

## **Background**

Strategically implemented exercise can improve movement patterns, improve function, decrease pain, increase strength, reduce or slow bone loss, and decrease falls risk all of which can lower the risk of bone fracture from osteoporosis.<sup>1</sup> Watson et al.<sup>1</sup> conducted a randomized control trial (RCT) for postmenopausal women with osteopenia and osteoporosis. The exercise group participated in a high intensity resistance and impact training program for 30 minute sessions, two times a week for eight months.<sup>1</sup> For the first month, a physical therapist led the participants in body weight or low-load full body exercises to learn the appropriate movement patterns.<sup>1</sup> In the following months, subjects completed the following workout: a warm-up of 2 sets and 5 repetitions for 50-70% 1 repetition maximum (1RM) deadlifts; resistance training with deadlifts, overhead press and back squat for 5 sets of 5 repetitions at 80-85% 1RM; and impact loading with jumping chin-ups with the bar at 90 degrees elbow flexion in standing.<sup>1</sup> Significantly less participants in the exercise group lost bone mineral density (BMD) in the femoral neck (FN) and lumbar spine (LS) compared to the control group that did not exercise.<sup>1</sup> The majority of participants maintained or gained bone mineral density while the control group did not.<sup>1</sup> There was significant improvement with lower extremity (LE) strength, back extensor strength, kyphotic posture, Timed up and go (TUG), 5 time sit to stand (5xSTS), functional reach test (FRT), and vertical jump.<sup>1</sup> One participant strained a muscle related to the program and seven participants had unrelated falls.<sup>1</sup> All eight of these patients who had adverse events were able to return to the exercise program.<sup>1</sup>

In addition to resistance training, other studies<sup>2,3</sup> have shown balance training is quite effective in reducing falls risk in people with osteoporosis. Smulders et al.<sup>2</sup> used balance training activities that included an obstacle course with uneven terrain, dimmed lighting, cognitive tasks, stepping stones, and reaching; and walking exercises with change in direction or speed with quick starts and stops. Smulders et al.<sup>2</sup> also did weight bearing exercises including lifting strategies, stairs, reaching with spine extension, and sit to stands. Additionally, participants were instructed on correcting gait abnormalities and trained in fall techniques.<sup>2</sup> This program was conducted in 11 sessions over 5.5 weeks during 60-150 minute sessions.<sup>2</sup> The exercise group in this study had a fall rate of 39% lower than the control group 1 year after the program ended.<sup>2</sup> In the exercise participants that did fall over the next year, they sustained significantly less injuries than the control group.<sup>2</sup> The exercise group also showed significant improvement on the Activities-specific Balance Confidence scale for balance while the control group did not.<sup>2</sup> There was also significant BMD improvement in the FN and LS in the exercise group after treatment compared to before treatment and compared to the control group.<sup>2</sup>

Madureira et al.<sup>3</sup> also included balance training in their RCT aimed to reduce falls risk in participants with osteoporosis. After a 15 minute warm-up consisting of head rotations, shoulder rotations, stretching of the upper and lower extremities, and 15 minutes of walking with upper extremity movement, 30 minutes of balance training was conducted.<sup>3</sup> Balance training included standing in dynamic and static positions, walking in tandem, walking on toes then heels, walking sideways, walking while raising one leg with the contralateral arm, and single leg stance.<sup>3</sup> These one hour sessions took place

one time per week for 40 weeks.<sup>3</sup> Participants that participated in the intervention group had significant improvement on the Berg Balance Scale, Clinical Test of Sensory Interaction on Balance, and number of falls in the following year compared to the control group.<sup>3</sup>

In addition to exercise, education plays a large role in fall and fracture prevention by way of promoting self-management and self-efficacy.<sup>4,5</sup> Lopez-Olivo et al.<sup>4</sup> compared effects of self-review of a multimedia tool to a printed booklet to educate participants with osteoporosis or at risk of developing the disease on osteoporosis, risk factors, prevention, and management. Knowledge about osteoporosis, decisional conflict, and disease management improved significantly for both groups measured by the Osteoporosis Patient Knowledge Questionnaire, Decisional conflict Scale, and the Effective Consumer Scale.<sup>4</sup> Self-efficacy did not improve significantly for either group as observed via the Osteoporosis self-efficacy scale.<sup>4</sup>

Perhaps use of a more individualized educational method would have improved self-efficacy in this study as seen in the RCT by Nahm et al.<sup>5</sup> In this study, effects of Social Cognitive Theory on hip fracture prevention was examined. The intervention group in this study was provided with structured modules and a discussion board monitored by someone trained in Social Cognitive Theory while the control group was provided a website with lists of resources to explore.<sup>5</sup> Topics covered in both groups were knowledge of osteoporosis, hip fracture risk, importance of calcium intake and exercise.<sup>5</sup> Both groups improved knowledge of osteoporosis and calcium-efficacy via the Osteoporosis Knowledge Test, 8-Item Hip Fracture knowledge test, and the Osteoporosis Self-Efficacy for Calcium Intake scale.<sup>5</sup> Neither group improved their

exercise self-efficacy.<sup>5</sup> While both groups improved similarly in the short term, higher use of the Social Cognitive Theory based discussion group significantly correlated with 3-month follow-up self-efficacy in exercise, calcium consumption, and osteoporosis knowledge.<sup>5</sup>

The Berg Balance Scale (BBS), Occiput to Wall Test (OWT), and the Osteoporosis Patient Knowledge Questionnaire (OPQ) are appropriate outcome measures to examine effectiveness of this program which aims to decrease risk of falls and fractures as well as improve knowledge of osteoporosis management. The BBS was created to measure functional balance and has excellent psychometrics in doing so for older adults.<sup>6</sup> A score of <47 indicates a patient is at high risk of falls and a score <40 indicates a patient is at almost 100% risk of falls.<sup>6</sup> In RCTs by Madureira et al.<sup>3</sup> and Miko et al.,<sup>7</sup> higher BBS scores paralleled with decreased number of falls in the year following intervention.

The OWT has good validity and reliability for determining hyperkyphosis which is a risk factor for vertebral fractures.<sup>8,9</sup> In fact, pain and a positive test for hyperkyphosis may indicate a present vertebral fracture.<sup>9</sup> In this test, if the occiput touches the wall, no kyphosis is present; if the occiput is 0-4 cm away from the wall, poor posture is indicated; 5+ cm distance from the occiput to the wall indicates hyperkyphotic posture.<sup>9</sup>

The OPQ was created to evaluate knowledge of osteoporosis.<sup>4,10</sup> It has a reliability coefficient of 0.84.<sup>10</sup> This is a 20 question test that varies from low to high difficulty in areas including information, risk factor, investigation, consequences, and treatment.<sup>10</sup> Each question supplies four possible answers.<sup>10</sup> A correct answer choice

scores a 1, an incorrect selection scores a -1, and an answer choice “I don’t know” scores a 0.<sup>10</sup> After reviewing osteoporosis educational materials , participants scored statistically significantly better on the OPQ posttest compared to the pretest.<sup>4</sup>

## Program Goals

1. At the end of the 12-week program, participants will improve their initial Berg Balance Scale (BBS) score by the minimal detectable change (MDC) to indicate improved functional balance and decreased risk of falls

BBS Initial Score	MDC
0 - 24	4.6
25 - 34	6.3
35 - 44	4.9
45 - 56	3.3

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2. At the end of this 12-week program, participants will maintain or improve their original Occiput to Wall Test distance to indicate decreased risk or no change in risk of vertebral fracture<sup>8,9</sup>
3. At the end of this 12-week program, participants will improve their baseline Osteoporosis Knowledge questionnaire to  $\geq 12$  points to demonstrate improved knowledge of osteoporosis<sup>4</sup>
4. One year following the end of this program, participants will sustain less falls (if  $\geq 1$  fall) than the year prior to the program <sup>1</sup>
5. One year following the end of this program, participants will report consistent exercise and nutritional supplementation based on their individual program goals<sup>5</sup>

## **Methods**

This free Osteoporosis Community-Based Health Program will be holding two informational/enrollment sessions 1-month and 2-weeks prior to the start date for community members at risk of or diagnosed with osteoporosis. The attendees will be given information on the program schedule, program leaders, program interventions, and program importance. Prospective participants will also be able to meet the program leaders and volunteers at these sessions. The program leaders will be two licensed local physical therapists, 3-5 local student physical therapists, and a local registered dietician. Student physical therapist will participate in a training session led by the licensed physical therapists and the registered dietician to learn outcome measures, educational tools, and exercise interventions utilized by the program.

The program will take place for two 45-minute sessions per week over a 12-week period at the Carrboro YMCA. However, the first and last week will have one extended session (1.5 hours total) for baseline and final outcome measuring. Baseline outcome measures will include BBS, OWT, OPQ, number of falls in the past year, and current exercise/nutritional supplementation habits. Final outcome measuring will include a free textbox for program feedback in addition to re-testing of the mentioned outcome measures. The participants will also be contacted 1-year after the program end date to record number of falls in the year following the program in addition record information on compliance to goals they set during the program in relation to exercise and nutrition. 1-year out, participants will also be asked to take a digital OPQ to test long-term osteoporosis knowledge. The end of the digital test will have a free text box for program feedback from a long-term perspective.

Educational sessions will be led by the physical therapists (with exception of the nutritional education sessions to be led by the registered dietician) and held in the YMCA classroom while the strength training and balance portions will take place in the group fitness room. The YMCA classroom will have enough chairs and tables for all participants to sit and take notes on the presented PowerPoint. The weekly PowerPoints will be emailed and printed for the participants to keep. The YMCA fitness room will be the location for the strength and balance training portions of the program and will be equipped with appropriate resistance bands, dumbbells, foam pads, and other equipment listed in the interventions. This portion of the program will be conducted in a small group format (no more than 4 participants per group leader). Each group will be led by either a physical therapist or student physical therapist.

The first session each week will take place every Tuesday and will be made up of 15 minutes of multi-media osteoporosis education with utilization of the Social Cognitive Theory. The educational topic will change every 3 weeks as listed in Table 1. The first two weeks of a topic will be presentation style with a PowerPoint and include 5 minutes of goal writing or goal modification related to the topic.<sup>5</sup> The educational session that takes place on the third week of each 3-week period will be discussion based. Behavior-oriented discussion questions will be posed to the participants related to the current topic to incorporate the Social Cognitive Theory. An example of a Social Cognitive Theory question may include the following: “which exercise goals did you set for yourself this week? Were you able to meet them? Why or why not? What can you do better going forward?”<sup>5</sup> The remaining 30 minutes will be used for lower body strength training. The second session of the week will be on Thursday where participants will

undergo 15 minutes of balance training and 30 minutes of upper body strength training.

The educational topics and exercises utilized are listed in Table 1.

Table 1. Osteoporosis Community-Based Health Program Schedule and Interventions

	1 <sup>st</sup> 45 Minute Session		2 <sup>nd</sup> 45 Minute Session	
Week	Education Topics (15 mins)	Lower Body Focused Strength Training (30 mins)	Balance (15 mins)	Upper Body Strength Focused Training (30 mins)
1-3	-osteoporosis general information <sup>5</sup> -risk factors <sup>5</sup>	-body weight/low load deadlifts; 2 sets, 5 repetitions <sup>1</sup> -jump chin-ups; 2 sets, 5 repetitions <sup>1</sup> -body weight/low load back squats, sit-to-stand, lifting strategies; 2 sets, 10 repetitions <sup>1,2</sup>	-walking with speed altering, quick stops, quick turns, head turns <sup>3</sup> -static Romberg or staggered stance, foam pad added as able <sup>3</sup>	-body weight/low load deadlifts; 2 sets, 5 repetitions <sup>1</sup> -jump chin-ups; 2 sets, 5 repetitions <sup>1</sup> -thoracic spine extension; 5 sets, 5 repetitions <sup>2</sup> -overhead press, cable row; 2 sets, 10 repetitions <sup>1</sup>
4-6	-fall and fracture risk associated with osteoporosis <sup>5</sup>	-50-70% 1 RM deadlifts; 2 sets, 5 repetitions <sup>1</sup> -jump chin-ups; 2 sets, 5 repetitions <sup>1</sup> -50-70% 1 RM back squats, sit-to-stand, lifting strategies; 5 sets, 5 repetitions <sup>1,2</sup>	-static Romberg or staggered stance with foam pad and reaching <sup>3</sup> -obstacle course with small hurdles and foam pads <sup>3</sup>	-50-70% 1 RM deadlifts; 2 sets, 5 repetitions -jump chin-ups; 2 sets, 5 repetitions -thoracic spine extension; 5 sets, 5 repetitions <sup>2</sup> -50-70% 1 RM overhead press, cable row; 5 sets, 5 repetitions <sup>1</sup>



7-9	-exercise for osteoporosis management <sup>5</sup>	-50-70% 1 RM deadlifts; 2 sets, 5 repetitions <sup>1</sup> -jump chin-ups; 2 sets, 5 repetitions <sup>1</sup> -80-85% 1 RM back squats, sit-to-stand, lifting strategies; 5 sets, 5 repetitions <sup>1,2</sup>	-walking with speed altering, quick stops, quick turns, head turns in dimmed lighting <sup>3</sup> -forward walking with cognitive tasks while holding a filled bag <sup>3</sup>	-50-70% 1 RM deadlifts; 2 sets, 5 repetitions -jump chin-ups; 2 sets, 5 repetitions -thoracic spine extensions; 5 sets, 5 repetitions <sup>2</sup> -80-85% 1 RM overhead press, cable row; 5 sets, 5 repetitions <sup>1</sup>
10-12	-nutrition and dietary supplementation for osteoporosis management <sup>5</sup>	-50-70% 1 RM deadlifts (2 sets, 5 repetitions) <sup>1</sup> -jump chin-ups; 2 sets, 5 repetitions <sup>1</sup> -80-85% 1 RM back squats, sit-to-stand, lifting strategies; 5 sets, 5 repetition <sup>1,2</sup>	-obstacle course with uneven terrain and dimmed lighting <sup>3</sup> -forward and backward walking with cognitive tasks while holding a filled bag and a book <sup>3</sup>	-50-70% 1 RM deadlifts; 2 sets, 5 repetitions -jump chin-ups; 2 sets, 5 repetitions -thoracic spine extensions; 5 sets, 5 repetitions <sup>2</sup> -80-85% 1 RM overhead press, cable row; 5 sets, 5 repetitions <sup>1</sup>

## Program Evaluation

Participants will be encouraged to participate in discussions regularly with the program leaders to encourage learning, compliance with goal setting, and the opportunity for regular program feedback. Small group exercise will also allow for an environment that encourages regular program feedback. Because of this open communication style, program details can be adjusted for the individual participants as needed as the program continues. Examples of this may include changing big group

discussions to partner discussions, randomizing exercise group instructors each week or keeping the instructors the same per group, etc.. Any changes made during the program should be thoroughly documented and included in the review process. The most telling of whether program goals were accomplished will be at the end of program outcome measure testing and the 1-year outcome measure testing.

When evaluating a program, it is important to consider who will be evaluating the results and determining if the program goals were successfully met.<sup>12</sup> Consulting other physical therapists and registered dieticians in addition to further diving into research may be needed to improve the program for the future. Consulting professionals other than the program leaders could help decrease some bias.<sup>12</sup> Those who are brought into the evaluation process will be asked to consider our program goals and interventions which are based off of high-quality evidence. Using existing standards from research is also helpful in decreasing bias in the evaluation process.<sup>12</sup> Participant feedback should be considered in this remediation process as they are major stakeholders in the program.<sup>12</sup> Evaluators will be asked to document potential bias, consider issues of context (such as altered methods or differences between methods of the program and the research) during data interpretation, and limitations in the program evaluation.<sup>12</sup>

If goals were not met at this time at the end of the program and at 1-year from the program end date, educational sessions and exercise sessions should be reconsidered and altered.<sup>12</sup> Any changes made for next year's cohort should be based on the evaluation findings in addition to evidence from the literature and expertise of the program leaders, evaluators, and participants.<sup>12</sup> An important part of changes to be

considered is training of program leaders/volunteers and if other volunteer assistance is needed to further enhance the program.<sup>12</sup>

## **Conclusion**

This community-based health program created by evaluation and incorporation of high-quality evidence has the potential to improve participants' knowledge of osteoporosis, decrease risk of falls, decrease risk of fractures, and improve self-efficacy for osteoporosis management.<sup>1-5</sup> The potential outcome of this program could be significant in improving the quality of life for our community members who suffer from osteoporosis.<sup>8</sup>

Funding for this program will be crucial for community outreach, recruitment of participants, development and printing of educational resources, and providing the proper equipment for exercise interventions and outcome measures. The more funding for this program, the more lives we can impact for the better.

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