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A novel sensorimotor movement and walking intervention to improve balance and gait in women

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A B S T R A C T

Purpose: This study evaluated the effectiveness of a 5-day mind-body exercise (MBE) program on measures of quality of life, balance, balance confidence, mobility and gait in community-dwelling women.

Methods: The MBE program was a 5-day retreat where multiple sessions of Feldenkrais®-based sensorimotor movement training and walking were performed daily. Forty-six women aged 40–80 years old participated in either the MBE program or maintained normal daily activity. Two-footed eyes-closed balance, gait characteristics, mobility via the Timed Up and Go test, balance confidence and quality of life were assessed before and after the intervention.

Results: Women in the MBE group experienced improvements in mobility (6%; $p = 0.01$), stride length (3%; $p = 0.008$), single limb support time (1.3%; 0.006), balance confidence (5.2%; $p < 0.001$) and quality of life ($p < 0.05$) while the control group did not change.

Conclusion: This short-term intensive program may be beneficial to women at risk of mobility limitations.

1. Introduction

Gait and balance deficits are common causes of falls in adults and falling can result in injury, functional limitations and subsequent disability [1,2]. Consequently, there is great interest in developing effective strategies to improve balance and mobility among older adults with the primary goal often related to fall prevention. Strategies traditionally include aerobic, strength, flexibility and specific balance exercises [3]. Research suggests that strength training, balance, gait, and coordination training be included as interventions to prevent falls in older adults [1]. The Feldenkrais Method® is a mind-body exercise that aims to enhance self awareness of motor skills and deficiencies and guide individuals to select more appropriate and effective movement patterns [4–7]. Awareness Through Movement is a Feldenkrais® teaching style in which a teacher verbally guides students through movement lessons that focus their attention on sensory information obtained during movement [4]. Training programs based on the Feldenkrais Method® have demonstrated improvements in balance confidence, mobility, and gait performance [5,7]. Benefits to participation in such programs have occurred in the elderly [5], people with non-specific musculoskeletal disorders [6,8], those with low back pain [9], neurological deficits associated with a stroke [10], and Multiple Sclerosis [11,12].

The Walk for Life program is mind-body exercise (MBE) intervention that is a departure from traditional Feldenkrais® exercise. This program has a foundation in the Awareness Through Movement Method® but a major difference between this MBE program and traditional Feldenkrais exercise is that this program focuses on standing posture and the fluidity of walking gait which were reinforced using outdoor walks over uneven terrain, whereas traditional Feldenkrais training primarily utilizes supine activities. This five-day workshop includes sessions of simple, gentle movements performed in a tranquil environment coupled with sessions of walking in nature with trekking poles and could be used as an intervention for individuals with balance or gait problems. The model for walking focuses on “evolutionary movement coordination, propulsion, impact and alignment” [13]. The MBE program is unique in that it is an intensive, comprehensive, sensorimotor

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Table 1
Descriptive statistics of the participants.

	MBE	Control	*P*-values
n	25	21	–
Age (years)	61 ± 8	57 ± 9	0.19
Height (cm)	163.9 ± 6.3	164.8 ± 5.2	0.62
Mass (kg)	68.2 ± 13.6	67.6 ± 14.7	0.88
BMI (kg m^{-2})	25.3 ± 4.7	24.8 ± 4.7	0.72

MBE = Mind-body exercise group, BMI=Body mass index. Data were analyzed with independent *t*-tests to compare MBE and Control groups.

intervention of only five days. Other interventions employing the Feldenkrais Method® have been carried out over several weeks [5–7]. The MBE program encourages participants to become self-directed learners that focus their attention on their own habitual movements with the overall goal to improve movement efficiency. It is possible that this complementary and alternative group approach to maintaining physical function can be an option in addition to traditional one-on-one physical therapy or personal training sessions. It is unknown if this short duration, yet concentrated regimen, is sufficient to elicit improvements in gait, balance and overall well-being. Thus, the purpose of this pilot study was to evaluate the effectiveness of a MBE program on measures of quality of life, balance, balance confidence, gait, and functional mobility in community-dwelling, older women. It was hypothesized that participants in the MBE program would experience improvements in these measures.

2. Materials and methods

2.1. Study design and participants

The study employed a non-randomized repeated-measures design with two groups of women between the ages of 40 and 80 years old (Table 1). The MBE group was made up of 25 women that enrolled and participated in a 5-day Walk for Life retreat in southern New Hampshire and the control group consisted of a convenience sample of 21 volunteers from the local community. Participants signed an informed consent that was approved by the University of New Hampshire's Institutional Review Board. Participants completed a general health history questionnaire and were excluded if they reported neuromuscular disorders and/or ambulated with an assistive device.

2.2. Measurements

Pre and post testing sessions consisted of measurements of height, weight, balance confidence, quality of life, static balance, mobility and gait to objectively and reliably assess the effect of the MBE intervention. The participants in the MBE program were tested at the site of the retreat and the participants in the control group underwent testing in a laboratory setting to provide a well-controlled assessment of the learning effects associated with repetition of the tests. The same researchers conducted both testing sessions using identical methods.

Balance confidence was assessed using the self-administered Activities-Specific Balance Confidence (ABC) Scale. This scale requires the subjects to rate their level of confidence doing certain daily activities without losing balance or becoming unsteady on a 0–100% scale. This scale has a test-retest reliability of 0.91 [14]. The subjects then self-administered the World Health Organization Quality of Life Scale-Brief Version (WHOQOL-BREF) assessment. This is a survey of 24 questions related to 4 domains: physical health, psychological, social relationships and environment. Additional questions directly asked participants to rate their quality of life and to rate how satisfied the participants were with their health [15].

Mobility was evaluated using the Timed Up and Go (TUG) test and by measuring habitual walking speed during gait assessment. For the TUG test participants started in a seated position in a straight-backed chair with a seat pan height of 46 cm and upon a verbal cue of “Go”, stood up, walked 3 m, turned around a cone, walked 3 m back, and returned to a seated position in the same chair. Participants were timed from the word “Go” until their back touched the chair upon return. The subjects performed this test twice and their times were averaged. This measure has a test reliability of 0.99 [16].

To assess gait, participants performed two walking trials on a five-meter instrumented walkway (GAITRite Walkway System, Sparta, NJ). Participants started at a designated starting point on the floor which was 2.1 m from the walkway, and walked at their preferred pace across the mat to the designated stopping point 2.1 m beyond the mat on the other side of the room. They walked across the mat four separate times without shoes and the first two successful trials, defined as at least two complete stride cycles with complete foot-strikes on the walkway, were averaged for analysis. The following variables were generated by the walkway system: gait speed (s), stride rate (strides min^{-1}), stride width and length (m), stride time coefficient of variation (% COV), stance time (% gait cycle), and single and double-limb support times (% gait cycle) were recorded. The test-retest reliabilities of the temporal and spatial measurements on the GAITRite Walkway System at preferred speeds are above 0.92 [17].

Two trials of two-footed eyes-closed balance were performed on the TekScan Matscan® (Tekscan®, CO) instrumented pressure mat. Participants removed their shoes, stepped onto the mat and stood in a normal upright body position with the arms at their sides and the head looking straight ahead. The participants closed their eyes while a spotter stood behind the participant. To quantify balance, the distance the center of pressure traveled (cm) (test–retest reliability = 0.93) and the area created by the center of pressure excursion (cm^2) (test–retest reliability = 0.71) were obtained with higher scores representing greater instability. The average of the two trials was used for analysis.

2.3. Intervention

The participants in the MBE program engaged in one to two sessions of Feldendkrais®-based activities and walking each day. The MBE program consisted of 45 individual functional processes which are organized in a sequential manner and taught over the course of five days. Each session included 3 areas of focus: 1.) posture control, strength, flexibility and balance training; 2.) walking with and without trekking poles; and 3.) guided relaxation. The sessions began with the participants conducting an individualized test regarding the planned movement activity. This initial test provided the participant with a point of reference for their personal movement, which included the participant performing the activity as they normally would while noting postural and movement patterns. A senior trainer in the Feldenkrais Method® who was not affiliated with the study design, data analysis, or drafting of the manuscript, guided the participants through the movement strategies with each participant moving at her own pace. The session concluded with the participants returning to the self-test movement to identify changes. Table 2 provides an example of one MBE session employed in the study.

2.4. Statistical analysis

Statistics are presented as means ± standard deviations. Descriptive characteristics were examined with independent *t*-