

Online Journal Club-Article Review

Background/Overview	
Article Citation	Fritz NE, Worstell AM, Kloos AD, Stiles AB, White SE, and Kegelmeyer DA. Backward walking measures are sensitive to age-related changes in mobility and balance. <i>Gait and Posture</i> . 2013;37:593-597.
Study Objective/Purpose (hypothesis)	<p>-Purpose: To compare spatiotemporal measures and their coefficients of variation of backward walking (BW) and forward walking (FW) in young, middle-aged, elderly people who have fallen, and elderly people who have not fallen. Also, to compare “the strength of the relationship between age and BW and FW measures to determine to utility of BW performance as a clinical measure of safety.”</p> <p>-Hypothesis: The author hypothesized that backward walking spatiotemporal measures “would be equivalent between young and middle-aged adults and would be significantly more impaired in elderly fallers than non-fallers.” Also, that “age would be more closely related to BW spatiotemporal measures than to FW measures.”</p>
Brief Background (why issue is important; summary of previous literature)	<p>-Summarized recent literature about the significance of backward stepping in maintaining balance, including the need for these movements in functional transfers (Chan et al., 2007), the increased gait variability seen in older adults walking backwards, and the correlation between increased gait variability and risk of falling. (Hausdorff et al, 1997) Additionally, the authors note previous literature finding that practicing backward or multi-directional stepping “improves mobility.” (Hackney & Earhart, 2009)</p> <p>-Authors noted that very few studies have looked at backward walking in elderly people, and “no studies to date have examined the characteristics of backward walking in middle-aged adults of elderly with declines in functional mobility.”</p>
Methods	
Study Design (type of trial, randomization, blinding, controls, study groups, length of study, follow-up)	<p>-Design: Cross-sectional multi-site study, 1 session only (no follow-up)</p> <p>-Randomization: None (sample of convenience, grouped by age)</p> <p>-Blinding: None</p> <p>-Study groups: 37 young adults (18-34 yo), 31 middle-aged adults (35-64 yo), 62 elderly adults (65 yo or older); elderly adults were further divided into those who self-reported at least 1 fall in the past 6 months (12) and those who had not (50)</p>
Target Population (dx, acuity,	-Inclusion criteria: All subjects had to walk >10 feet without an assistive device or physical assistance

inclusion/exclusion criteria)	<p>-Exclusion criteria: Pregnancy, orthopaedic or neurologic conditions that altered walking</p> <p>-Target population: Authors hope to apply the study findings to ambulatory adults over 65, especially to correlate the findings with history of falls/risk of falls.</p>
Interventions (if applicable): (specificity of interventions, ability to replicate, frequency, duration)	-No intervention performed – one session of gait assessment only. Subjects walked 3 trials forward and 3 trials backward on a GAITRite® mat (approximately 10 meters for each trial) without an assistive device, wearing a gait belt and guarded by a physical therapist.
Outcome Measures (relevant to purpose of the study; reliable, valid, clinical utility)	<p>-Dependent variables: Gait parameters as per below (including velocity), coefficient of variation values, Tinetti Mobility Test (also known as Performance-Oriented Mobility Assessment or POMA) for elderly participants only, self-reported history of any falls within the past 6 months</p> <p>-Gait parameters assessed: Gait velocity (backward and forward), stride length, base of support, double support percent of the gait cycle, swing percent, stance percent, coefficient of variation (CV) for step time, CV for step length, CV for swing time, CV for double support.</p>
Statistical Analysis (statistics used, appropriate application)	<p>-One-way repeated-measures ANOVA with Tukey's post hoc tests were performed to detect differences between gait parameters in forward and backward walking, and between age groups; <i>p</i>-value set at .05 to minimize type I error.</p> <p>-Pearson correlation coefficients were obtained to look at the relationship between age and gait.</p> <p>-Independent t-tests were performed to examine the differences in gait parameters for elderly participants with versus without a fall in the past 6 months (study refers to these individuals as “fallers” and “non-fallers”).</p> <p>-Two-tailed Mann-Whitney U test was performed to examine the difference between the mean score on the Tinetti Mobility Test for the group of elderly participants who were “fallers” versus “non-fallers.”</p>
Results	
Enrollment/Subject Characteristics (sample size, gender, age, functional level; were groups similar on important variables prior to application of the intervention)	<p>-Sample size: 130 adults, including “more females than males,” gathered via a sample of convenience of individuals living in on near Columbus, Ohio.</p> <p>-Participant ages: 37 young adults (18-34 yo), 31 middle-aged adults (35-64 yo), 62 elderly adults (65 yo or older); participants were grouped by age, and authors note that twice as many elderly participants were included to allow this age group to be divided into “fallers” and “non-fallers.”</p> <p>-Participant functional level: Young and middle-aged adults were all community-dwelling; 25% of elderly were assisted-living facility residents, 75% of elderly were community dwelling; 50% of elderly participants used an assistive device outside the home. 90% of elderly participants reported exercising at least once per week.</p>

<p>Summary of Primary and Secondary Outcomes (include aggregate and sub-group findings if reported); note results that were statistically significant; How many reached a level of clinical significance (exceed MCID if known); Was there retention of changes following intervention (if studied)</p>	<p>GAIT PARAMETERS:</p> <p>Velocity:</p> <ul style="list-style-type: none"> -No significant difference between young and middle-aged participants, both for forward (1.49 ± 0.18 m/s and 1.48 ± 0.22 m/s, respectively) and backward (1.13 ± 0.2 m/s and 1.03 ± 0.2 m/s, respectively) -<i>Significantly lower ($p < .001$)</i> in elderly when compared to young or middle-aged (1.07 ± 0.31 m/s forward, 0.52 ± 0.2 m/s backward) <p>Other spatiotemporal gait parameters, both forward and backward gait:</p> <ul style="list-style-type: none"> -<i>Significantly shorter ($p < .001$)</i> stride length in elderly versus other groups -<i>Significantly greater ($p < .001$)</i> double support and stance time in elderly, as percentage of gait cycle, versus other groups -<i>Significantly wider ($p < .001$)</i> base of support in elderly versus other groups -<i>Significantly wider ($p < .03$)</i> base of support in middle-aged versus young participants, backward only <p>Backward versus forward gait:</p> <ul style="list-style-type: none"> -In backward walking, all 3 groups showed <i>significantly ($p < .001$)</i> slower velocity, shorter stride length, decreased swing percent, greater stance and double support percent, and wider base of support than in forward walking <p>Coefficient of variation:</p> <ul style="list-style-type: none"> -<i>Significantly greater ($p < .001$)</i> variability in step time, stride length, swing time, and double support time for elderly participants versus young or middle-aged, in both backward and forward walking -<i>Significantly greater (no p-value given)</i> within-group variability for backward walking versus forward walking, noted in all 3 groups -No significant difference between young and middle-aged in either forward or backward walking <p>“Fallers” versus “non-fallers” (elderly group only):</p> <ul style="list-style-type: none"> -<i>Significantly lower velocity and shorter stride ($p < .001$)</i> for fallers in forward walking (no significant differences in other forward gait parameters) -<i>Significantly lower velocity, shorter stride, wider base of support, high stance percent, higher double support percent, variability of step time ($p < .001$)</i> for fallers in backward walking -Authors proposed backward velocity “cutoff scores” of 0.6 m/s backward velocity (sensitivity=100%, specificity=33%) or 0.4 m/s (sensitivity=58%, specificity=82%, positive likelihood ratio=3.2) to optimally identify fallers <p>TINETTI MOBILITY TEST (elderly group only)</p>

	<p><i>Significantly lower ($p < .05$) mean score for fallers than non-fallers</i></p> <p>-Fallers: mean score 21.3 ± 5.8 (range 8-28); Non-fallers: mean score 25 ± 2.8 (range 17-28)</p> <p>-Max score for the TMT is 28</p>
Authors' Discussion and Conclusions	
Brief Summary of Authors' Main Discussion Points; Authors' Conclusion	<p>-Multiple parameters of both forward and backward walking declined significantly in elderly participants versus the young or middle-aged groups, with a sharper decrease in backward walking parameters. The biggest decline in gait parameters happened after age 65.</p> <p>-Increased variability in gait parameters (as calculated by the Coefficient of Variation)</p> <p>-The authors conclude that measuring basic spatiotemporal gait parameters in short distances of backward walking can be a reliable way to detect age-related changes in balance and gait and possibly to predict a risk of falling.</p>
Reviewer's Discussion and Conclusion	
Study Strengths	<p>-The cross-sectional study design was relatively simple, with only three treatment groups and more than 30 subjects in each group.</p> <p>-Gait parameters were measured using the GAITRite® system, a well-established tool in physical therapy literature for assessing spatiotemporal parameters.</p>
Study Limitations and Potential for Bias	<p>-Possible bias in the sample (all subjects from the same area of Ohio, more females than males.</p> <p>-Participants were not randomized, and study assessors were not blinded to the participants' age.</p> <p>-Study design (cross-sectional) did not allow for following changes in individuals over the course of time, as study participation consisted of only one session.</p> <p>-More studies needed to corroborate their results before using their protocol to predict fall risk.</p>
<p>Applicability:</p> <ul style="list-style-type: none"> • Types of patients (dx) that results apply to • Types of settings or patient acuity that the results apply to • Can interventions be reproduced? Can results be applied to other pt populations? 	<p>-Could be applied to ambulatory individuals over 65, to detect impairments in gait and balance in backward walking that might not be readily apparent in functional forward walking. More concurrent-validity-related research is necessary to determine if backward gait could be a reliable and valid tool to predict risk of future falls.</p> <p>-Could be applied in inpatient, outpatient, or home care settings, with or without the capability for instrumented gait analysis. Many of the parameters most significantly different in the elderly participants (especially those with falls) were velocity, stride length, stride time, and base of support, all of which can be measured with a timer and tape measure.</p>
How will study results impact PT management of this patient population?; List suggestions for how to implement changes in your clinic/department to integrate study findings into patient care	<p>-A therapist can quickly and easily measure backward walking velocity in those over 65 to gain a more full picture of balance deficits, much as we now use tests like the Timed Up and Go to quickly measure forward velocity and turning.</p> <p>-More research is needed to fully validate the authors' proposed "cut-off scores" of 0.6 m/s or 0.4 m/s to determine if either is a statistically and clinically meaningful predictor of future falls. However, the</p>

	possibility of utilizing backward walking velocity as an additional gait measure could enhance patient health and wellness care in a variety of treatment settings.
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