

Alternative Movement Program in Geriatric Rehabilitation

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Abstract

Objective: There is limited quantitative research in the field of somatic education. The aim of this pilot study was to assess the physical and psychological benefits, if any, of a relatively new somatic education program called Bones for Life®.

Methods: Twenty-five participants, with a mean age of 73, attended a 90-minute Bones for Life class, once a week for six weeks. Participants completed a general health questionnaire and the SF-36v2® Health Survey prior to performance measure testing. Timed Up and Go; turning 360°; alternating feet on a step while standing unsupported (20-Second Step Test); and standing on one leg assessed the physical performance of the subjects. A postintervention interview answering specific questions about balance, benefits, and the uniqueness of the Bones for Life program was recorded.

Results: Two movement tasks used to assess dynamic balance, the 360° Turn Test ($P=.006$) and the 20-Second Step Test ($P=.001$), demonstrated the most sensitivity to change. Changes in Quality-of-life measures were found to be statistically significant using the SF-36v2® Health Survey in the domains of Vitality ($P=.026$) and General Health ($P=.029$). Post-intervention interview

revealed improved physical function, posture, and balance.

Conclusion: This pilot study exhibited positive effects among community-dwelling seniors with diverse physical capabilities and medical challenges. With minimal expense, participants achieved improvement in function and balance after 6 weeks of Bones for Life classes. Evidence suggests that Bones for Life increases the stability of organized single-leg stance during movement and successfully carries over into more challenging tasks that require a smaller base of support, like walking, turning, reaching, and climbing. Participation in Bones for Life classes has a positive influence on quality of life indicators like peace, happiness, calmness, and increased energy. The outcomes suggest that the Bones for Life program may be a safe, feasible, and effective way for seniors to improve function. This pilot study serves as a call for funding and a footprint for further investigation. It also highlights the need to research alternative approaches to movement and activities used to improve function and balance that meet the demands of the aging population and complement the current medical model.

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Introduction

In the last 20 years, the focus of senior healthcare has shifted from palliative to preventative, from focusing on aging to focusing on wellness, and from alleviating chronic diseases to improving the quality of life. A number of research studies have been performed to assess the benefits of alternative movement and exercise programs for seniors.¹⁻⁵ The fast aging population is driving the need for this research. Between 2010 and 2020, it is projected in the US that there will be an increase of 14.5 million in the population over age 65 and an increase of 1.1 million in the population over age 85.⁶ In addition to the motivation to reduce costs associated with the care of an at-risk population, there is an increasing awareness that quality of

life throughout aging is important.⁷ Beyond the benefits on physical health such as minimizing physical discomfort, stiffness, and pain, exercise is now also recognized for its positive effects on cognitive and emotional health.⁸

A recent exercise approach, *Bones for Life*, often offered in a weekly, 60-90-minute class format, uses both demonstrated and verbally-guided movement sequences that are modeled after primal patterns of locomotion including the elements of crawling and creeping. The exercises are largely directed toward developing an upright posture that is well-aligned and able to withstand and transmit pressure proportional to environmental demand, with the least amount of joint shear and extraneous muscular effort thus eliminating the need for obsessive, unsupportive habits of tension. Not dependent on targeted muscle strengthening or specific joint range-of-motion exercises, *Bones for Life* uses various positions and novel movement activities like the following: unsupported sitting with unilateral weight-shifting; lying on the back and pressing a foot on the wall; rolling with hand-eye coordination; standing and bouncing on the heels; general movement patterns that facilitate lateral bending and rotation of the trunk; and spiraling movements of the extremities in reference to an imaginary center line. A hallmark of the *Bones for Life* program is the capacity to create an environment where participants can improve, regardless of their entry-level functional capacity. Simple tools facilitate the development of controlled resistance to pressure like using a strip of cloth as a harness, known as the *Bones Wrap* (Appendix F), rollers, pushing a wall, lifting weights, using self-touch for orientation and mechanical perturbation, and multi-position options (sitting, standing, lying). The suggested ways of moving are explored slowly with participants being assisted with the movement patterns as needed. Appropriate levels of rest are built in to each lesson to maximize the student’s learning and discovery of the integration and reciprocal coordination of all body parts in a movement pattern.

The *Bones for Life* program was created by Ruthy Alon and is based on Dr. Moshe Feldenkrais’ approach to somatic education. Most somatic education programs “explore developmental movements and access the power and plasticity of the central nervous system to improve human function by increasing self-awareness in movement.”⁹ These programs attempt to “de-program” habitual fixations following injury, illness, posture and faulty learning that result in counter-productive movements and poor joint alignment. Reconnecting a person to their natural capacity for feeling, thought, and action, these programs improve movement coordination and the collaborative functions of the skeletal, muscular, and nervous systems. The *Bones for Life* program asks students to fully participate in learning exercises that challenge their awareness, thinking, problem-solving skills, balance, and self-care. Variations of specific movement patterns within functional tasks are

incorporated into the movement activities to maximize carryover into daily life.

There is limited quantitative research in the field of somatic education.¹⁰ Three controlled studies were published in 2009 and 2010. Two, randomized and using the *Feldenkrais Method*[®] as an intervention tool for older adults, showed significant improvement in several measures of balance, mobility, gait speed and confidence.^{5,11,12} There is also evidence that the Alexander Technique has been effective in reducing back pain.¹³ In reviewing the *Bones for Life* program, only one other (non-published) pilot study has been completed; it was neither controlled nor randomized.¹⁴ The aim of this pilot study was to assess the physical and psychological benefits of a relatively new somatic education program called *Bones for Life*.

Method

Recruitment of Subjects

The Integrative Learning Center collaborated with the Dunham Recreation Center in Cincinnati, Ohio, to assess a population of active, elderly, community-dwelling adults. Participants were recruited through informational flyers, word-of-mouth, attendance at introductory *Bones for Life* lectures, and e-mail solicitation and had no prior history or exposure to *Bones for Life*. A group meeting was held with prospective subjects to explain the purpose of the pilot study and the *Bones for Life* intervention. The data in Table 1 identifies the selection criteria used for this pilot study. All participants completed a written health history and were apprised of the risks and potential benefits of the study. Subjects were informed that they would receive no compensation for their participation and written informed consent was obtained. All testing and interventions were conducted at the Dunham Recreation Center. Although no Internal Review Board was involved in this study, procedures were followed in accordance to the ethical standards outlined in the Helsinki Declaration (2000 revision). Table 2 outlines the demographics of the subjects who participated in the pilot study.

Table 1. Selection Process

Inclusion Criteria	Exclusion Criteria
> 55 years of age	Total Joint Replacement
Community Dwelling	Active balance disorder or vertigo within the last 6 month
Able to get down to and up from the floor with assistance	Medical condition or disability that prevent participation in routine clinical balance testing

Table 2. Demographics of Subjects

Variable	Number Reported
Mean Age	72
Gender	
Female	22
Male	3
Mean Class Attendance (6 total classes)	5.3
Medical History	
Osteoporosis	4
Osteopenia	3
Hypertension	9
Diabetes Type 2	3
Thyroid Dysfunction	5
Walking aid	1
Orthotic	5
Corrective lenses	17
Hearing aid	3
Other	
Walking 1-5 times/week for 15-60 minutes	12
weekly exercise (walking, water aerobics, swimming, Tai Chi, Zumba, weight lifting)	14
Fall history in the prior year	6
Ability to stand without support	
<10 min	1
10 min	3
15 min	1
>20 min	16

Table 3. Post-Intervention Interview Questions

Question 1	Describe your ability during functional activity to balance before taking this class. Did you have problems? If so, what kind?
Question 2	Compare your balance during functional activity now that you have taken this class. Can you do more?
Question 3	What Benefits did you gain from this class?
Question 4	What about this class seemed most interesting compared to other movement/exercise classes?

Collection of Data

Intra and inter-tester reliability was established between the authors prior to pilot study data collection using the following performance measures: Timed Up and Go (ICC = 0.963), 20-Second Step Test (ICC = 0.992), and 360° Turn (ICC = 0.981). The same pilot study selection criteria, volunteers from the Cincinnati, Ohio and Columbus, Indiana communities participated in the reliability study. All physical performance measures testing for the pilot study were videotaped and performed by the authors.

Design Overview

25 subjects, (22 females, 3 males) between the ages of 62 and 89 (mean age of 73), underwent baseline testing of performance measures to assess balance, function and a quality of life survey. To preclude any learning effects from

the tests, 12 of the subjects were randomly assigned to a 6-week wait list. The wait list subjects were informed that they were to not discuss the class activities with their peers and that they were to continue in their usual routines. The wait list subjects’ performance measures were retested prior to starting their intervention. Subjects then attended a 6-week Bones for Life class (90 minutes each, once a week). Post-intervention testing included a reassessment of performance measures, quality of life survey, and participation in a videotaped interview with specific questions, outlined in Table 3 inquiring about balance, class benefits, and identification of the most interesting aspects of the class.

Procedure

A general health questionnaire (Appendix A) and the SF-36v2® Health Survey (Appendix B) were completed prior to performance measure testing. To assess the physical performance of the subjects, each participant underwent the following activities: The Timed Up and Go; turning 360°; alternating feet on a step while standing unsupported (20-Second Step Test); and standing on one leg. Prior to the performance measure being tested and to ensure that uniformity in instruction for each activity was given consistently to every subject, the evaluator was required to read from a specific written script (Appendix C). All subjects were videotaped/voice recorded during the physical performance testing.

Intervention

The intervention for each group was performed by lead teacher, certified Bones for Life teacher/trainer, Cynthia Allen and assisted by a certified Bones for Life teacher. Table 4 outlines the exercises taught to the two groups. Each week, questions and comments were taken and class explorations were integrated to address those items. In addition, the table also identifies themes that were discussed throughout the 6-weeks. After the study, abbreviated homework notes were made available for all subjects so that they could carry on their explorations of the movement patterns on their own (Appendix D).

Post Intervention Interview

Following the reassessment of the physical performance measures and quality of life survey, subjects were individually interviewed by the lead teacher or Shereen Farber, PhD, certified Bones for Life teacher. Each subject was asked the same questions reflected in Table 3, and in the same order. Recorded answers from the videotape were then transcribed to a table so that qualitative analysis could be performed.

Data Analysis

Of the original 25, only 21 individuals completed the study shifting the mean age to 72 and the youngest participant’s age to 65. Contributing to attrition were illness,

Table 4. Class Curriculum: Movement Processes

Week 1	Introduction of safety principles and empowerment BOH Align neck, hand on sternum Align lumbar, shorten front Walking to front of chair and back—using a wrap to assist Intro of Roman Sandal in chair Spiral to stand from chair and slightly lower surface Stomp and HA in walking
Week 2	BOH with alignment Beginning of wave, feet on wall Partner Tango Spiral up and down from floor
Week 3	BOH with alignment Added aligning cervical with hand on neck Review of Week 1 and 2 Goat Skipping in chair Walking with foot stomp, HA! And seeing others
Week 4	BOH Knee bends kneed behind chairs Mini Wrap for BOH and Walking Tapping Pelvis Crossed Arms Spiral up and down from floor
Week 5	BOH with alignment Tantrum BOH in Rotation—this one was not taught in group 2 Mini Wrap Spiral up and down from floor
Week 6	Recap of all prior processes Knee Bends Knee at Wall Spiraling up and down fine tuned
Themes discussed during classes	Self-care Weight shift, fulcrums Alignment/neutrality—stacking of bones Proportional flexibility Dynamic balance Domino effect Awareness Multi-tasking Neuro-plasticity

Note: In addition to the movement processes, questions and comments were discussed each week.

Abbreviations: BOH, Bounce on Heels

Table 5. SF-36v2® Health Survey: Comparison of pre-post intervention

	Pre Intervention		Post Intervention		P value
	Mean	SD	Mean	SD	
SF-36 v2					
PF	80.5	18.6	80.7	18.9	.940
RP	82.7	19.9	81.5	25.4	.839
GH	78.6	15.4	82.6	15.4	.029
BP	73.3	23.4	73.7	22.7	.893
VT	64.0	14.1	69.0	13.9	.026
SF	89.9	24.9	84.5	23.3	.186
RE	89.7	15.3	88.5	18.0	.727
MH	78.8	11.8	82.4	12.4	.155
PCS	50.1	8.1	50.3	9.4	.924
MCS	52.9	7.3	53.6	8.3	.616

Note: For the 21 participants, there were significant increases on two scales in the SF-36-v2

Abbreviations: SD, Standard Deviation; PF, physical functioning; RP, role-physical; GH, general health; BP, bodily pain; VT, vitality; SF, social functioning; RE, role-emotional; MH, mental health; PCS, physical component summary; MCS, mental component summary.

Table 6. Physical Performance Measures

Performance Measures	Pre Intervention		Post Intervention		P value
	Mean	SD	Mean	SD	
Timed Up and Go	8.6	1.9	8.6	2.2	.981
360 Degree Turn	6.4	1.6	5.9	1.5	.006
20 Second Step Test	15.2	4.7	17.5	5.0	.001
Stand On One Leg	13.3	7.2	13.3	6.5	.983

Note: For the 21 participants, there was a significant increase in the number of steps during the 20 Second Step Test and a significant decrease in time to complete the 360 Degree Turn.

Abbreviations: SD, Standard Deviation.

hospitalization, transportation issues, and lack of interest. Paired *t* tests ($P = 0.05$ level of significance) were used to compare quantitative data between pre- and post-intervention. SF-36v2® Health Survey scores and performance measures at baseline and post-intervention are presented in Tables 5 and 6. Analysis of the post-intervention interview questions used a percentage based on the frequency of similar responses. Qualitative data from the interview questions is presented in Table 8. Evaluation of the performance measure data from the 12 subjects who were randomly assigned to a 6-week wait list showed no learning effect from the tests and is reflected in Table 7.

Results

For the 21 participants, Table 6, displays the two movement tasks used to assess dynamic balance that demonstrated the most sensitivity to change, the 360° Turn Test ($P = .006$) and the 20-Second Step Test ($P = .001$). Analysis of the SF-36v2® Health Survey, Table 5, shows significant improvements in Vitality ($P = .026$) and General Health ($P = .029$). Question 1, of the post-intervention interview questions found in Table 7, revealed that at least 50% of the subjects reported balance problems prior to the study. Question 2 showed that subjects reported significant improvement in two categories: Function and Balance.

Table 7. Wait List Control Pre-and Post-Testing

	Control (n = 12)		Control (n = 12)	
	Mean	SD	Mean	SD
PF	72.5	26.6	83.4	15.5
RP	81.8	16.9	82.8	15.8
GH	80.2	7.9	80.2	9.9
BP	71.8	19.0	74.3	15.6
VT	68.2	8.6	63.0	11.8
SF	95.8	8.1	91.7	28.9
RE	93.1	12.7	93.8	11.9
MH	84.6	8.9	81.7	10.5
PCS	47.5	6.3	50.2	6.2
MCS	57.3	6.3	54.3	7.3
Timed Up and Go	8.8	1.6	8.6	1.7
360 Degree Turn	6.2	1.6	6.0	1.5
20 Second Step Test	15.2	4.9	15.8	5.0
Stand On One Leg	11.6	6.0	13.3	6.9

Note: Comparison demonstrates no learning effect.

Abbreviations: SD, Standard Deviation; PF, physical functioning; RP, role-physical; GH, general health; BP, bodily pain; VT, vitality; SF, social functioning; RE, role-emotional; MH, mental health; PCS, physical component summary; MCS, mental component summary.

Definitions of the categories are listed in Appendix E. Question 3 asked participants to identify the benefits they gained from the Bones for Life program. The most common responses were function and posture. For example: “I get up easier from the floor”; “My posture is increasing and I am more aware of my posture so I am walking straighter”; and, “I have better balance and posture and can get up off of chairs and sofas easier.” In Question 4, subjects were asked to list qualities that made the Bones for Life program different than other movement or exercise classes. Subjects cited both the learning of functional applications and quality of results as the most interesting aspects of the class: “this is a multi-faceted and covered a wide range of areas. It addressed many people’s problems...increased awareness, strength and stretching, all these things work together. I was moving better because things were working together”; “it has done more in 6 weeks than I ever had in other classes”; “...exercise class is more repetitive. Here you learn functional things like how to walk, balance”; and “This class taught me easiest way to do things”. Video Link 1 (<https://youtu.be/HtnWq7pi8pE?list=UUe11Wvh9AhlNqK8jOeG0oIA>)

Discussion

Physical Performance Measures

Following the Bones for Life intervention, Table 6 reflects subjects could execute the 360° Turn Test more quickly and could complete more repetitions in the

Table 8. Post-Intervention Interview Summary

Question	%
Q.1 Describe your ability during functional activity to balance before taking this class. Did you have problems? If so, what kind	57.1
Q.2 Compare your balance during functional activity now that you have taken this class. Can you do more?	
Pain Relief/Comfort	36.8
Flexibility	15.8
Posture	47.4
Function	79.0
Balance	57.9
Subcortical	15.8
Cognition	31.6
Emotional	36.8
Awareness	47.4
Vitality	15.8
Q.3 What benefits did you gain from this class?	
Pain Relief/Comfort	21.0
Flexibility	5.3
Posture	52.6
Function	73.7
Balance	26.3
Subcortical	15.8
Cognition	10.5
Emotional	15.8
Awareness	31.6
Vitality	10.5
Q.4 What about this class seemed most interesting compared to other movement/exercise classes?	
Instructor quality	26.3
Pacing	15.8
Instruction clarity	5.3
Functional application	31.6
Anatomy	10.5
Unique	26.3
Depth	21.0
Active learning	31.6
Quality of results	42.1

Note Percentage answering yes or spontaneously providing a response that fits the listed category.

20-Second Step Test despite medical history and activity diversity among the subjects. It is reasonable to expect that subjects with prior and/or current physical challenges and positive fall histories would experience change or improvement after the class. However, *both* the participant with the lowest level of function (difficulty navigating to and from the floor or climbing stairs) and a medical history of post-polio syndrome Video Link 2 (<https://youtu.be/cFCSot4L1PI>) and the highest functioning participant (bicyclist and preparing for a 50-mile walk) demonstrated measurable improvement Video Link 3 (<https://youtu.be/sRvtBDuMifA>). The results can be understood as the Bones for Life program challenges long-standing habitual and inefficient movement patterns

by learning and practicing the elements involved in transitional movements. For example, floor to/from standing and sit to/from stand using a spiraling motion; turning; rolling; lateral exploration of weight-shifting and weight-bearing through different aspects of the feet. It is possible, therefore, that quality function vs. dysfunction is primarily informed by organized vs. disorganized movement patterns.

Unilateral standing is necessary to complete both the 360° Turn Test and the 20-Second Step Test. However, a shorter unilateral stance time during the 360° Turn Test allows subjects to use their non-stance leg for temporary support sooner. Improvements in the 360° Turn Test and the 20-Second Step Test were not dependent on targeted muscle strengthening or specific joint range-of-motion exercises, but rather on the use of various positions and novel movement activities like unsupported sitting with unilateral weight-shifting; lying on the back and pressing a foot on the wall; rolling with hand-eye coordination; standing and bouncing on the heels; general movement patterns that facilitate lateral bending and rotation of the trunk; and spiraling movements of the extremities in reference to an imaginary center line. The somatic exploration of movement patterns appears to provide neuromuscular improvement and perceived sense of strength due to neurogenic changes (increased rate of nervous system response due to repetition of each muscular effort) rather than myogenic changes (structural changes to the dimension and composition of the muscle). Efficient alignment patterns of the lower extremity, trunk and head would allow subjects to sustain a smaller base of support with reduced postural sway and musculoskeletal demand. This is critical for seniors, as reduced ability to balance and increased fall risk are observed in challenging postural tasks that require a smaller base of support, like single-leg vs. bipedal stance.¹⁵

Quality of Life Measures

The SF-36v2® Health Survey is a 36-question subjective assessment of an individual's perceived health status. Although not intended to be a comprehensive health survey, it reflects two broad components or aspects identified as Physical and Mental Component Summary measures. The broad components are then subdivided into eight domains that profile functional health and well-being.¹⁶ The survey is not designed to target a specific age, disease, or treatment group (although there is some evidence to suggest that it may demonstrate a greater sensitivity to change in elderly women).¹⁷ reliability and validity of the SF-36 and Euroqol on an elderly female population, and to compare them with the OPCS Disability Survey. Three hundred and eighty women aged 75 and over participated in a randomized controlled trial of the use of clodronate provided the sample. As part of the trial, patients were asked to complete the UK SF-36 and Euroqol, and the OPCS disability survey instrument administered by

interview in a hospital clinic at baseline. A random subsample of respondents were retested six months later. The SF-36 achieved poorer levels of completion by dimension (68.1%-88.9%) The SF-36v2® Health Survey has also been shown to be a practical and valid instrument in community-dwelling populations over the age of 65.¹⁸

Table 5 identifies significant improvements in Vitality ($P = .026$) and General Health ($P = .029$) and a strong tendency in Mental Health ($P = 0.155$). The Vitality domain (VT) is defined as the measure of energy level and fatigue. Low scores indicate feeling tired or worn out. High scores indicate feeling full of energy all or most of the time.¹⁹ The General Health domain (GH) is defined as the measure of overall health, including current and prior health, health outlook, and resistance to illness. Low scores indicate general health as poor and likely to worsen. High scores indicate general health as favorable, even excellent.¹⁹ The Mental Health domain (MH) is defined as the measure of perceived anxiety level, depression, loss of behavioral/emotional control, and psychological well-being. Low scores indicate frequent feelings of nervousness and/or depression. High scores indicate feeling peaceful, happy, calm, and full of energy all or most of the time.¹⁹

Results of the SF-36v2® Health Survey statistically validate and quantify a commonly-reported response that participants in Bones for Life classes describe: a confident sense of well-being and a feeling of vitality and happiness. The term *quality of life* has been examined in various settings, from international development to politics to healthcare. Customary indicators of quality of life include not only wealth and employment, but also environmental, physical and mental health, level of education, recreational and leisure time, and sense of social belonging.

Upon completion of a Bones for Life class, instructors often report that participants express a significant change in energy level, noting less fatigue, and more energy. The SF-36v2® Health Survey categorizes this as Vitality and Mental Health. Ruthy Alon, Bones for Life creator, refers to it as *Biological Optimism*, which is an intrinsic and often unexpected outcome for participants in Bones for Life classes. Alon defines *Biological Optimism* as a somatically-sensed feeling of inner joy.²⁰ Most subjects openly expressed positive changes in their perception of Vitality and Mental Health. They describe feeling peaceful, happy, calm, and energized. In this pilot study, these sentiments are reiterated in the post-intervention videotaped interviews and the written survey.

Improvement in the SF-36v2® Health Survey category, General Health, demonstrated significant high scores of improved health outlook and overall perception of health following the Bones for Life intervention. Closer examination of personal medical history questionnaires revealed interesting trends in general health, past medical histories, and social profiles. There was a wide range of challenges reported on the questionnaires, including

post-polio syndrome, plantar fasciitis, COPD, thyroid dysfunction, history of cancer with treatment, surgeries, fall history, and history of vertigo. Likewise, there was a range of reported activity levels, from no regular walking or exercise to one participant in training for a 50-mile walk. All subjects were similar in the diagnostic areas of cardiac, diabetes, tendonitis/bursitis, osteoarthritis and degenerative spinal disorders, and no subject was dependent on a walking aid. Despite the diversity in general health, positive effects were seen among participants in a very short time (median class attendance was 5 sessions). Old injuries and inefficient movement patterns are often associated with osteoarthritis, tendonitis, bursitis, and degenerative spinal disorders. A tenet of somatic education includes movement awareness at various speeds, often slow paced, and in relationship with breath cycle. As noted in the discussion section of Physical Measures, the Bones for Life curriculum brings mindfulness to long-standing habitual and inefficient movement patterns. Like improvements in Physical Measures, improvement in overall perception of general health may be due to changes in ineffective and disordered movement patterns resulting in increased function since medical history and diagnoses remained the same throughout the program.

Post-Intervention Interviews: Primary Benefits Balance vs. Function

Response time and maintaining balance during physical tasks like walking and reaching are essential requirements for independent living. At least 50% of the subjects reported having balance problems prior to the study, describing themselves as “not having good balance” or having “poor balance.” When asked specifically to compare their balance during functional activity following the Bones for Life class, 90% of the subjects reported improvement. Examples of transcribed statements from subjects during the interview include: “I don’t need to hold onto the back of the chair to stand”; “I am walking straighter with improved balanced”; “I have increased confidence in my balance because I have more knowledge on how my body works. I may not look more balanced to an outsider but I feel more balanced”; “I can walk better without tripping or stumbling”; “I feel better about myself and can stand on one foot”; “I can climb on a step stool without holding on”.

More impressive, “improved balance” was not the primary perceived benefit of the Bones for Life class. Functional gains and carryover into daily activities were the top-cited benefits of the class (79%). Even the subject that reported no change in balance reported that it was easier to “get out of a chair” following the class. Also cited was the ease and ability to get down and up from the floor. This is certainly plausible, as it is one of the central functional themes of the Bones for Life program.

Additional reported benefits of the class included functional outcomes like reaching into cabinets, climbing

stools/ladders, changing light bulbs, and hanging clothes. Improvements in recreational activities such as walking programs (increased speed, confidence, and improved postural alignment) and playing golf (improved stance, swing, and better ability to concentrate during play) were noted as well. This was an unpredicted carryover effect as these specific functional activities were not included nor practiced in the program.

Subjects were not given exercises to do outside of class, but many reported sharing their learning with others outside of the group participants. Specifically, one subject could use methods taught in the class to help a neighbor get up from the ground after a fall.

Posture

Posture was the second-most important perceived benefit noted during post-intervention interviews. Research on body language and the influence of non-verbal communication between individuals is not particularly new. However, what *is* new in the field of social psychology research is how the human body, when assuming certain postures or poses, can influence a person—literally changing minds, behaviors, and even outcomes in life.^{21–24} Despite the lack of formal postural analysis, a review of class videos and interview transcriptions revealed that participants used consistent and repetitive language to describe their psychological changes during the study such as increased confidence with a more upright and skeletally aligned posture after the class Video Link 5 (<https://youtu.be/CTh62Vb30Kw?list=UUe11Wvh9AhlNqK8jOeG0oIA>). Although these empirical responses had already been experienced by the instructors personally and observed in other Bones for Life classes; the repetitive comments on class benefits reflecting this was a corroborated finding.

Clinical Applications

The novel and exploratory somatic learning platform in the Bones for Life® program has the potential for practical application in several rehabilitation fields. Improved sitting, standing, and walking postures are foundational in all therapeutic disciplines. In human movement, variability or, normal variations that occur in motor performance across multiple repetitions of a task,²⁵ is a natural and essential attribute. The importance of variability is recognized in the professional fields of movement science, neuroscience, and (most recently) physical therapy, suggesting that variations in human movement are necessary for function.²⁶ Movement variability, as it relates to motor learning and health, may account for why participants in this pilot study reported improvement in chronic aches and pains and an increased comfort level with movements in and outside the classroom.

Changes in performance measures, the TUG and standing on one leg are often used in traditional clinical performance testing. In this pilot study, neither were statistically significant. However, the unconscious impact

and carryover of the exercises influencing improvement in other areas of mobility (walking, changing and maintaining body positions, and carrying and handling objects) are very promising and worthy of additional research. This is especially true, given the U.S. based 2012 Middle Class Tax Relief and Jobs Creation Act, Section 3005(g) mandating that all outpatient rehabilitative disciplines seeking Medicare reimbursement use Therapy Functional Reporting, or G-codes.²⁷

Limitations of Pilot Study

As in all studies, the importance of choosing and identifying the best functional assessment tool is critical, especially when there are significant variations of functional capacities among the participants. In this pilot study, it was challenging to identify the best physical performance measure prior to the study. Although not “frail,” the subjects in the study demonstrated disparate functional capacities, from “high functioning” (preparing for a 50-mile walk) to “transitional” (struggling to ascend/descend stairs and getting down/up from the floor), and they reported a wide range of medical backgrounds (post-polio syndrome, COPD, plantar fasciitis, and partial right-arm paresis). The selected tests were not sensitive enough to effectively capture the ability and needs of all the participants in this pilot study. A functional assessment scale that may be more appropriate in future studies would be the Time Movement Battery in which the researchers could select items from a wider range of activities.²⁸ Visible positive changes in participant’s functional and postural capacities were observed even though the changes were not reflected in their performance scores, but in the qualitative data. Recent articles in *Physical Therapy* recommend exploring the efficacy of performance-based mobility tools that can be applied to a wide spectrum of older adults (especially community-dwelling seniors)²⁹ such as the Modified Gait Efficacy Scale³⁰ and the Tandem Stance Tests of Balance³¹ but protocols are not standardized. Objective The purpose of this study was to explore the impact of: Overwhelming, in this pilot study, subjects reported the function of getting down to and up from the floor as an important aspect of the class. It allowed them to complete tasks they previously could not, and it allowed them to perform tasks more easily, quickly, and effectively. A reliable and valid test to measure capacity for getting down to and up from the floor is needed in the collection of standardized testing for dynamic balance and mobility.

Possible Further Investigation

Regarding improving the reliability and validity of this pilot study, future design recommendations include a randomized control group with matched crossover design (both arms having the same characteristics and variables), including 6 weeks of normal daily activity. This should help answer two questions with more clarity: (1) Is the Bones for Life class more effective than routine activity?

and (2) Do benefits gained from Bones for Life classes fade over time, or do they last for at least 6 weeks (average class length) after formal class participation?

Compared to females, participation of men in group settings for exercise is not as common. Since males tend to participate in individual activities or competitive group activities, active recruitment and explanation of potential benefits gained by participating in a program are needed to eliminate gender bias and the lack of male participants (3 Males vs 22 Females) as was seen in this pilot study. However, it would also be interesting to observe the results of a study limited to all women bringing a broader generalizability to the group.

Conclusions

This pilot study exhibited positive effects among community-dwelling seniors with diverse physical capabilities and medical challenges. With minimal expense, participants achieved improvement in function and balance after 6 weeks of Bones for Life classes. Evidence suggests that Bones for Life increases the stability of organized single-leg stances during movement and successfully carries over into more challenging postural tasks that require a smaller base of support, like walking, turning, reaching, and climbing. Participation in Bones for Life classes has a positive influence on quality of life indicators like peace, happiness, calmness, and increased energy. This pilot study serves as a call for funding and a footprint for further investigation. It also highlights the need to research alternative approaches to movement and activities used to improve function and balance that meet the demands of the aging population and complement the current medical model.

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Appendix A. General health questionnaire

Medical History Form

Name: _____ Date: _____

Gender: Male Female Date of Birth: _____

Your answers on this form will help us define the current health state of our research group and understand that pre/post assessment results in relationship to that health state of the research group. Best estimates regarding dates are fine. Thank you!

Medications: Prescription and non-prescription medicines, vitamins, home remedies, herbs:

Medication	Dose	Times per Day

I have had a Bone Mineral Density Test Yes No

If yes, date (most recent date) _____ Office/Place Tested _____

Location where density was measured (wrist, heel, hip, lumbar) _____

My results were: Normal At Risk (osteopenia) High Risk (osteoporosis)

In the past year, have you fallen or unexpectedly ended up with any part of your body coming into contact with the ground or floor? (If yes, how long ago. Describe in a sentence how it happened)

Complete this statement:

I am able to stand without aid (holding onto a cane, walker, leaning against a chair or another individual) (*circle the one that best fits*) <10 min 10 min. 15 min. 20 min. or longer

I use the following:

Prescription eye glasses/contacts? no yes

A hearing aid? no yes

A foot orthotic in my shoe? no yes

A walking aid? no yes

If female, my menopausal state is

pre (menses monthly)

peri (starting into menopause; menses periodically)

post (have not had menses in two years)

Review of Systems: Please check (✓) any current problems that you have:

Fevers/chills/sweats

Heart Palpitations

Anxiety/stress

Unexplained weight/loss gain

Cough/wheezing

Problems with sleep

Fatigue/weakness

Difficulty breathing

too much

Excessive thirst or urination

Muscle/joint pain

too little

Change in vision

Headaches

Depression

Difficulty hearing/ringing in ears

Dizziness/light-headedness

Other (please specify)

Problems with teeth/gums

Numbness

Chest pain/discomfort

Memory loss

Leg pain with exercise

Loss of coordination

For those items you have checked, please provide a sentence or two of additional information:

Appendix A. (continued)

Personal Medical History:

Please indicate (✓) whether you have had any of the following medical problems with approximate date of illness or diagnosis.

- | | | |
|---|---|---|
| <input type="checkbox"/> Osteoporosis (brittle bones) | <input type="checkbox"/> Depression | <input type="checkbox"/> Musculoskeletal injuries or problems
(low back pain, herniated disc, broken arm,
fractured ankle, frozen shoulder, etc.) |
| <input type="checkbox"/> Osteopenia | <input type="checkbox"/> Alcoholism | <i>specify type</i> _____ |
| <input type="checkbox"/> Congenital Heart disease:
<i>specify type</i> _____ | <input type="checkbox"/> Other chemical dependency
<i>specify type</i> _____ | <i>specify type</i> _____ |
| <input type="checkbox"/> Myocardial Infarction (heart attack) | <input type="checkbox"/> Polio | <i>specify type</i> _____ |
| <input type="checkbox"/> Hypertension (high blood pressure) | <input type="checkbox"/> Cerebral Palsy | Balance disorder (tinnitus, ringing in ears,
vertigo, loss of balance) |
| <input type="checkbox"/> Diabetes | <input type="checkbox"/> Alzheimer's disease | <i>specify type</i> _____ |
| <input type="checkbox"/> Stroke | <input type="checkbox"/> Dementia | Other unlisted disease/chronic symptom:
<i>specify type</i> _____ |
| <input type="checkbox"/> Thyroid Problem
<i>specify type</i> _____ | <input type="checkbox"/> Muscular Dystrophy | |
| <input type="checkbox"/> Cancer (malignancy)
<i>specify type</i> _____ | <input type="checkbox"/> Parkinson Disease | |
| Did you receive chemotherapy? _____ | <input type="checkbox"/> Dystonia | |
| Did you receive radiation? _____ | <input type="checkbox"/> Fractures in adult life | |
| | Specify age and location _____ | |

Surgical History (please list all prior operations and dates):

Operation	Date

Social History

Substances:

Cigarettes (check one)

- Quit: Date _____
- Never
- Current Smoker: packs/day _____ # of yrs. _____
- Other Tobacco: _____

Do you drink alcohol? Yes No

If yes, # of drinks per week _____

Exercise:

Do you exercise regularly?

Specify type: _____

of times per week _____

of minutes per episode: _____

Family History (to the best of your knowledge):

- My mother had/has osteoporosis
- My father had/has osteoporosis
- My grandmother had/has osteoporosis
- My grandfather had/has osteoporosis

Appendix B. SF-36v2™ Health Survey

This survey asks for your views about your health. This information will help you keep track of how you feel and how well you are able to do your usual activities.

Answer every question by selecting the answer as indicated. If you are unsure about how to answer a question, please give the best answer you can.

1. In general, would you say your health is:

Excellent	Very good	Good	Fair	Poor
<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

2. Compared to one year ago, how would you rate your health in general now?

Much better now than one year ago	Somewhat better now than one year ago	About the same as one year ago	Somewhat worse now than one year ago	Much worse now than one year ago
<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

3. The following questions are about activities you might do during a typical day. Does your health now limit you in these activities? If so, how much?

	Yes, limited a lot	Yes, limited a little	No, not limited at all	
a Vigorous activities, such as running, lifting heavy objects, participating in strenuous sports	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	
b Moderate activities, such as moving a table, pushing a vacuum cleaner, bowling, or playing golf	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	
c Lifting or carrying groceries	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	
d Climbing several flights of stairs	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	
e Climbing one flight of stairs	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	
f Bending, kneeling, or stooping	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	
g Walking more than a mile	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	
h Walking several hundred yards	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	
i Walking one hundred yards	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	
j Bathing or dressing yourself	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	

4. During the past 4 weeks, how much of the time have you had any of the following problems with your work or other regular daily activities as a result of your physical health?

	All of the time	Most of the time	Some of the time	A little of the time	None of the time
a Cut down on the amount of time you spent on work or other activities	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
b Accomplished less than you would like	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
c Were limited in the kind of work or other activities	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
d Had difficulty performing the work or other activities (for example, it took extra effort)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

5. During the past 4 weeks, how much of the time have you had any of the following problems with your work or other regular daily activities as a result of any emotional problems (such as feeling depressed or anxious)?

	All of the time	Most of the time	Some of the time	A little of the time	None of the time
a Cut down on the amount of time you spent on work or other activities	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
b Accomplished less than you would like	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
c Did work or activities less carefully than usual	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

6. During the past 4 weeks, to what extent has your physical health or emotional problems interfered with your normal social activities with family, friends, neighbors, or groups?

Not at all	Slightly	Moderately	Quite a bit	Extremely
<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

7. How much bodily pain have you had during the past 4 weeks?

None	Very mild	Mild	Moderate	Severe	Very severe
<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

8. During the past 4 weeks, how much did pain interfere with your normal work (including both work outside the home and housework)?

Not at all	A little bit	Moderately	Quite a bit	Extremely
<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

9. These questions are about how you feel and how things have been with you during the past 4 weeks. For each question, please give the one answer that comes closest to the way you have been feeling.

How much of the time during the past 4 weeks...

	All of the time	Most of the time	Some of the time	A little of the time	None of the time
a Did you feel full of life?	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
b Have you been very nervous?	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
c Have you felt so down in the dumps that nothing could cheer you up?	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
d Have you felt calm and peaceful?	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
e Did you have a lot of energy?	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
f Have you felt downhearted and depressed?	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
g Did you feel worn out?	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
h Have you been happy?	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
i Did you feel tired?	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

10. During the past 4 weeks, how much of the time has your physical health or emotional problems interfered with your social activities (like visiting friends, relatives, etc.)?

	All of the time	Most of the time	Some of the time	A little of the time	None of the time
<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

11. How TRUE or FALSE is each of the following statements for you?

	Definitely true	Mostly true	Don't know	Mostly false	Definitely false
A I seem to get sick a little easier than other people	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
B I am as healthy as anybody I know	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
C I expect my health to get worse	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
D My health is excellent	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

Thank you for completing these questions!

Appendix C Specific written script

We will be doing a series of assessments, many of which are timed for speed. Prior to each assessment, I will read the instructions completely. Then you will have an opportunity to ask questions. In some cases, you will also get a practice. Some assessments are done more than once. Rests will be inserted throughout. You are free to ask for additional rests as you need.

Timed Up and Go

Instructions: When I say go, you will stand up from the chair, walk as quickly and safely as possible crossing the blue line with both feet, turn around, walk back to the chair and sit down. I will be timing you for speed and will stop timing when your back is against the chair. Your start cue will be “Ready, set go.” We will be doing this 3 times. One as practice and two that will be timed with rests in between.

Step Test

Instructions: This test is timed for speed. Place the entire foot alternately on the step/stool as many times as you can in 20 seconds. I will tell you when to stop.

Turn 360 Degrees

Instructions: This test is timed for speed. Turn around in a full circle. Pause. Then turn a full circle in the other direction.

Standing on One Leg

Instructions: Please stand on one leg as long as you can, without holding on to an external support. You may choose the leg you wish to start with.

Appendix D. Homework Notes – Sample Bones for Life® Research Group

These notes appropriate only for those who have taken the class. They are highly abbreviated and you will still need to use your memory and own internal wisdom to guide you to the best outcome.

Follow these safety tips

Use only 20% or less effort or pressure. Do nothing that hurts. Use small, gentle movements; even try doing the movement in your imagination. Use a chair or the wall for balance. Set yourself up for a good and safe outcome. Remember your goal is to learn to move more intelligently.

Bouncing on Heels with vocalization: Pum, Pum

Use a light, quick rhythm so you do not land hard on your heels. Knees are not locked nor are they bent but in a state of readiness.

Aligning the low back (lumbar spine) by passively shortening the front

Hands hold tissues of the lower belly and lightly pull the hands up. In this position, send movement through the alignment such as Bounce on Heels, walking in place, or running in place.

Aligning the neck (cervical spine) by using the hand on the chest

Press the breastbone up and back as you breathe out. In this position, send movement through the alignment such as Bounce on Heels, walk and then run in place.

Walking the Buttocks/Sitting Bones forward and back on the chair.

Play with two options:

- 1) Use the feet to press the floor to lift each buttock.
- 2) Lift each buttock without much involvement from feet.

Roman Sandal Seated in Chair

Sit at front of chair, slide one foot back until the heel rises from the ground and you find more weight is resting on the ball of the foot. Press through the Roman Sandal and train the counter pressure to move up the spine. When done well, the hip on the same side will lift and your weight will shift to the other buttock/sitting bone. When you press the foot, the knee will go down and the hip rises. You can also play with finding pressure through the line of each toe in sitting as you did in Roman Sandal at the Wall.

Appendix D. (continued)

Stamp and Ha

Walk in a 4-count rhythm. On the 4th count make a stamp, landing on bent knee and press down through the front of the heel so the counter pressure will stream up helping you get taller as the knee is straightened. Add saying HA! as you stamp. Watch that you get taller with good alignment of your neck and do not strain forward with the chin. The HA should come deep from the belly

Roman Sandal at the Wall

Position: Hands lightly on the wall about shoulder height and width apart. Nice to do barefoot.

- Select a foot you want to improve.
- Using a straw or pencil, place along the length of each toe (inserting as far back as where the root of the toe begins at the ball of the foot). Balance your weight so it is mostly on the foot you want to improve (the other foot can just be toe/ball touching with heel raised, if comfortable). Both knees are bent.
- Following the direction of the toe/straw and while straightening your knees, raise yourself up.
- Come back down and as soon as that heel grazes the floor, bend both knees. Sink your weight down a little with bent knees and weight more in the direction of the heels.
- This should not feel like a lot of work in the calves or shins. If it does, don't lift so high and be sure you don't hold the position.
- Only do a couple of movements along each toe and then finally along the line of the Roman Sandal (where a thong in a thong sandal or flip flop, would go).



Spiral to Stand –from the floor, other heights including a chair.



Cross your legs lightly. Lean on the hand on the same side that the foot is closest to your pelvis. Look at the other hand which is extended out to the side and swing it around.



Watch the hand until it lands close to the hand you are leaning on. Look down at the hand and let your weight shift to that sitting bone.



Distribute even pressure through the two hands and the outside standing foot so you can drag your buttocks/pelvis back and up into the air without leaning on your knee. This will also allow you to flex under the inside toes and provide leverage against the floor. Turn the heel of that foot around the weight bearing flexed toes.



As you spin around, bring the buttocks/pelvis up and let the head hang down toward the floor.



As you stand up think of dropping the buttocks/pelvis, like a teeter totter, and allow the trunk and head to come up.

You will be standing and facing the opposite direction of where you started.



Appendix E Qualitative Definitions of Post Interview Categories

Eleven categories describing how subjects defined their experience during the study were derived or modified from definitions.net, the Merriam-Webster Dictionary, and the post-intervention interview.

1. **Awareness:** The kinesthetic knowing about one's self and one's relationship to the environment.
 2. **Balance:** The dynamic state or condition where all regions of the body are functionally aligned so that the center of gravity is over the base of support and the body can adapt to the changing conditions of the environment. There is equilibrium among the parts.
 3. **Cognition:** The act or process of knowing through perception, learning and reasoning.
 4. **Emotional:** The affective aspect of consciousness subjectively experienced as a feeling often accompanied by a change in physical state.
 5. **Flexibility:** The capacity to easily shape, bend, and adapt to variable requirements.
 6. **Function:** Improved performance or a newfound capacity to perform an activity for a specific purpose.
 7. **Negative Response:** An adverse reaction that occurred during the process of the study.
 8. **Pain/Comfort Continuum:** The self-reported description of bodily sensation ranging from acute or chronic distress to comfort/ease.
 9. **Posture:** The arrangement of the body and limbs in relationship to gravity.
 10. **Sub-cortical:** When a motor act is integrated within the Central Nervous System so that it occurs automatically without need of conscious/cortical processing.
 11. **Vitality:** The sensation and confidence that one can accomplish what one needs and/or desires to do throughout the day.
-

Appendix F.

In this Bones for Life class, a length of fabric, slightly less than 6 meters in length and 114 cm wide, was used. The traditional wrap in most classes is 7 1/2 meters. A shorter length was used to reduce fall hazard and to help make the management of the fabric easier.

Holding the ends of the fabric, the hands slide up the fabric to locate the midpoint of the cloth. The subject places the midline of the fabric around posterior side of the buttocks, as if getting ready to make a sling for the buttocks/pelvis. Time is taken to confirm that the width of the fabric extends from the top of the boney pelvis to most inferior aspect of the hip joints/greater trochanters.

The two ends of the fabric are then brought to the front of the pelvis where they are pulled tight, crossed and then twisted. They are instructed to repeat this process a few times to get the feeling that the hip joints and pelvis are firmly held together. While holding onto the knot, one end is slung over one shoulder, the other end of the fabric over the other shoulder. Grasping the ends of the fabric that are near the hip joints/greater trochanters, the ends are pulled downward on each side providing a slight tension that encourages upright posture.

Various standing and walking exercises (homo and contralateral walking, tall posture and ground reaction force exercises), are explored during this wrap configuration to clarify the relationship of each side of the pelvis to the shoulder while experiencing a sustained sense of a hip and sacral joints compression.

The wrap is slowly removed with the same care in which it is applied to allow the sensation of tallness and a well-aligned pelvis to remain during the first moments of standing and walking.