

## Functional and Biomechanical Assessments of A Matter of Balance/Volunteer Lay Leader Model: A Pilot Investigation

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The purpose of this pilot study was to evaluate the effectiveness of A Matter of Balance/Volunteer Lay Leader model (AMOB/VLL), an evidence-based falls prevention program, on improving balance and mobility. Twenty-eight community-dwelling older adults completed an eight-week AMOB/VLL program. Pre/post assessments of biomechanical and functional outcomes of balance during single and dual-task trials, as well as perceptions of fear of falling, were compared using pairwise t-tests and Wilcoxon signed rank tests. Our findings suggest that while improvements in functional indicators of mobility and perception regarding fear of falling were observed, biomechanical and functional assessments specific to balance during the single-task trials remained unaffected by the intervention. Interestingly, the group exhibited improvements in biomechanical measures during the dual-task trials. Since AMOB/VLL primarily focuses on restructuring participants' perceptions about falls and only includes generalized exercises, including balance-specific training within the program can potentially improve balance outcomes among older adults.

### INTRODUCTION

Falls represent a major health care issue in the elderly population and are associated with increased morbidity and disability (CDC, 2009; Horton, 2007; Nachreiner, 2007; Smith et al., 2010; Thomas, 2007). The prevalence of falls in elderly individuals is approximately 40% (Rossat et al., 2010) and alarmingly, two-thirds of the deaths from unintentional injuries are related to a fall event in this population (AGS, 2001; Smith, Hochhalter, Chen, Wang, & Ory, 2011). Age-related changes in both motor and cognitive abilities have been linked to increased falls risk in the elderly. In particular, due to sensory degradation (visual, vestibular, somesthetic), reduced attentional and/or information processing capacity, and impaired neuromuscular functions, postural stability and balance is compromised in older adults (Aniansson, Grimby, & Rundgren, 1986; Brocklehurst, Robertson, James-Groom, 1982; Choy, Brauer, & Nitz, 2003; Lopez, Jonrubia, & Bolah, 1997). Thus several training approaches, such as static and dynamic balance, strength and exercise, and behavioral trainings, have been previously employed in laboratory- and community-based settings to reduce falls risks among older adults (reviewed in Zech et al., 2010).

*A Matter of Balance* (AMOB) evidence-based program is designed specifically to reduce fear of falling among community-dwelling older adults (Tennstedt et al., 1998). As originally envisioned in the randomized

control trial, AMOB is a cognitive behavioral intervention program that focuses on promoting self-efficacy and control of falling. It is a multidimensional balance intervention program that enhances perception of falls management and control, recognizes intrinsic and extrinsic factors related to falls risk, and promotes physical exercise to increase strength and balance (Tennstedt et al., 1998). *A Matter of Balance/Volunteer Lay Leader* model (AMOB/VLL), where certified master trainers teach lay leaders to deliver the program with fidelity (Healy et al., 2008; Ory et al., 2010), has enabled the program to be embedded in community-based organizations, thus easing the implementation and dissemination of this program to older adults in diverse settings (Smith et al., 2011).

Both AMOB and AMOB/VLL have shown positive effects in increasing falls efficacy, improving overall physical activity levels, and reducing interference with normal everyday routines (Ory et al., 2010; Smith, Jiang, & Ory, 2012b; Tennstedt et al., 1998). In addition, the effectiveness of AMOB/VLL in improving physical and mental health indicators is also well-known (Smith, et al., 2012b); however, AMOB/VLL's ability to improve balance-specific outcomes, particularly those related to falls risks, is less known. The purpose of this study was to explore the impact, if any, of AMOB/VLL on biomechanical and functional assessments of balance and mobility, as well as on perceptions about fear of falling. Biomechanical assessments were measured

during single- and dual-task conditions. Given that AMOB/VLL primarily targets cognitive behavioral changes that influence falls risk and generalized strength and balance exercises, it was hypothesized that program-related improvements would be observed in general mobility and perceptions about fear of falling.

## METHODS

### Participants

Upon informed consent, 28 community dwelling older adults (3 males, 25 females; mean age of 78.07 (SD=7.69) years) participated in the 8-week AMOB/VLL program. All participants also completed pre/post assessments. Recruitment was limited to ambulatory adults 65 years of age or older who passed the MiniCog test (Borson, Scanlan, Brush, Vitaliano, & Dokmak, 2000). Overall, participants were older than 75 years (75%), female (89.3%), Non-Hispanic White (96.4%), and had at least two chronic conditions (78.6%). At baseline, 4 participants (14.3%) reported a fall in the last month.

### Procedure

All participants were enrolled in the 8-week AMOB/VLL program. Participants were required to attend a two-hour group session each week (for eight consecutive weeks) that relied on several training techniques, such as videotape, lecture, group discussion, mutual problem solving, role-playing, exercise training, assertiveness training, home assignments, and behavioral contracting (PHA, 2009). The early sessions focused on cognitive restructuring, i.e., changing participant attitudes and self-efficacy prior to attempting changes in actual behavior. On the other hand, strength and balance training exercises (~30 minutes) were included in six of the eight sessions to instruct and encourage subjects to continue them independently. Detailed descriptions of the AMOB and AMOB/VLL programs are discussed elsewhere (Healy et al., 2008; NCOA, n.d.; Ory et al., 2010; Tennstedt et al., 1998). Program-based assessments were conducted in separate sessions a week before and after the 8-week program for each participant. The assessments included: 1) performing single- and dual-task static balance trials on a commercial balance board; 2) performing functional assessments of balance (Reach test) and mobility (Timed Up and Go (TUG) test); and 3) completing self-reports about fear of falling.

*Biomechanical assessments.* Participants performed a series of static balance trials on a commercial balance board (HUMAC Balance, CSMi, MA, USA) in the absence and presence of a secondary cognitive task. In the single task, participants were

instructed to maintain balance for 30 seconds while focusing on a red dot on the wall in front of them at eye height. In the dual task, participants were instructed to maintain their balance while performing a 2-choice reaction time (CRT) task displayed to them on a computer screen at eye height. Biomechanical balance assessments included two sway measures of Center of Pressure (COP): average path velocity (PV) and average radial distance (RD). PV was defined as the average COP distance per second (A.W. Smith, Ulmer, & Wong, 2012). Lower PV indicates better balance performance. RD was defined as the average radial distance of the COP from the ensemble center of the COP path, with lower RD indicating better postural balance (A.W. Smith et al., 2012). Both COP measures were computed using custom-built MATLAB program (ver. 2013, Mathworks Inc.). Performance on the 2-CRT task during the dual-task condition was measured using a composite cognitive index, namely *throughput*, which is defined as a corrected response rate measure giving the number of successes per unit of discretionary time (Thorne, 2006).

*Functional assessments.* Participants completed two functional tests: 1) Reach Test that measures static balance (Duncan, Weiner, Chandler, & Studenski, 1990); and 2) TUG test that measures dynamic balance and mobility (Podsiadlo & Richardson, 1991). In the Reach test, participants stood with their feet a comfortable distance apart and their dominant arm raised to 90 degrees shoulder flexion. They were asked to reach as far forward as possible without overbalancing. Overbalancing was defined as needing to take a step or requiring hands-on assistance to maintain balance. In the TUG test, participants were observed and timed while they rose from an armchair, walked 3 m, turned, walked back, and sat down again. Participants performed two trials of each test at each of the pre/post sessions, and average Reach and TUG values were used for comparison.

*Perceptions about fear of falling.* Participants completed a single survey item widely used in other AMOB/VLL studies (Ory et al., 2010) that measured their perceptions about fear of falling. Participants were asked to rate “*How fearful are you of falling (not at all, a little, somewhat, a lot)?*” The scale was recoded such that lower score indicates greater fear of falling.

### Statistical analysis

Pairwise t-test and Wilcoxon signed rank test were used to compare any improvements in each of the study outcomes. The level of significance for all analyses was set at  $p < 0.05$ , and the analyses were conducted using SPSS v22 (IBM SPSS Statistics, NY,

USA). All summary values are presented as (1) means, along with standard deviations (SD) for interval variables, and (2) frequency with valid percentages (%) for categorical variables.

## RESULTS

With regards to the biomechanical assessments, the group showed no improvements in average path velocity ( $p=0.127$ ) or average radial distance ( $p=0.23$ ) for the single-task condition. Interestingly, in the dual-task condition the group showed significant improvements, i.e., decreased values, in both path velocity (13.5% improvement;  $p=0.033$ ) and radial distance (27.1% improvement;  $p=0.034$ ; Figure 1). Additionally, the group showed significant improvement in throughput performance (13% improvement;  $p=0.009$ ) on the 2-CRT task.

## DISCUSSION

The purpose of this pilot investigation was to examine the effectiveness of A Matter of Balance/Volunteer Lay Leader model (AMOB/VLL) on balance-related outcome measures during varied conditions, along with functional assessment of mobility (TUG) and perceptions of fear of falling. As expected, the findings indicate that the AMOB/VLL program improved functional mobility and fear of falling. However, the program did not improve balance during single-tasks or during functional reach tests. Interestingly, participants' balance during the dual-task conditions improved significantly after the completion of the program.

Numerous studies have reported the effectiveness of AMOB in improving mobility and fear of falling (AGS, 2001; Graffmans et al., 1996; Healy et al., 2008; Vellas, Wayne, Garry, & Baumgarner, 1998). However, the effectiveness of AMOB/VLL in improving biomechanical outcomes of balance, and associated changes in functional assessment of balance, has not been investigated. The primary aim of AMOB/VLL program is to reduce fear of falling, while increasing physical, social, and functional activity serves as its secondary aim. Thus, the lack of balance improvements during single-task conditions in the present investigation is not completely surprising. The lack of significant program-related improvements in balance outcomes may also be attributed to the use of "static" balance tests over "dynamic" tests, thus future work needs to assess AMOB/VLL program benefits on *both* static and dynamic balance.

The focus of AMOB/VLL is on cognitive restructuring to achieve greater perceived control, greater confidence in one's abilities, and more realistic assessment of failures (Tennstedt et al, 1998), thus it is possible that participants effectively managed the added task requirements in the dual-task condition after training. One could argue that program-related balance improvements during the dual-task conditions could be attributed to participants' tendencies to attend primarily to the balance task. If that were the case, performance on the 2-CRT task would have been compromised. However, performance data on the 2-CRT task indicate that participants showed significant improvements in *both* balance and 2-CRT tasks. Indeed, several studies have emphasized that cognitive control training, particularly in dual-task balance training programs streamline neural resources that positively impact postural balance (Hiyamizu, Morioka, Shomoto, & Shimada, 2012; Silsupadol et al., 2009). Comparable

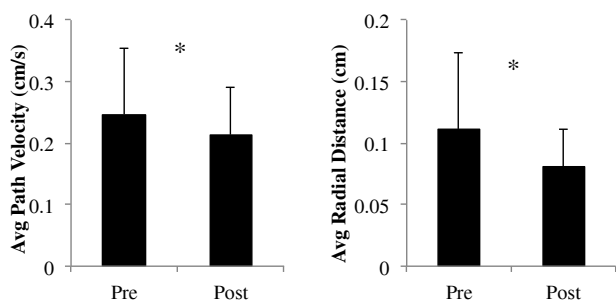


Figure 1. Impact of AMOB/VLL program on average path velocity (left) and average radial distance (right) during dual-task conditions. \* denotes significant ( $p<0.05$ ) differences between pre/post assessments. Error bars indicate SD.

While the group showed significant improvements in TUG (11.3% improvement;  $p<0.001$ ), no differences in functional assessment of Reach were observed ( $p=0.103$ ; Figure 2). Finally, a significant improvement in perception about fear of falling was observed (22.1% improvement;  $p=0.009$ ).

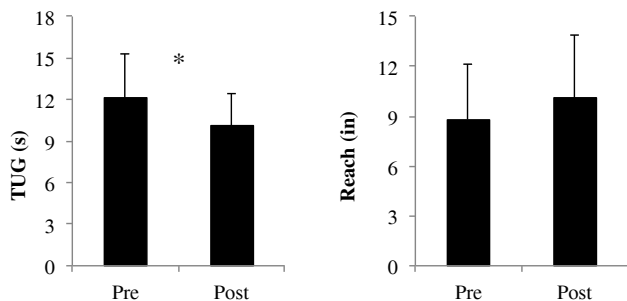


Figure 2. Impact of AMOB/VLL program on TUG (left) and Reach (right) tests. \* denotes significant ( $p<0.05$ ) differences between pre/post assessments. Error bars indicate SD.

cognitive control training strategies, adopted in AMOB/VLL program, may have contributed to the improvements observed in the dual-task conditions; however this is yet to be confirmed.

There are several limitations to the current study. Given the preliminary nature of the study, pre/post assessments with a control group were not conducted. The initial intent of this investigation was to first explore if the evidence-based AMOB/VLL program had any effects on balance-specific outcomes. The selection of participants was not random; as such self-selection bias may affect the results. The relatively small sample size prevents generalization to larger populations, and the small numbers may have influenced the ability to detect significant differences. The findings obtained here are the first to examine impact on balance-specific outcomes due to AMOB/VLL program; as such further investigations must be conducted to verify these results. Even so, the objective assessment using external force plates provides rigorous evaluation of balance sway measures (Raymakers, Samson, & Verhaar, 2005; A.W. Smith et al., 2012). The preliminary findings suggest that existing training strategies in the AMOB/VLL program are relatively less successful in influencing balance-specific outcomes during single-tasks when compared to their success in reducing fear of falling and associated restrictions in activity levels among older adults, including those from diverse backgrounds (Smith et al., 2012a; Smith et al., 2012b; Tennstedt et al., 1998). However, program-related improvements in balance during dual-task assessments suggest that cognitive control training approaches within the AMOB/VLL program are beneficial to balance during multitasking. Encouraged by these pilot findings, future work will include a rigorous randomized controlled trial, with a larger sample size and a control component, to investigate the nature and extent to which AMOB/VLL improves balance-specific outcomes.

Additional research is needed to explore the effectiveness of additional training components incorporated into existing AMOB/VLL protocol. Such efforts would enable researchers to identify the relative advantage of different balance-related training techniques and measure the incremental benefits using objective balance assessments. To address this critical need, this study serves as a pilot for our ongoing research efforts to explore the effectiveness and feasibility of a modified AMOB/VLL program that borrows strategies from both cognitive restructuring as well as balance rehabilitative approaches to improve both falls efficacy as well as balance/mobility (Zech et al., 2010). Additional efforts are needed to integrate

balance-specific training modules into existing AMOB/VLL delivery in community settings (e.g., training lay-leaders, purchasing equipment, measuring outcomes). This study shows promising trends about the potential of tailored balance training programs on reducing falls risks among community-dwelling older adults.

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