Complementary Therapies in Clinical Practice 20 (2014) 311–316

Contents lists available at ScienceDirect

Complementary Therapies in Clinical Practice

journal homepage: www.elsevier.com/locate/ctcp

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

Summer B. Cook [a,*], Dain P. LaRoche [a], Erik E. Swartz [a], Precious R. Hammond [b], Marjorie A. King [b]

[a] *University of New Hampshire, Durham, NH, USA*
[b] *Plymouth State University, Plymouth, NH, USA*

Keywords:
Feldenkrais
Balance
Gait
Aging
Women

ABSTRACT

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

* Corresponding author. Department of Kinesiology, University of New Hampshire, 124 Main Street, Durham, NH 03824, USA. Tel.: +1 603 862 0895; fax: +1 603 862 0154.
E-mail address: summer.cook@unh.edu (S.B. Cook).

http://dx.doi.org/10.1016/j.ctcp.2014.09.003
1744-3881/

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*-

Table 2
Sample exercise session of MBE intervention. Adopted with permission from: Ruthy Alon. Walk for Life Study Guide. 2011. pp 3–11.

1. Restoring ankle extension	Lying on the back, place right foot on a wall. Bend left knee and place foot on the floor. Slide right foot upward and downward on the wall. Notice how the angle of the ankle opens and closes, alternately and sense how the lumbar and neck curve out and in accordingly.
2. Revitalizing the toes: Contribution of toes to stability and propulsion	While standing, shift weight from one leg to another to determine stability of foot on weight-bearing leg. Choose foot that needs improvement. Wrap a strip of cloth, 2 m in length at the bottom of one foot. Hold the strips crossed and twisted above the bridge, keeping the heel on the floor. Curl the toes under. Lift ball of foot, elevate toes and separate them as foot returns to floor. Repeat until smoothly coordinated with lumbar, chest, cervical neck and head response.
3. Throwing sand backwards: Reclaiming assertive power of toes	Stand with one side of the body along the back of a chair using the hand for support. With the foot closest to the chair, mobilize toes to sprinkle sand backwards with the intention that the sand will reach far behind. Acknowledge the opening of the ankle's angle and sense the pushing force of the foot. Then throw the sand diagonally, in slight rotation of the body and in different directions. Then brush the sand backward in walking. Use one foot to throw the sand every 4 steps, then throws the sand every 2 steps, the each step. Do it in different levels of intensity.
4. Aligning neck: Secure the vulnerable curves	Using hand, gently move the chin closer to the throat and place the thumb on one cheek and the index finger on the other cheek. Reach with the little finger to touch the collar bone and place your wrist and fore arm to the chest. With the other hand behind the curve of the neck sense the change. Hold that position and step in place from one foot to the other and then walk around.
5. Walking backward: Spontaneous reorganization	Walk freely outdoors paying attention to how it feels. From time to time walk backwards several steps. Then walk forward noticing if walking is different. Repeat this cycle several times. While walking align lumbar by pinching belly in front, align cervical neck by mobilizing chin closer to throat. Regulate breathing in a four step rhythm in which on step 1 make a strong exhale with the sound "Ha" and then allow 3 more steps breathing in passively.
6. Relaxation after walking: Knees from side to side	Lie down on the back. Pull knees toward chest, cross ankles and hold knees with interlaced fingers. With one hand at a time, drag the whole body to its side. Roll on spine, not onto ribs. Rock side to side.

tests. Separate repeated measures analysis of variance were used to compare ABC Scale scores, WHOQOL-BREF scores (four domains and quality of life questions), TUG time, balance area and distance, and gait parameters (gait speed, stride rate, stride width, stride length, stance time, single-limb support time, double-limb support time, and stride time % COV) between the two groups from pre to post tests. Effects of time, group and group by time interactions were performed. Only when a significant interaction was evident, *t*-tests were used to determine if groups differed at specific time points (independent *t*-tests) and from pre to post intervention (dependent *t*-tests). To control familywise (Type 1) error rate for multiple *t*-tests, a Bonferroni adjustment was used. Partial eta squared (η_p^2) was calculated to describe the proportion of the variance in the dependent variable that was accounted for by the intervention group. Data were analyzed using IBM SPSS Statistics version 19.0 (Armonk, NY). Significance was set at $P \leq 0.05$.

3. Results

There were no differences in the mean age, height and mass of the groups (Table 1). Prior to program participation, the MBE participants had poorer ABC scores ($89.0 \pm 8.5\%$ vs $94.0 \pm 5.6\%$ $p = 0.02$, Fig. 1), slower gait speed (1.17 ± 0.21 m s^{-1} vs 1.36 ± 0.16 m s^{-1}, $p = 0.002$, Fig. 2A), slower TUG times (9.7 ± 2.6s vs 8.0 ± 0.9s, $p = 0.01$, Fig. 2B), 34.7% greater balance distance ($p = 0.004$), 3.1% shorter single-limb support time ($p = 0.004$, Table 3), 8.6% longer double-limb support time ($p = 0.012$), 9.8% slower stride rates ($p < 0.001$), and 30% greater stride time variability than the control group ($p = 0.005$) (Table 3). Stride length and stride width were not different between groups at the pretest (Table 3).

A significant main effect of time existed for gait speed ($p = 0.003$, Fig. 2A) largely from a 4.3% increase in MBE with less change in controls (1.5%). A significant time effect also occurred for stride time % COV which increased slightly in both groups at the posttest (Table 3), yet there was no effect of the MBE program on this measure of gait rhythmicity. A significant group × time interaction occurred for TUG time indicating the MBE participants improved but controls did not ($p = 0.01$, $\eta_p^2 = 0.13$, Fig. 2B). A significant interaction also occurred for stride length which increased by 6.5% in the MBE group and stayed the same in the control group ($\eta_p^2 = 0.15$, Table 3). Similarly, the MBE group had small, but significant, improvements in stance time (−0.8%, $\eta_p^2 = 0.14$), single-limb support time (+1.1%, $\eta_p^2 = 0.16$), and double-limb support time (−3.0%, $\eta_p^2 = 0.11$) which were unchanged in controls (Table 3).

Following the MBE program, the participants' ABC scores increased 5.2% and were unchanged in the controls (−0.3%) ($p < 0.001$, $\eta_p^2 = 0.32$, Fig. 1). There were no differences between the groups at the pretest for the WHOQOL-BREF survey, but there were significant group × time interactions in physical health ($\eta_p^2 = 0.16$), psychological ($\eta_p^2 = 0.27$), and environmental domains ($\eta_p^2 = 0.17$), and for overall perception of health ($\eta_p^2 = 0.26$), indicating improvements in the MBE participants only (Table 4).

4. Discussion

The results from this pilot study support the hypothesis that perceived quality of life, balance confidence, and gait would improve in community-dwelling women following the MBE program whereas the hypothesis that two-footed balance would be improved was not supported.

While participants in MBE program exhibited lower gait and balance performance at baseline compared to controls, they experienced improved balance confidence, TUG time, gait speed, stride length, stance time, single-limb support time, and double-limb support time. The poorer balance, mobility, and balance

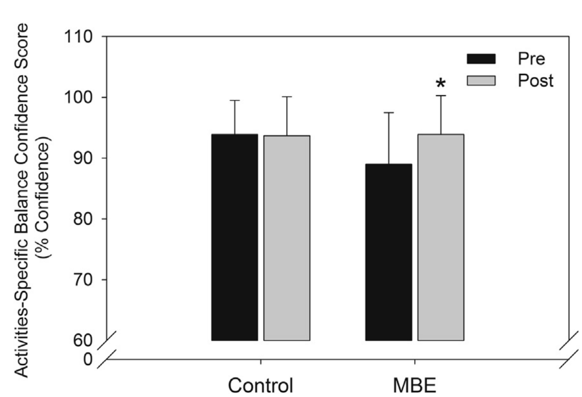

Fig. 1. Pre and post Activities-Specific Balance Confidence Score in participants in the Mind Body Exercise (MBE) program and the control group. Data were analyzed with repeated measures analysis of variance (ANOVA) comparing variables pre and post intervention between groups. * denotes significantly different from pre ($p < 0.05$).

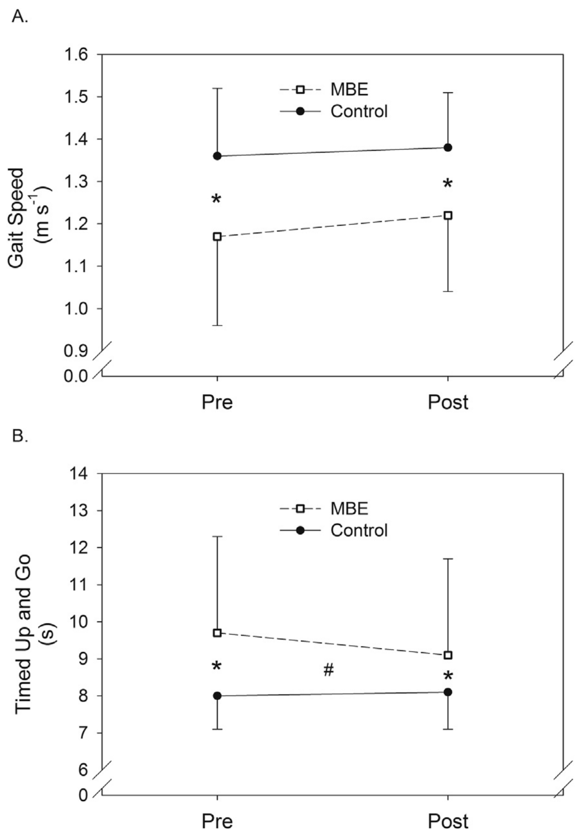

Fig. 2. Pre and post gait speed (A) and timed up and go (TUG) (B) in Mind Body Exercise (MBE) program and control participants. Data were analyzed with repeated measures analysis of variance (ANOVA) comparing variables pre and post intervention between groups. * denotes significant difference between groups at either pre or post ($p < 0.05$), # denotes significant group × time interaction ($p < 0.05$).

confidence in the MBE group compared to the control group at the pretest measurement must be considered. It is plausible that this occurred because some MBE participants may have been experiencing declines in their physical function and sought participation in the MBE program as a means to address these declines. For example, at the pretest the time to complete the TUG test was 21% slower, walking speed was 14% slower, and balance distance was 35% greater in MBE participants when compared to the control subjects. These tests are measures of postural stability and functional mobility and are highly predictive of long-term health outcomes. As a benchmark of mobility, the speed required to cross the street at a signaled intersection is 1.2 m s^{-1} [18]. At the beginning of the study the control group was above this speed (1.36 m s^{-1}) whereas MBE participants fell below (1.17 m s^{-1}). However, both groups exhibited walking speeds above the 1.0 m s^{-1} threshold shown to identify high risk of adverse health outcomes that include lower-extremity limitation, hospitalization, and death [19]. Studies have shown that a slow walking speed is associated with a twofold risk for both death and nursing home admission, and a fivefold increase in risk for developing a mobility disability [20–22]. Because there is a linear relationship between walking speed and health, the maintenance or improvement of walking speed with age is an important health initiative and necessitates interventions designed to enhance balance and mobility in older adults. This study demonstrates that women with low gait speeds and poor balance can experience improvements with the MBE program.

Muscle weakness, altered gait, slow walking speed, and balance deficits are among the top predictors of falling in older adults [1]. While MBE participants exhibited poorer balance and gait function at baseline, participation in the program elicited an 8% improvement in TUG time and 4% improvement in walking speed that placed them above the 1.2 m s^{-1} benchmark. With 13% and 18% of the variance in TUG time and gait speed, respectively, being attributed to the MBE program, these findings are of clinical significance. Similar to the current study, Ullman et al. [7] noted a 3% decrease in TUG time and an 8% improvement in gait speed following 5-weeks of Feldenkrais® exercise training, yet did not observe any changes in gait characteristics. Concurrent with improved walking speed, MBE participants had a 3% increase in stride length, and a small (1%) but significant increase in single-limb support time, and reductions in double-limb support time (−3%) and stance time (−1%). These positive gait changes appear to be linked to the short, but time intensive MBE program as 11–16% of the variance in these measures were accounted for the MBE intervention. The study design prevents a complete understanding of the mechanisms by which these gait and mobility improvements occurred, but neurological control of muscle has been shown to be enhanced in exercise programs of short duration [23]. This may include improved abilities to activate the muscle or to coordinate movement among muscle groups. It is not likely that changes in the physical properties of the muscles or tendons can account for the improved function as these adaptations occur over weeks and months. Therefore, a novel finding of this investigation is that a short duration, mind-body, group exercise intervention focused on balance and movement awareness may elicit meaningful improvements in walking ability in older women.

Studies incorporating Feldenkrais® exercises have demonstrated improvements in balance confidence of 7–19% [5,7,12] and a reduction in the fear of falling[7, 8] following several weeks of training. The participants in the MBE program experienced 5% improvement in balance confidence and 32% of the total variance in balance confidence was explained by the MBE program. When

Table 3
Comparison of walking gait and balance variables between the mind-body exercise participants and controls before and after the intervention.

	Pre		Post		*P*-values		
	MBE	Control	MBE	Control	Group effect	Time effect	Group × time interaction
Stride rate (strides min^{-1})	**56.0 ± 5.1***	**62.1 ± 5.4***	56.6 ± 4.5	62.7 ± 4.8	**<0.001**	0.096	0.765
Stride length (m)	1.24 ± 0.14	1.31 ± 0.09	1.29 ± 0.12	1.32 ± 0.09	0.179	**<0.001**	**0.008**
Stride width (m)	0.09 ± 0.03	0.09 ± 0.03	0.09 ± 0.02	0.09 ± 0.03	0.758	0.217	0.192
Stance time (%GC)	**63.2 ± 1.7***	**61.9 ± 1.1***	62.7 ± 1.4	61.9 ± 1.2	**0.014**	0.076	**0.009**
Single-limb Support Time (%GC)	**36.9 ± 1.7***	**38.1 ± 1.1***	37.3 ± 1.4	38.1 ± 1.3	**0.015**	0.076	**0.006**
Double-limb support time (%GC)	**26.4 ± 3.3***	**24.3 ± 2.1***	25.6 ± 2.7	24.2 ± 2.5	**0.027**	0.051	**0.027**
Stride time COV (%)	**1.3 ± 0.6***	**1.0 ± 0.4***	1.6 ± 1.0	1.5 ± 0.7	0.051	**0.001**	0.586
Balance distance (cm)	**27.2 ± 9.4***	**20.2 ± 5.1***	28.3 ± 7.2	19.9 ± 5.4	**<0.001**	0.601	0.358
Balance area (cm^2)	1.09 ± 0.90	1.18 ± 0.68	0.96 ± 0.57	1.01 ± 0.68	0.720	0.123	0.849

MBE = Mind-body exercise group, %GC = percent of gait cycle, COV = coefficient of variation. Data were analyzed with repeated measures analysis of variance (ANOVA) comparing variables pre and post intervention between groups. * and bold denotes significant difference between groups at pretest, $P < 0.05$.

Table 4
Results from the WHOQOL-BREF before and after the intervention.

	Pre		Post		*P*-values		
	MBE	Control	MBE	Control	Group effect	Time effect	Group × time interaction
Domain 1: Physical health	**60 ± 7**	63 ± 9	**64 ± 7***	63 ± 8	0.437	**0.008**	**0.008**
Domain 2: Psychological	**67 ± 11**	69 ± 8	**73 ± 9***	67 ± 8	0.314	0.070	**< 0.001**
Domain 3: Social relationships	**64 ± 20**	73 ± 19	**72 ± 21***	75 ± 18	0.172	**0.001**	0.053
Domain 4: Environment	**82 ± 11**	86 ± 11	**87 ± 13***	85 ± 10	0.541	0.114	**0.019**
Overall quality of life	4.4 ± 0.7	4.6 ± 0.5	4.6 ± 0.6	4.6 ± 0.5	0.420	0.334	0.152
Overall perception of health	**3.6 ± 1.0**	4.2 ± 0.7	**4.4 ± 0.6***	4.1 ± 0.7	0.248	**0.003**	**0.001**

MBE = Mind body exercise group. Data were analyzed with repeated measures analysis of variance (ANOVA) comparing variables pre and post intervention between groups.
* and bold denotes significant difference from pre for MBE condition ($P < 0.05$).

compared to other studies investigating the Feldenkrais Method®, our participants had higher ABC scores and were younger and therefore, the margin of improvement for our subjects was likely lower. A probable mechanism for improved gait and mobility following participation in the MBE program is improved balance confidence. We were unable to detect changes in balance performance following the MBE program, but it is possible the eyes-closed static balance test we used was not sensitive to changes in the dynamic stability required of walking, and emphasized by the MBE program. The participants in the MBE program had lower balance confidence than controls prior to program participation and experienced a significant increase at the end of the program. Improved balance confidence is a potential benefit of MBE that should not be overlooked. Fear of falling is commonly reported in older adults and has been linked to gait changes (e.g. slower speed, wider stride width, and decreased single-limb support time) that may place those with poor balance confidence at increased risk of falling [24]. It may be that participation in MBE resulted in improved balance confidence, leading to faster self-selected walking speed, which resulted in an improved gait pattern. Thus, the improved stride length and increased single-limb support time shown in MBE participants may be directly attributed to the improved balance confidence and subsequent faster self-selected walking speed at the study's completion.

The enhanced scores in the WHOQOL-BREF survey demonstrate that the MBE program positively affected perceived physical health, psychological well-being, and environment. The improvements from pre-to-post testing could be due to several aspects of the MBE program. For example, the participants in the program voluntarily attended, often traveling from great distances and some were taking a vacation from work and family to partake in the MBE program. They engaged with peers that had similar interests, and resided in a natural, tranquil environment with meals provided. It has been shown that changes in the physical health domain of the WHOQOL-BREF assessment in older fallers is correlated to performance on balance tests, fear of falling scales and depression [25]. Therefore, it is plausible to suggest that participation in the MBE program led to increases in mobility and balance confidence which could lead to greater satisfaction in physical health, psychological well-being, and environment.

There are limitations in this study that should be addressed. First, the participants were not randomly assigned to the groups as they voluntarily enrolled in the program and chose to participate in the study. This raises the chances that some of our positive results may be due to issues not necessarily related to the physical aspects of the MBE program, but perhaps to the environmental and social aspects of the MBE program and the expectation of improved physical function. Regardless, participation in this program had a positive effect when compared to a laboratory controlled group with no expectations of improved performance. Future research should attempt to clarify which aspects of group exercise programs contribute most to improved physical function. Additionally, the participants in the control group were not randomly selected and were of higher physical functioning at baseline testing than the MBE group, despite our attempts at matching the sample for age, height and body mass. It has been shown that in studies involving older adults, volunteers typically have higher physical functioning than those selected from a random sample [26]. It is possible that the MBE participants may have been aware of early declines in their physical function and enrolled in the MBE program as a means to address these declines. Future studies should evaluate the effectiveness of this novel MBE intervention using a random sample. Although there are limitations in this study, the practical value of interventions that focus on movement awareness, balance, and walking may be beneficial to women at risk of mobility limitations as it is easy to execute, is feasible and can be employed on a large scale to affect many people.

5. Conclusions

This study demonstrate that a five-day retreat, where multiple sessions of Feldenkrais®-based sensorimotor movement training and walking were performed daily, improved mobility, walking gait, balance confidence and quality of life. Short and intensive Feldenkrais-based retreats may be beneficial to individuals with mobility limitations.

Conflict of interest statement

None declared.

Acknowledgments

This study was supported by the Foundation for Movement Intelligence, which is the organization that developed the Walk For Life program. The Foundation for Movement Intelligence had no involvement in the study design, in the collection, analysis and interpretation of data, in the writing of the manuscript or in the decision to submit the manuscript for publication.

References

[1] Panel on Prevention of Falls in Older Persons, American Geriatrics Society and British Geriatrics Society. Summary of the updated american geriatrics Society/British geriatrics society clinical practice guideline for prevention of falls in older persons. J Am Geriatr Soc 2011;59:148–57. http://dx.doi.org/10.1111/j.1532-5415.2010.03234.x.
[2] Salzman B. Gait and balance disorders in older adults. Am Fam Physician 2010;82:61–8.
[3] Sherrington C, Whitney JC, Lord SR, Herbert RD, Cumming RG, Close JC. Effective exercise for the prevention of falls: a systematic review and meta-analysis. J Am Geriatr Soc 2008;56:2234–43. http://dx.doi.org/10.1111/j.1532-5415.2008.02014.x.
[4] Buchanan PA, Ulrich BD. The Feldenkrais method: a dynamic approach to changing motor behavior. Res Q Exerc Sport 2001;72:315–23.

[5] Connors KA, Galea MP, Said CM. Feldenkrais method balance classes improve balance in older adults: a controlled trial. Evid Based Complement Altern Med 2011;2011:873672. http://dx.doi.org/10.1093/ecam/nep055.
[6] Ohman A, Astrom L, Malmgren-Olsson EB. Feldenkrais(R) therapy as group treatment for chronic pain–a qualitative evaluation. J Bodyw Mov Ther 2011;15:153–61. http://dx.doi.org/10.1016/j.jbmt.2010.03.003.
[7] Ullmann G, Williams HG, Hussey J, Durstine JL, McClenaghan BA. Effects of feldenkrais exercises on balance, mobility, balance confidence, and gait performance in community-dwelling adults age 65 and older. J Altern Complement Med 2010;16:97–105. http://dx.doi.org/10.1089/acm.2008.0612.
[8] Vrantsidis F, Hill KD, Moore K, Webb R, Hunt S, Dowson L. Getting grounded gracefully: effectiveness and acceptability of Feldenkrais in improving balance. J Aging Phys Act 2009;17:57–76.
[9] Ruth S, Kegerreis S. Facilitating cervical flexion using a feldenkrais method: awareness through movement. J Orthop Sports Phys Ther 1992;16:25–9.
[10] Batson G. Effects of feldenkrais awareness through movement on balance in adults with chronic neurological deficits following stroke: a preliminary study. Complement Health Pract Rev 2005;10:203–10.
[11] Malmgren-Olsson EB, Branholm IB. A comparison between three physiotherapy approaches with regard to health-related factors in patients with non-specific musculoskeletal disorders. Disabil Rehabil 2002;24:308–17.
[12] Stephens J, DuShuttle D, Hatcher C, Shmunes J, Slaninka C. Use of awareness through movement improves balance and balance confidence in people with multiple sclerosis: a randomized controlled study. J Neurologic Phys Ther 2001;25:39–49.
[13] Alon R. Walk for life by Ruthy Alon. 2012. http://www.walkforliferetreat.com.
[14] Powell LE, Myers AM. The activities-specific balance confidence (ABC) scale. J Gerontol A Biol Sci Med Sci 1995;50A:M28–34.
[15] World Health Organization. WHOQOL-BREF introduction, administration, scoring and generic version of the assessment. 1996. www.who.int/mental_health/media/en/76.pdf.
[16] Podsiadlo D, Richardson S. The timed "up & go": a test of basic functional mobility for frail elderly persons. J Am Geriatr Soc 1991;39:142–8.
[17] van Uden CJ, Besser MP. Test-retest reliability of temporal and spatial gait characteristics measured with an instrumented walkway system (GAITRite). BMC Musculoskelet Disord 2004;5:13.
[18] Rantanen T, Guralnik JM, Izmirlian G, Williamson JD, Simonsick EM, Ferrucci L, et al. Association of muscle strength with maximum walking speed in disabled older women. Am J Phys Med Rehabil 1998;77:299–305.
[19] Cesari M, Kritchevsky SB, Penninx BW, Nicklas BJ, Simonsick EM, Newman AB, et al. Prognostic value of usual gait speed in well-functioning older people–results from the health, aging and body composition study. J Am Geriatr Soc 2005;53:1675–80.
[20] Guralnik JM, Ferrucci L, Pieper CF, Leveille SG, Markides KS, Ostir GV, et al. Lower extremity function and subsequent disability: consistency across studies, predictive models, and value of gait speed alone compared with the short physical performance battery. J Gerontol A Biol Sci Med Sci 2000;55:M221–31.
[21] Guralnik JM, Simonsick EM, Ferrucci L, Glynn RJ, Berkman LF, Blazer DG, et al. A short physical performance battery assessing lower extremity function: association with self-reported disability and prediction of mortality and nursing home admission. J Gerontol 1994;49:M85–94.
[22] Laukkanen P, Heikkinen E, Kauppinen M. Muscle strength and mobility as predictors of survival in 75-84-year-old people. Age Ageing 1995;24:468–73.
[23] Moritani T, deVries HA. Neural factors versus hypertrophy in the time course of muscle strength gain. Am J Phys Med 1979;58:115–30.
[24] Maki BE. Gait changes in older adults: predictors of falls or indicators of fear. J Am Geriatr Soc 1997;45:313–20.
[25] Lin MR, Wolf SL, Hwang HF, Gong SY, Chen CY. A randomized, controlled trial of fall prevention programs and quality of life in older fallers. J Am Geriatr Soc 2007;55:499–506.
[26] Ganguli M, Lytle ME, Reynolds MD, Dodge HH. Random versus volunteer selection for a community-based study. J Gerontol A Biol Sci Med Sci 1998;53:M39–46.