 Walk Test, SP = straight path.