**Health & Wellness Proposal: Assignment 4**

***I. Statement of Need***

Osteoporosis (OP) is a progressive skeletal disorder that results in decreased bone mass and bone strength and leads to increased fracture risk, affecting 25 million Americans.1 In fact, OP is estimated to affect 33% of all women over the age of 50.1 In this population, more than 1 million fractures are reported annually.3 Hip fracture is likely the most serious side effect of osteoporosis and is related to early death and disability.4 In addition, vertebral and wrist fractures are common.4 Sustaining one vertebral fracture increases the risk of future vertebral fractures leading to height loss and kyphosis.5 Often fractures in older individuals with OP are results of falls, which can be indicated by environmental as well as other medical factors such as impaired vision, muscle strength, and balance.4 Osteoporotic-related fracture contribute to chronic pain, reduced quality of life, admission to long-term care and health, as well as social care costs.4 Further, impaired physical functioning, immobility, low self-esteem, depression, anxiety, and isolation may ensue.5 Physical, social, emotional and functional well-being all contribute to health-related quality of life, which is also decreased in patients with OP who experience these complications.4,5

Postmenopausal women are more likely to develop OP than men or younger women due to the rapid decrease in estrogen levels post-menopause.11 This happens because estrogen inhibits bone resorption by osteoclasts.8 Non-Hispanic white women make up the majority of this population.9 Of the 20 million women in the United States who have OP, only 4 million have been diagnosed, and only 1 million are seeking treatment.12 This is concerning financially as well considering costs associated with treating OP nationally are estimated to be $18 billion.12

Osteoporosis affects more than 1.27 million North Carolinians over 50 years old and leads to fracture in 1 out of 2 women.2 By 2020, OP is projected to affect 1.94 million North Carolinians, a 50-60% increase since 2002.11 Rural residents were less likely to have had a dual-energy X-ray absorptiometry (DEXA) test to address or diagnose OP.3 Additionally, Medicare reimbursement for DEXA scans performed in non-facility settings such as physicians’ offices decreased in 2007, which may cause some providers to stop providing this service, leading to concerns over whether patients are even aware of OP diagnoses, or are educated about the risk factors leading to OP.3

The predominantly rural Burke County in the foothills of western North Carolina was ranked 76th for overall health of the 100 counties in North Carolina.18 Caucasians represent 84% of the population.18 Twenty-nine percent of the population is older than 55 years old.18 In 2010, the per capita personal income in Burke County was almost $2,700 lower than the NC average.18 The median household income for those aged 45-64 is $47,217 and for the age group over age 65 it is $26,800, both lower than the statewide median for those age groups.18 Two hundred and fifty physicians serve the 90,912 residents of Burke County.18 Residents listed top health concerns as diabetes/obesity, drug abuse, cancer, heart disease, mental health, and “aging problems.”17 Additionally, unhealthy eating, lack of exercise, and tobacco use were cited as top unhealthy behaviors present in Burke County.18 Osteoporosis wasn’t mentioned by respondents as a top concern; however, since many of the risk factors and behaviors indicated are related to OP, it is likely that this is a health issue in this rural, socioeconomically disadvantaged county with an older population.

Physical therapists can play a unique role in the care of patients with OP in terms of establishing habits to modify risk factors over a longer period of time while monitoring safety in exercise alongside nutritionists and psychologists. Because of this longer time period over which to work, physical therapists can help increase or maintain bone mineral density, increase strength, decrease pain and increase walking speed to reduce the effects of the progression of OP, reduce the risk of fracture, as well as reduce the financial burden on the patient and society.

This program will address these modifiable risk factors through levels of the Socioecological Model (SEM), originally developed by Urie Broffenbrenner.17 The SEM was established to help understand individuals and their behavior based on their environment, on many different levels.17 Targeting three levels of the SEM—the intrapersonal and interpersonal levels directly, and indirectly on community level—will allow this program to help establish behavior changes that are more likely to succeed in the long-term, and involve not only the patient, but also social networks and support systems, as well as organizations and institutions.17 The intrapersonal factors level of the SEM, which includes knowledge, attitude, and behavior of individuals, will be addressed by educational sessions to inform participants about the importance of physical activity with osteoporosis.16 The interpersonal processes and primary groups level of the SEM, which includes family, friends, and social networks, will be addressed by the organization of the program into small group training sessions after the initial evaluation.16 Lastly, the program will indirectly target community level changes by empowering participants who can participate on community boards or give presentations to other community organizations such as churches, non-profits, town halls, and local businesses.

In summary, the current evidence shows the incidence of, cost associated with, severity of complications, and most of all the preventable nature of OP, establish it as an ideal target for a community health and wellness promotion program. Due to the available evidence on incidence, this program will be targeted to postmenopausal non-Hispanic women in rural Burke County, NC. This combined with the identification of multiple levels of the SEM including directly interpersonal and indirectly community level changes could help the program reach more than the immediately involved participants.

***II. Background***

The modifiable risk factors related to OP, which will be addressed in this program, are nutrition, and physical activity. A diet deficient in calcium and vitamin D can result in decreased osteoblast activity.2,7,8,15 Calcium supplementation has been found to reduce bone turnover markers.9 A recent study has additionally determined dietary intake of kilocalories, carbohydrates, and potassium were associated with calcium absorption.10 The European Society for Clinical and Economic Aspects of Osteoporosis and Osteoarthritis recommends adequate vitamin D intake is 800IU/day to help maintain serum 25-hydroxyvitamin D levels greater than 50nmol/L, and a calcium intake of 10000mg/day.19 Additionally, appropriate protein intake is important in postmenopausal women with OP to allow for appropriate muscle strength mass and gain.19 The ESCEO recommends a daily dietary protein intake of 1.0-1.2g/kg body weight, with at least 20-25g of high-quality protein at each main meal.19 Combining calcium, vitamin D, and protein intake maintenance with both resistance and endurance exercises has been shown to increase bone mineral density in women with OP.1,2,7,11,15 Therefore, education on dietary modifications will be included for program participants by a nutritionist.

Overall, the combination of resistance and cardiovascular training have been shown to improve bone mineral density and bone mass more readily over time than one or the other separately.7,9,20 Mechanical loading of bone has been shown to improve bone mineral density, while decreased mechanical loading (i.e. cessation of weight-bearing or resistance exercise) leads to loss of bone mineral density.7,9,15 Mechanical loading of bone is produced by ground reaction forces as well as contracting muscles, which either helps maintain or increase bone mass.20 According to a recent systematic review on exercise and osteoporosis in postmenopausal women, physical activity involving both of these kinds of loading, gravitational, and muscular loading are important and produce more maintenance or generation of bone mass than non-impact loading.20 In terms of specifics about frequency, repetition, and duration, one study found a supervised circuit training session twice per week, in a set of five training periods each lasting 8-10 weeks, over a year and a series of exercises at home 4 days per week did work locally to increase bone mass.7 Resistance exercises included three or four of the following: chest fly, latissimus pull down, military press, seated row, and bicep curl.7 The home program consisted of a circuit program with skipping, (30s), bounding over soft hurdles (13-16 cm), drop jumping (10-15 cm), and hopping on one leg (10x).7 Aerobic exercise was interspersed between circuits for two weeks, three times throughout the year, and was in the form of a dance class.7

The same concept seems to be true in regards to loading with aerobic activity. Aerobic non-weight bearing exercisers usually present with lower BMD compared with those who participate in impact loading aerobic exercise.20 Walking has been shown to produce osteogenic effects in the femoral BMD, but not spinal BMD.20 One study used three fast 30-minute walks at a hospital center, and one or two sessions of one-hour resistance and cardiovascular combined training at a training center.9 This training included 25 minutes of strengthening for the arms, legs, back, and stomach, 25 minutes of aerobic exercise, and 5 minutes of stretching.9 Of course considering the accessibility of cardiovascular exercise to this particular patient population would be important, when taking into account other chronic diseases or age-related degenerative changes. For example, one study utilized lower-impact aerobic activity in the form of biking, alongside impact weight bearing and strengthening activity.20

Even though research supports exercise for this population, it’s important to consider other physical or medical limitations in this particular population such as vertebral compression fractures that already exist, osteoarthritis, and herniated discs that may prevent them from engaging in this type of exercise regimen.20 More specifically, recent studies have revealed that exercise to produce osteoblastic activity include: dynamism and high-intensity, short-duration stimulus.20 Dynamism can be described as resistance combined with velocity for power.20 An example of high-intensity and short-duration of stimulus would be a few repetitions.20 This form of training is best as it causes very vigorous muscle contraction and utilizes action of type II fibers in muscle, which are the fibers most capable of stimulating bone formation.20 More specifically in terms of exercise, trunk flexion exercises have been determined to increase the risk of vertebral body fracture, while trunk extension exercises have been found to be protective.16 Trunk extensor exercises have been found to decrease the risk of vertebral fractures as well as enhancement of balance and falls reduction.20 Additionally, when comparing patients with OP to healthy control patients, the patients with OP were found to have weaker trunk musculature, both in the flexors and the extensors.21

One theory has arisen that the weakening of the bones, and muscular changes that occur due to OP can lead to changes in center of gravity, potentially creating balance challenges and changes and leading to falls and/or fracture.21 Postural sway is also increased in patients with OP compared to healthy controls.21 This deems proprioceptive and balance exercises important to improve postural control and functional capacity, and reduce falls and fracture risk.20 This has been done in the past by Tai Chi training, ballroom dancing, and dynamic stabilization on uneven and unstable surfaces.20 Performing tai chi training for three 60 minute sessions per week for twenty-four weeks did show increased tread width and trunk stability.22 Another study did balance training by using limits of stability in sitting and standing, walking on uneven surfaces, gait training with dual-task interference, and changing speeds, and postural reactions to loss of balance for 45 minutes a session, three times a week for twelve weeks.24 This program was progressed based on basic/moderate/advanced levels and progression as appropriate.24 Increased gait speed with dual-task interference, fast gait speed, and LE physical function were results found with this intervention.24

To help address these behavior changes, consultations using the ideas of the Health Belief Model, developed to help explain why people failed in programs to prevent and detect disease, will be used.23 In summary, this theory states that people must feel threatened due to perceived susceptibility and severity in order to make behavioral changes.23 To accomplish this, participants need to believe that changing, by overcoming perceived barriers, and employing self-efficacy will result in a perceived benefit.23 Perceived susceptibility has been shown to be the most powerful predictor of preventative health behavior than sick-role behavior.23 Perceived barriers are the single strongest predictor of change across all studies in a review.23 This has been validated using many health topics including breast cancer, and risky sexual behaviors, though no studies to date were found regarding osteoporosis and the Health Belief Model.23

While there are many studies investigating these variables separately, none look at the combined effect of all of these kinds of exercise interventions supervised by a physical therapist with a nutrition intervention supervised by a nutritionist. This program is unique in that it will focus on resistance training of the lower and upper extremities as well as the trunk, aerobic training in the form of brisk walking, and balance exercises, all supervised by a PT and/or a PTA. In addition nutritional counseling, specifically related to OP, will be provided by a nutritionist. Finally, incorporating the levels of the SEM, and the constructs of the HBM, both backed up by significant research, set this program apart and will help ensure its success in establishing long-term health behavior change related to preventing osteoporosis.

***III. Methods***

Objectives:

1. At least 60% of participants will show increased femoral BMD by at least 0.005g/cm2 upon completion of the one-year program.8
2. Participants will demonstrate increased knowledge regarding personalized benefits of and barriers to exercise for reducing OP susceptibility as evidenced by at least a 30% higher post-test score upon completion of the year-long program.22
3. Participants will demonstrate increased knowledge regarding proper diet, and appropriate exercise regimen progression for use post-program as evidenced by completion of both the program and a final goal setting session.
4. Participants will demonstrate improved performance of consuming a proper diet based on a food journal, and of exercise based on an exercise log and competent demonstration by all participants of exercise regimen.
5. Participants will demonstrate improved single-leg-stance time by at least 5 seconds or to appropriate age-matched norms by the completion of the program.
6. Fast gait speed will increase by at least 0.2m/s or to appropriate age-matched norms by the end of the year-long program.24
7. Overall muscular strength will increase by at least 1 grade or to 5/5 upon completion of the year long program.
8. Participants will meet at least 4/5 personalized SMART goals established by him/her and supervising PT & nutritionist at the initial evaluation.

Program Methods:

Twenty-five participants will be selected for this program after diagnosis of OP, BMD measurement by DEXA-scan, and exercise clearance from the participants’ primary care physician (PCP). The program will be one-year in duration and will educate patients on the personalized preventative measures for progression of OP using an initial one-on-one evaluation with a physical therapist and nutritionist. Baseline measures will include: strength based on manual muscle test (MMT), single leg stance (SLS) time, fast gait speed. Additionally, current dietary habits will be discussed. This will be followed by exercise sessions three times a week with resistance, aerobic, and balance training in small groups of 4-5 supervised by volunteer personal trainers. Additionally, monthly large group educational programs about HBM constructs related to OP, diet, and exercise, will be discussed for one hour after the 1st Monday exercise session of the month, with question/answer time with the PT and nutritionist following. . All instructional materials provided to participants will include HBM constructs discussed previously.

Participants will also take a pre-test about preventative risk factors for OP, their general knowledge of diet and exercise, and HBM constructs related to that on-site prior to evaluation for discussion with the supervising nutritionist and PT to help establish personalized S.M.A.R.T. goals related to behavior change and OP. Participants will be encouraged to start to explore group fitness options for balance and aerobic training as they prepare to transition out of the program.

Site Parameters:

The exercise sessions will be completed by all small groups at the YMCA of Catawba Valley in Burke County, NC from 9:30-11:00 AM on Mondays, Wednesdays, and Fridays for one year, starting January 15, 2015. These visits have been coordinated with the other courses held at the community center as to not interfere with scheduling. Requirements for instruction of the course will be: 3 sets of 3-20 lb dumbbells, indoor track, latissimus dorsi pull down machine, leg extension machine, leg press machine, and 3, 2x2 foam squares. This is all equipment the YMCA of Catawba Valley has available, and has agreed to allow for use. The YMCA of Catawba Valley has also provided 5 volunteer personal trainers, who will be available on site to work with participants post-evaluation, throughout the program, with on-site supervision of PT for all of the sessions. The supervising PT and nutritionist will provide program recommendations and educational materials for each discipline personalized to each participant.

**Interventions:**

Example schedule: Group 1 for week 1, month 1

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Location | Time | Monday | Wednesday | Friday |
| Aerobic: indoor track/outside | 9:30-10 | aerobic | resistance | balance |
| Resistance: gym weight floor | 10-10:30 | resistance | aerobic | resistance |
| Balance: group exercise studio A | 10:30-11 | Balance | balance | aerobic |
| Edu session: Conference room B | 11-12 | --- | Educational session | --- |

**1) Aerobic exercise:**

|  |  |  |
| --- | --- | --- |
| Timeframe | Duration | Exercises |
| Months 0-3 | 30 min, 2x/wk | Brisk walks on the indoor track, or outdoors in the community, with instructions to maintain RPE of at least 5/10 |
| Months 3-6 | 30 min, 3x/wk | Brisk walks on the indoor track, or outdoors in the community, with instructions to maintain RPE of at least 6/10 |
| Months 6-9 | 30 min, 3x/wk | Brisk walks on the indoor track, or outdoors in the community, with instructions to maintain RPE of at least 7/10 |
| Months 9-12 | 1 hour, 2x/wk | Participate in a cardiovascular-oriented group fitness class at the YMCA (i.e. Silver Sneakers, cycle, Zumba), with instructions to maintain RPE of at least 6/10 |

**2) Resistive exercise:**

|  |  |  |  |
| --- | --- | --- | --- |
| Timeframe | Repetitions | Duration | Exercises |
| Months 0-3 | 2 sets of 15 repetitions  at appropriate weight as established at baseline evaluation, increasing as appropriate | 30 min, 2x/wk | -chest press  -latissimus dorsi pull down  -bicep curl  -single arm row  -goblet squat  -lunges  -calf raises  -leg press  -side-lying hip abduction |
| Months 3-6 | 3 sets of 15 repetitions, at appropriate weight as established at baseline evaluation, increasing as appropriate | 30 min, 2x/wk | -opposite leg & arm extension from quadruped  -chest press  -military press  -cable back row  -deadlift  -tricep extensions  -bicep curls  -transverse lunges  -leg press  -knee extension machine |
| Months 6-9 | 3 sets of 10 repetitions, at appropriate weight as established at baseline evaluation, increasing as appropriate | 30 min, 2x/wk | -chest fly  -latissimus dorsi pull down  -bicep curl  -single arm row  -low back extension  -goblet squat  -lunges  -calf raises  -leg press  -knee extension machine |
| Months 9-12 | 4 sets of 6-8 repetitions, at appropriate weight as established at baseline evaluation, increasing as appropriate | 1 hour, 2x/wk | -opposite arm & leg extension from quadruped  -chest press  -military press  -cable back row  -deadlift  -tricep exetension  -bicep curl  -transverse lunges  -leg press  -knee extension machine |

**3) Balance training:**

|  |  |  |
| --- | --- | --- |
| Timeframe | Duration | Exercises |
| Months 0-3 | 30 min, 2x/wk | -limits of stability in sitting and standing  -walking on uneven surfaces indoors  -gait training with changes in speed |
| Months 3-6 | 30 min, 2x/wk | -limits of stability in standing  -walking on uneven surfaces indoors  -gait training with dual-task interference and speed changes  -postural reactions to loss of balance |
| Months 6-9 | 30 min, 2x/wk | -walking on uneven surfaces outdoors  -standing on foam without visual cues  -gait training with dual-task interference |
| Months 9-12 | 1 hour, 2x/wk | -tai chi class at the YMCA  -or continuation of progression of dynamic balance activities |

**4) Nutritional consultation:**

A nutritionist will meet with each participant initially to discuss the importance of Calcium and vitamin D intake, proper protein intake, suggested dietary changes. Participants will meet with nutritionist monthly to discuss dietary choices and changes, by using a food journal.

**5) Monthly educational session topics:**

|  |  |  |
| --- | --- | --- |
| Month | Topic | Presenter |
| 1 | What is OP? | PT & nutritionist |
| 2 | Smoking, Nutritional Concerns related to OP | nutritionist |
| 3 | Benefits of resistive exercise for patients with OP | PT |
| 4 | Benefits of balance training for patients with OP | PT |
| 5 | Benefits of cardiovascular exercise for patients with OP | PT |
| 6 | Goal setting workshop on re-establishing goals for the half-way point of the program | PT & nutritionist |
| 7 | Fracture prevention workshop | Local orthopedic surgeon |
| 8 | Group exercise class and schedule orientation for the YMCA | Director of group exercise at the YMCA |
| 9 | How to track progress on goal-setting applications on the computer and smartphones | PT & nutritionist |
| 10 | Community health resources workshop | County Health Department, senior center, community center |
| 11 | Common co-morbid, chronic, preventable diseases (hypertension, diabetes mellitus, and obesity), and how exercise affects them | Local primary care physician |
| 12 | Celebration of completion of the program potluck | Participants, staff, family, & community members |

***IV. Program Evaluation***

As mentioned previously, each participant will have a one-on-one baseline evaluation with the lead physical therapist and nutritionist. As follow-up, each participant will have one-on-one time with both the lead therapist and nutritionist at 6 months during the goal setting workshop, and at completion of the program. These meetings will be an opportunity for each participant to receive feedback on their individual goals, barriers and potentially benefits and/or barriers he/she has encountered. Hopefully these follow-ups will also be used to re-evaluate prior goals, and set new goals as appropriate for the rest of the program, or to discuss strategies to maintain the behavior changes after the program ends. These follow-ups of course will also be a time to assess the number of drop outs, and follow-up with phone calls and e-mails soliciting reasons for dropping out.

Program evaluation surveys will also be e-mailed to every participant at 6 months and at completion of the program. Hopefully these questions will elucidate what changes should be considered for future implementation of this program, and can be subjective evaluative tools for the effectiveness of the program.

Evaluation surveys will include the following questions:

**Please circle the number that most closely represents your opinion:**

**(1= strongly disagree, 2= disagree 3=agree 4=strongly agree)**

1. I feel as though my knowledge of healthy eating choices has increased.
2. I am confident in my abilities to recognize and choose healthy options to purchase at the grocery store.
3. I am confident in my abilities to recognize and choose healthy options when making menu selections at restaurants.
4. I am confident in my ability to work out on my own based on the program’s established workouts.
5. Overall, I am satisfied with the program.
6. I found the programs’ educational sessions appropriate, helpful, and informative.
7. I found the programs’ exercise regimen to be accessible, feasible, and also challenging.
8. I feel confident and plan on continuing with the healthy behavior changes I made after the program ends and know what resources are available in the community to help me with this.

**Free text response:**

1. Briefly comment on the strengths of this program.
2. Briefly comment on any weaknesses of this program.
3. Briefly comment on any changes you think should be made improve this program for the future.

**Tools to Evaluate Program Effectiveness:**

Strength will be evaluated by the lead physical therapist at baseline, mid-program (6 months), and at completion of the program by manual muscle test (MMT). This is a measure commonly used to assess strength in this population.7,9,20 Increases in strength could help reduce falls, improve independence with ADLs, improve BMD, and increase gait speed.20, 21

BMD will be measured at baseline and completion of the study by DEXA-scan to determine if any increases have been made based on this program. Other programs with similar interventions indicate changes in BMD.9,20

Single-leg stance (SLS) time will be evaluated at baseline, mid-program (6 months), and at completion of the program by the lead physical therapist. Programs with interventions similar to this one for this population in the past have shown change in SLS, indicating improved balance, increased fast gait speed, reduction in falls risk, and increased gait speed with dual-task interference.22,24

Fast gait speed will also be evaluated at baseline, mid-program (6 months), and at completion of the program by the lead physical therapist. Programs with interventions similar to this one have shown changes in fast gait speed which could mean more independence with community ambulation, improved balance, strength, cardiovascular endurance, and decreased falls risk.22,24

Participants’ food journals will be reviewed by the lead nutritionist at baseline, mid-program (6 months), and at completion of the program. This will help ensure participants are meeting recommendations for Vitamin D, Calcium, and protein intake, shown to improve BMD.2,7,11,15

Findings from this program can be interpreted based on the how many of the program goals are met, and how well the results relate to the current evidence. As this comprehensive of a program has not been attempted based on the current literature, perhaps it would be valuable to consult with colleagues in an academic setting to see about publishing this as a study in the future. It’s important to consider the following when interpreting the findings: the number of drop outs, community resources available, and whether any confounding variables are present.

Limitations to this program could include cost of the DEXA-scan, difficulty in finding a volunteer lead physical therapist and lead nutritionist, difficulty in finding volunteer personal trainers to monitor participants’ exercise, and that the length of the program may deter participants. Hopefully, the times selected will be relatively un-crowded times at the gym, so that participants in the program will not interfere with YMCA patrons.

Hopefully this program will be relevant and generalizable to patients with OP in other geographical areas with differing socioeconomic status, and in men as well. Additionally, ideally this program would serve as a general model to comprehensively address physical activity and nutritional concerns for patients with other chronic, preventable diseases such as hypertension, type II diabetes mellitus, and obesity to help make long-term health behavior changes.

Overall, when looking at merit, worth, and effectiveness of this program, it is important to consider the specific population, resources, and research. The specific, measurable, and feasible program goals used which are supported by research, combined with individualized goals and educational programs related to community resources will help establish high levels of effectiveness and merit for use of this program in this population. Donated services and facility use alongside sponsorships will allow this program to be completely free to participants. Hopefully it will additionally be deemed by patients’ to be worth their time based on the health behavior changes they make, effects they experience, and education they receive.

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