EARLY OSTEOPOROSIS PREVENTION IN THE ADOLESCENT

A LEARNING MODULE

by

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STATEMENT BY AUTHOR

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I would like to thank Dr. Deborah Vincent for her assistance and guidance on this project. You helped me realize that I can do this. A teacher is one who helps others to realize their potential, thanks for being my teacher. Also, I would like to thank Dr. Kathleen May and Dr. Sandy Cromwell for agreeing to be members of my project committee. Thank you so much for your time and participation.

Mom, thanks for reading all of my drafts, I value your insights and comments; you are not only my mom, but my dearest friend. Noelle, my sister of the soul, thank you for your continued encouragement, support, and friendship. Your unflagging confidence in my ability has helped me persevere.

Finally, I would like to thank my husband Craig, and my children Christine and William. I know that the last two years have been very difficult. Thank you for hanging in there, I love you all.
DEDICATION

I dedicate this project to my Dad, James A. Snyder (1921-2005). My dad died quietly at home surrounded by his loved ones, on November 9, 2005. He is not here to see me finish, but I know he is with me in spirit. My Dad has always been there for me, whenever I needed him. He is my hero, my superman, my Dad. He is my gauge against whom I measure all others. I miss him very much. I feel fortunate to have been his daughter. He played a large part in making me who I am today. Thank you Dad, I love you, and I will see you again some day.
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ABSTRACT

Osteoporosis is a preventable chronic disease that begins during critical periods of childhood and adolescent bone growth (Schrader, Blue, & Horner, 2005). The majority (90%) of peak bone mass, or 90% of maximal bone strength, occurs by the age of 18 (Doniger, 2002). Thus, osteoporosis prevention should begin during childhood and adolescence when rapid bone growth occurs and the calcium content of bone triples (Hightower, 2000). Adequate dietary calcium intake and regular weight bearing physical activity maximizes the development of peak bone mass throughout the adolescent and young adult growth period (Nichols, Bonnick, & Sanborn, 2000). Prevention of osteoporosis should begin in adolescence and continue throughout adulthood (Matkovic et al., 1994). This paper is a proposal for an educational module for early osteoporosis prevention in the adolescent by promoting increased dietary calcium intake and the development of regular weight bearing physical activity behaviors.
CHAPTER I

Background

Osteoporosis is a chronic disease that exacts a great toll not only on an individual’s health, but on the health related costs of an already overburdened health care system. Osteoporosis reflects the lack of adequate accumulation of bone tissue during skeletal growth and/or excessive losses later in life, usually after the age of 60, resulting in porous, fragile bones. As bone density decreases, the risk of hip, spine and wrist fractures increases (National Institutes of Health Osteoporosis and Related Bone Diseases National Resource Center, 2005a). The World Health Organization (WHO) defines osteoporosis as a bone mass measurement more than 2.5 standard deviations below the standardized young adult mean. For each standard deviation decrease in measured bone mineral density, the risk of fragility fractures doubles (Nichols et al., 2000). Although osteoporosis was once considered an inevitable part of aging, current medical knowledge has determined that osteoporosis can be prevented. Maximizing bone mass during growth and development and minimizing post-menopausal bone loss will prevent osteoporosis (Matkovic et al., 1994).

Osteoporosis affects more than 75 million people in Europe, Japan, and the United States (World Health Organization, 2003a). It affects both men and women (National Institutes of Health Osteoporosis and Related Bone Diseases National Resource Center, 2005a), although women have a three times higher incidence than men (World Health Organization, 2003a). The National Institutes of Health (NIH) report that 10 million people in the United States currently have osteoporosis. An additional 34 million
people in the United States have low bone mass or osteopenia, which places a person at greater risk for developing osteoporosis. Osteoporosis is considered a major public health threat and is responsible for more than 1.5 million fractures annually (National Institutes of Health Osteoporosis and Related Bone Diseases National Resource Center, 2005a).

Osteoporosis occurs in all populations and at all ages, and may be responsible for 80-95 percent of fractures of the hip and spine in postmenopausal white women (U.S. Department of Health and Human Services, 2004). Factors that predispose an individual to osteoporosis are those that limit peak bone mass attainment during adolescence or cause accelerated bone loss during the perimenopause and postmenopausal period (Hamerman, 2005). Factors in adolescence that limit peak bone mass attainment include: menarche at late age, limited dietary intake of calcium and protein, cola drinks, smoking, exercise induced amenorrhea, and Depo-Provera birth control injections. Inheritable factors that limit peak bone mass attainment include: polycystic ovary syndrome, Turner’s syndrome, growth hormone deficiency, and idiopathic juvenile osteoporosis. Acquired disorders that limit peak bone mass attainment include diseases that require corticosteroid use and cancer (Hamerman, 2005). Interventions in adolescence need to be tailored to address factors that may result in decreased peak bone mass.

After adolescence (skeletal maturity), osteoporosis prevention focuses on preventing increased rates of bone loss. Early menopause (natural or surgically induced) in the perimenopausal period significantly increases bone loss. Postmenopausal factors that influence increased bone loss include: age, fracture history, body mass index,
medications, smoking, weight bearing physical activity, years post menopause, and maternal history of osteoporosis (Hamerman, 2005).

According to Nichols, Bonnick and Sanborn (2000), almost one out of two women will be affected by osteoporosis at some point in their lives. Osteoporosis directly contributes to approximately 50,000 deaths annually (Nichols et al., 2000). Direct care costs for osteoporosis fractures can range from $12.2- $17.9 billion dollars annually. This does not include indirect care costs such as time lost from work by the patient and/or caregiver (U.S. Department of Health and Human Services, 2004). It is estimated that over the next decade 5.2 million hip, spine, and forearm fractures in women aged 45 and over will occur in the United States, costing 45.2 billion dollars in total health care expenditures (World Health Organization, 2003b).

Osteoporosis is a silent disease that often goes undiagnosed until a fracture occurs (Schrader et al., 2005). The peak bone mass obtained early in life and the amount of bone loss later in life are the two most important factors that contribute to the development of osteoporosis (Nichols et al., 2000). Current research suggests that adequate bone building in childhood and adolescence is the key to osteoporosis prevention. Despite this, osteoporosis prevention strategies have most often been aimed at bone loss prevention in adults, rather than promoting maximal bone growth in childhood and adolescence (Schrader et al., 2005). Adolescence is a period of rapid bone growth when the calcium content of bones triples (Hightower, 2000). Bone growth continues into the early twenties with 90% of peak bone mass occurring by the age of 18. During this time there is a small window of opportunity to maximize peak bone mass
through nutrition and weight bearing physical activity (Nichols et al., 2000). Proper nutrition and weight bearing physical activity are essential for proper bone building to occur (Doniger, 2002).

Adolescents today are eating increased amounts of fast food. This has led to an overall decrease in the consumption of calcium rich foods (Schrader et al., 2005). Twenty years ago, milk was the primary beverage of children and adolescents. Today, adolescents drink twice as much soda pop as they do milk (Di Rado, 2003). Consumption of dietary calcium has decreased 90% in girls and 50% in boys over this period, while phosphorous consumption has increased. Increased phosphorous intake, due to increased soda pop consumption, can hamper the kidneys ability to process active vitamin D which is needed by the body to absorb calcium into the blood (Bachrach, 2001; Di Rado, 2003).

In addition to lack of dietary calcium, adolescents today are also living a much more sedentary lifestyle. They have replaced regular vigorous weight bearing physical activity with increased time spent using the computer, playing video games, and watching television (Bachrach, 2001). A lack of vigorous weight-bearing physical activity decreases the body’s ability to maximize bone mass during childhood and adolescence (Kohrt, Bloomfield, Little, Nelson, & Yingling, 2004).

Education and Osteoporosis Prevention

This paper is a proposal for an educational module to teach adolescents of middle-school age (11 to 14) how to build strong bones through diet modification and increased weight bearing physical activity. Adolescents current knowledge and beliefs about bone
health, nutrition, and weight-bearing physical activity will be assessed through use of a knowledge questionnaire (Appendix A), and Belief questionnaire (Appendix B). Weight bearing physical activity will be assessed using a two question self-measure (Appendix C), and current nutritional intake of calcium and vitamin D will be assessed through use of a Short Food Frequency self measure (Appendix D). The initial measures will be followed by a short Power Point presentation that will provide information about how bones grow, how nutrition and weight bearing physical activity impact bone growth, osteoporosis, osteoporosis prevention, dietary sources of calcium and vitamin D, and appropriate weight-bearing physical activity. Adolescents will then be instructed to select one nutrition goal and one weight bearing physical activity goal from a list of provided goals to address deficiencies identified earlier in the assessment portion of the module. Adolescents will track their progress towards their particular goals through the use of a check off chart. After six weeks, the initial questionnaires and self-measures will be repeated and the data will be analyzed for evidence of change in knowledge, beliefs and behaviors.

Current programs in the literature that support this type of educational model include the EatFit intervention and the Better Bone Buddies program. The EatFit intervention is a program based on Social Cognitive Theory (SCT) and is an example of a goal directed intervention plan. It promotes dietary and weight bearing physical activity behavior change in the adolescent, 11 to 15 years of age, through goal setting. Goal setting has been found to be an effective tool in changing dietary and weight bearing physical activity habits among adults (Shilts, Townsend, & Horowitz, 2002).
The Health Belief Model (HBM) guided the development of the Better Bone Buddies osteoporosis prevention program. This program was designed to see if improving children’s knowledge of bone health, including the consequences of poor bone health, would increase their dietary calcium intake. Almost half of the students participating in the program reported continued dietary changes one month after the study was completed (Schrader et al., 2005).

Summary

Osteoporosis is a preventable chronic disease that begins during critical periods of childhood and adolescent bone growth (Schrader et al., 2005). The majority (90%) of peak bone mass, or 90% of maximal bone strength, occurs by the age of 18 (Doniger, 2002). Thus, osteoporosis prevention should begin during childhood and adolescence when rapid bone growth occurs and the calcium content of bone triples (Hightower, 2000). Adequate dietary calcium intake and regular weight bearing physical activity maximizes the development of peak bone mass throughout the adolescent and young adult growth period (Nichols et al., 2000). Prevention of osteoporosis should begin in adolescence and continue throughout adulthood (Matkovic et al., 1994).

Current trends in decreased dietary calcium intake and lack of participation in weight bearing physical activity puts today’s adolescents at great risk for the development of osteoporosis (Bachrach, 2001). Osteoporosis is a major public health threat and is responsible for 1.5 million fractures annually in the United States (National Institutes of Health Osteoporosis and Related Bone Diseases National Resource Center, 2005a). It is a silent disease and often goes undiagnosed until a fracture occurs.
(Schrader, 2005). Direct care costs for osteoporosis related fractures may reach $17.9 billion dollars annually (U.S. Department of Health and Human Services, 2004). This paper is a proposal for an educational module for early osteoporosis prevention in the adolescent by promoting increased dietary calcium intake and the development of regular weight bearing physical activity behaviors. Two programs have already shown some success in changing adolescent dietary and weight bearing physical activity behavior. The EatFit intervention is a program promoting dietary and weight bearing physical activity behavior changes to promote overall health, and the Better Bone Buddies osteoporosis prevention program that more specifically addresses dietary calcium intake.
CHAPTER II

Review of the Literature

Calcium is essential in many body processes and is primarily obtained through the diet. However, if insufficient dietary calcium is ingested, calcium stored in the skeleton will be used to maintain essential body processes. The skeleton is the body’s main storage system for calcium. Calcium homeostasis, or regulation, is controlled hormonally. The hormones essential in this process are parathyroid hormone and calcitonin. Vitamin D is also essential in calcium homeostasis. Vitamin D facilitates the cellular calcium transport system in the intestines. Without vitamin D, dietary calcium cannot be absorbed through the gut and calcium must be obtained from the bones (Arnaude, 1985).

Bone is a dynamic connective tissue that is continually in the process of renewing itself or remodeling. Old bone is dissolved, while new bone is formed. This process occurs at the bone surfaces and is responsible for maintaining the structural integrity of the skeleton (Burke, 2001). Bone remodeling is the body’s method for general maintenance and repair of the skeletal structure and occurs throughout the lifespan (Burke, 2001). The functional units (cells) of bone responsible for this process are osteoblasts and osteoclasts. Together they form the basic multicellular unit (BMU) of the bone and they work very closely together to maintain balance between bone formation and bone resorption (Rosenberg, 2005). Osteoclast cells, responsible for bone resorption, break down bone and release essential minerals, including calcium, into the blood stream. Osteoblast cells are responsible for bone formation. They take essential minerals from
the blood stream and form new bone (Burke, 2001). Osteoclasts and osteoblasts are “coupled” during bone reformation and work on the same part of the bone surface. In a healthy skeleton, remodeling maintains current bone structure rather than creating large gains or losses in bone structure (Arnaude, 1985).

Human bones grow from birth through adolescence in length, width and density (Silverwood, 2003). Bones provide not only the rigid support to extremities needed for locomotion but the rigid support needed by body cavities to protect the vital organs (Arnaude, 1985). Bone modeling, the process by which the macroscopic skeleton is formed, begins during fetal growth and continues until the longitudinal growth of the skeleton is completed at around 18 to 20 years of age. Bone modeling (formation) is the predominant process during the first 20 years of life (Arnaude, 1985). Once the skeleton has reached maturity (90% of maximum bone mass), bone remodeling, which occurs concurrently with bone modeling, becomes the predominant process and helps to maintain a healthy skeleton. When the skeleton has reached maturity bone formation slows and skeletal bone mass increases only an additional 5-12% over the next decade (Bachrach, 2001). In a normal healthy adult, skeletal bone resorption should equal skeletal bone formation thus maintaining a healthy skeleton. Osteoporosis develops when bone resorption is greater than bone formation. Approximately 10% of the skeleton is replaced annually through bone reformation (Rosenberg, 2005). The bone remodeling cycle takes about four months in the normal healthy skeleton. Osteoclasts resorb bone over one month, and osteoblasts repair the same area of bone over three months. There
are at least a million active “packets” or BMUs active at any one time throughout the body (Arnaude, 1985).

Two types of bone comprise the human skeleton: the outer cortical layer and the inner trabecular layer. Cortical bone consists of densely packed mineralized collagen that is put down in layers and provides bone its structural rigidity. Cortical bone is the major component of tubular bones, which make up about 80% of the skeleton, and is found in the hip and long bones of the extremities. Cortical bone provides the strong structural support for the body (Arnaude, 1985; Gallo, 1996). The inner layer of bone or trabecular bone is a spongy, honeycomb-like meshwork that provides strength and elasticity to the skeleton. It increases the strength of the skeleton while minimizing the overall weight of the skeletal structure. Trabecular bone comprises about 20% of the skeleton and is the major portion of the axial skeleton. It is found in the vertebrae, parts of the hip, and at the ends of long bones (Arnaude, 1985; Gallo, 1996).

After the age of 40 bone resorption begins to outpace bone formation. The three factors that contribute to this are: decreased calcium absorption through the gut, diminished vitamin D synthesis, and decreased osteoblast activity (Gallo, 1996). The highest percentage of bone demineralization (resorption) first occurs in the spongy trabecular bone. Loss of trabecular bone decreases the internal strength and flexibility of the bone, making it more brittle. Additionally, after the age of 50, bone loss begins to occur in the denser cortical bone, further increasing risk of fragility fractures (Gallo, 1996). Women are affected by osteoporosis at an earlier age than men because decreased estrogen levels during peri-menopause and menopause lead to accelerated bone loss.
Because trabecular bone is lost first, the typical injuries seen in osteoporosis include: vertebral crush injuries, femoral neck fractures, and fractures at the distal end of the radius. These are all areas high in trabecular bone content. Men, if they live long enough, will develop osteoporosis because bone resorption outpaces bone formation (Burke, 2001).

Any condition that limits attainment of maximum bone mass during growth and development or speeds bone loss will predispose a person to developing osteoporosis (Hamerman, 2005). Prevention strategies begun during skeletal growth and maintained throughout the lifespan will prevent the occurrence of osteoporosis. The two key components of osteoporosis prevention are maximizing skeletal growth and bone density during childhood and adolescence and preventing bone loss during the post-menopausal/aging years (Nichols et al., 2000).

**Peak Bone Mass**

Peak bone mass is the maximum bone tissue present by the time an individual has reached skeletal maturity. At most bone sites this occurs by the age of 30 (Bloomfield, 2005). Children gain 26% of their peak bone mass during puberty and have reached 90% of their peak bone mass by the age of 18, when most adolescents have reached their adult stature (Bachrach, 2001; Bloomfield, 2005). Heredity, gender, diet, endocrine factors, weight bearing physical activity and exposure to risk factors such as smoking and alcohol all determine ultimate peak bone mass (Matkovic et al., 1994). Hereditary or genetic differences account for 60-80% of the variance in peak bone mass. Genetic differences include body and bone size and genes that modulate bone mineral accrual. These are
factors that cannot be changed (Bachrach, 2001). Two factors that can be changed to promote maximization of peak bone mass in the adolescent are diet and weight bearing physical activity. Multiple studies have been done to determine when intervention in maximizing peak bone mass would be most successful.

Results of a cross sectional study on timing of peak bone mass suggests that adolescent girls reach their adult height, or cessation of longitudinal bone growth (skeletal maturity), by the age of 16. The study also suggests that the majority of bone mass accrual occurs between the ages of 11 to 15 (Matkovic et al., 1994). After the age of 16 (or skeletal maturity), adolescent girls continue to accumulate bone mass at various skeletal sites for an additional 1 to 7 years (Matkovic et al., 1994). This research supports the idea that maximizing bone mass accrual during the adolescent growth period leads to a higher overall peak bone mass in adulthood and may prevent osteoporotic fractures later in life.

The Saskatchewan Bone Mineral Accrual Study (BMAS) is a longitudinal study that supports the findings from the Matkovic et al. (1994) study. The authors of the BMAS followed bone growth in 220 boys and girls ages 8 to 14. Results of the study indicate that the most rapid growth period for boys occurs at approximately age 14.0 ± 1.0 years, and the most rapid growth period for girls occurs at approximately age 12.5 ± 0.9 years. The authors concluded that this is the time of fastest bone mineral acquisition during the growth period, or the maximal peak bone mineral content velocity (Whiting et al., 2004). This again suggests that adolescence is the best time for intervention to promote peak bone mass in the adult.
The BMAS also indicated that boys gain more bone mineral than girls at every age. Boys have 22% more bone mineral content than girls by the age of 18. This result in part explains why women are three times more likely than men to have osteoporosis. Men start with a higher overall peak bone mass than women. Thus, they can tolerate more bone loss before functional impairment occurs (Whiting et al., 2004). A logical conclusion from these results suggests that maximizing peak bone mass in both boys and girls will lead to greater tolerance of bone loss throughout aging, decreasing osteoporosis and its complications.

Calcium and Peak Bone Mass

Calcium is the most abundant mineral in the human body and is essential in most body processes. The body’s preferred source of calcium is dietary, which can only be absorbed in its ionized form. Ionized calcium bonds easily to proteins, allowing it to be carried throughout the body. Absorption of calcium occurs mostly in the ileum of the small intestine. Vitamin D plays an essential role in this process. Without sufficient dietary calcium and vitamin D, maximum bone mineral accrual will not occur. Calcium ions for bone development are obtained mostly from extracellular fluid. The body tightly regulates extracellular calcium. Insufficient dietary calcium intake results in bone resorption thus maintaining calcium homeostasis (KassWolff, 2004; “Stong Skeletons”, 2004). This leads to the phenomenon of adult bone loss and eventually osteoporosis (Sandler et al., 1985).

Young adults aged 21 to 35 need 12 to 15 mg of calcium per kilogram of body weight per day. Children and adolescents during rapid periods of skeletal growth need
double or triple that amount of calcium (Arnaude, 1985). Up to 75% of dietary calcium can be absorbed during periods of growth (KassWolff, 2004). The authors of the BMAS used the bone mineral accrual data during growth, to calculate the calcium requirements of adolescents. They determined that 1500 mg of calcium a day was needed for the two year period surrounding peak bone mass accrual for girls and 1700 mg of calcium daily was required for boys. Further, the dietary analysis done during this study indicated that adolescents were actually consuming less than the calculated amount of calcium required. Girls were found to average less than 900 mg of dietary calcium per day, and boys’ intakes averaged 1000 mg of dietary calcium per day (Whiting et al., 2004). This finding is consistent with survey data from the United States Department of Agriculture (USDA) which indicates that adolescent and young adult women have calcium intakes consistently lower than the current recommended daily allowance (RDA) of 1300 mg per day (Ilich, Badenhop, & Matkovic, 1996).

Matkovic et al. (2005) found that during the bone modeling phase of the pubertal growth spurt the calcium intake threshold, or the calcium needed to maximize bone accrual, was approximately 1500 mg per day. Once skeletal maturity was reached in late adolescence and bone remodeling became the primary force, calcium needs dropped to approximately 960 mg per day. Because less calcium was needed to facilitate bone remodeling (versus bone modeling), the placebo group (unsupplemented control group) was found to be slowly increasing their bone mineral content or “catching-up” to the experimental group (calcium supplemented) during this period. They called this the “catch-up” phenomenon and believe that this suggests a reversible mineral deficit is
acquired during the pubertal growth spurt and that during bone consolidation (late adolescence/early adulthood) reversal may be possible (Matkovic et al., 2005). An incidental but provocative finding during this study period was that the calcium supplemented group had fewer fractures than the placebo group. This suggests that calcium supplementation cannot only prevent osteoporosis later in life, but can prevent bone fragility fractures during growth (Matkovic et al., 2005).

Food is thought to be the best source for meeting the body’s calcium needs, and milk has long been thought to be the best source of calcium. Sandler et al. (1985) in a retrospective study of women aged 47 to 66 looked at the effects of milk consumption during childhood and adolescence on post menopausal bone density. Results of the study indicated that women who had consumed milk with all meals during childhood and adolescence had higher bone density than those who did not; for those who continued to consume milk frequently through the age of 35, an even greater difference was noted in bone mineral density. Current mean calcium intake for women in this study was found to be 720 mg, which was significantly lower than the 1200 mg per day suggested for post menopausal women (Sandler et al., 1985). Unfortunately, a major limitation of this study was that it required women to recall how much milk they drank thirty years ago.

Implications of the studies reviewed suggest that sufficient calcium intake throughout childhood, adolescence, and early adulthood helps prevent osteoporosis later in life. Sufficient calcium intake means a higher peak bone mass at skeletal maturity and peak bone mass is a strong determinant of osteoporosis risk. Maximizing peak bone mass through dietary intervention in adolescence will promote stronger bones. Stronger
bones (greater bone mass) means that more bone can be lost before structural problems occur. If good nutrition continues throughout the lifespan, osteoporosis and its complications can be prevented. Osteoporosis prevention strategies must include sufficient intake of dietary calcium and Vitamin D. An additional strategy essential in osteoporosis prevention is the promotion of weight bearing physical activity.

**Weight Bearing Physical Activity and Peak Bone Mass**

Weight bearing physical activity helps optimize the levels of bone mineral density during childhood and adolescence when bone modeling (the formation of the macroscopic skeleton) accompanies growth (Nichols et al., 2000). Bone formation and bone resorption are regulated by mechanical loads that are caused by muscle forces (Silverwood, 2003). Weight bearing physical activity increases muscle size and larger muscles can exert more muscular force. Increasing muscular force on bones increases their mechanical load, which leads to increased bone formation. Increased bone formation increases the bone mineral density and strength of the growing skeleton (Rauch, Bailey, Baxter-Jones, Mirwald, & Faulkner, 2004).

In a 2002 study by Sundberg et al. it was hypothesized that a higher level of weight bearing physical activity in children ages 9 to 13 would increase bone modeling (bone formation). Increased bone modeling would lead to increased bone accrual and bone size. Children aged 9 to 13 were divided into low level activity and high level activity groups. Bone mass and bone density were then evaluated. Results of the study indicated that both boys and girls in the high level activity groups had higher bone mineral concentration and bone mineral density at the femoral neck (a major load bearing
bone) than boys and girls in the low activity groups. The researchers concluded that bone modeling before puberty can be modifiable by weight bearing physical activity (Sundberg et al., 2002).

Weight bearing physical activity causes mechanical strain on weight bearing bones, which leads to the bone modeling response, resulting in bone hypertrophy and increased strength and density. Children and adolescents participating in high weight bearing activities such as basketball, gymnastics, and tennis have higher bone mass when compared with contemporaries who participate in low or non-weight bearing activities such as swimming or walking (Janz, 2002).

In a randomized controlled seven month study of the effects of high impact activity (jumping) on the bone mineral content and bone mass of the femoral neck (hip) and lumbar spine in prepubertal children, it was found that there were significant increases in bone mineral content and bone mass of the lumbar spine and hip (femoral neck) compared to the control group (non-jumpers). After an additional seven month period of detraining (no jumping) the study concluded that though both groups (study and control) had similar gains in femoral neck bone mineral content and bone area over the 14 month period, the “jumpers” bone mineral content and bone area remained significantly higher in the femoral neck. Results were not the same for the lumbar spine however. Increased bone mineral content of the lumbar spine was lost over the 7 months of detraining (Fuchs & Snow, 2002). This study indicates that some areas of trabecular bone, such as the femoral neck, may have longer lasting benefits from weight bearing physical activity than trabecular bone in the spine which loses its gains when weight
bearing physical activity is stopped. These results suggest that continued weight bearing physical activity throughout the lifespan would promote better bone health and prevents osteoporosis by increasing bone density in puberty and preventing or minimizing bone loss after age 40.

A review of the literature has shown that peak bone mass is gained during adolescence when the skeleton is growing. Factors that influence peak bone mass include genetics, hormones, weight bearing physical activity and nutrition. Calcium and vitamin D intake are of paramount importance to the growing skeleton. Additionally, weight bearing physical activity has its greatest impact on maximizing peak bone mass during childhood and adolescent skeletal growth. By encouraging appropriate dietary intake of calcium and vitamin D rich foods and weight bearing physical activity throughout childhood and adolescence optimum peak bone mass can occur. This reduces the risk for osteoporosis and osteoporotic fractures later in life. It also promotes good dietary and weight bearing physical activity habits into adulthood which can help maintain bone strength. Osteoporosis prevention starts in childhood.

The focus needed now is how best to promote healthy eating and weight bearing physical activity behavior in the adolescent. Two programs identified earlier in this paper have had some success in changing adolescent dietary and weight bearing physical activity behaviors. The EatFit intervention is a program based on Social Cognitive Theory (SCT) and is an example of a goal directed intervention plan. It promotes dietary and weight bearing physical activity behavior change in the adolescent (Shilts et al., 2002). Goal development is based on self-assessment, and experiential, hands–on lessons
that provide the adolescent with the ability to meet the desired goals. Goals used in this program are pre-formulated by the practitioner (guided goal setting). This provides appropriate specificity and difficulty, while maintaining the adolescents’ autonomy of choice. The EatFit pilot study found that the EatFit intervention contributed positively to adolescents’ dietary and weight bearing physical activity behaviors (Shilts et al., 2002).

The second program is the Better Bone Buddies osteoporosis prevention program. It was developed by school nurses to see if improving children’s knowledge of bone health, including the consequences of poor bone health, would increase dietary calcium intake. The study targeted children ages 9 to 15 living in the Midwest. The Health Belief Model (HBM) was used as the framework in this program to guide strategies for increasing knowledge about bone health and changing dietary behavior to promote increased calcium intake. Results of this study showed that the Better Bone Buddies program did have a positive impact on preventive strategies. Almost half of the students participating in the program reported continued dietary changes one month after the study was completed (Schrader et al., 2005). The theoretical framework that is the basis for my proposed intervention is Pender, Murdaugh, & Parsons (2006) revised Heath Promotion Model (rHPM).

Theoretical Framework

Health promotion is behavior motivated by the desire to feel better, to be as healthy as one can be. Health promotion differs from disease prevention in that disease prevention motivates behavior change through a desire to avoid illness, or detect illness early (Pender, Murdaugh, & Parson, 2006). In health promotion, health is viewed as a
multidimensional concept that includes biopsychosocial, spiritual, environmental, and cultural dimensions. Health is constantly evolving and its definition changes over the lifespan. The rHPM emphasizes strengths, resiliencies, resources, potentials and capabilities of an individual, family or community, rather than on disease or pathology (Pender et al., 2006). Pender, Murdaugh, and Parsons (2006) believe that health and illness are qualitatively different concepts that are interrelated and may coexist. Figure 1 shows the concept of the health continuum throughout the lifespan as it interacts with active and chronic illness.

![Figure 1 The Health Continuum throughout the Lifespan (Pender et al., 2006).](image)

The rHPM views individuals within the context of their family and community. The goal is to move an individual towards their personal optimal level of wellness based on each individual’s capabilities and potential. Through strengthening an individual’s, family’s, or community’s resources, negative risks may be decreased.
By providing a framework for integration of nursing and behavioral science perspectives, the rHPM helps to explain factors that influence health behavior. Self-efficacy, taken from Social Cognitive Theory (SCT), is one major concept of the rHPM that is essential to the design of this learning module. Self-efficacy is a person’s belief in their capability to perform or organize certain actions or tasks; a person’s belief about their self-efficacy shapes how they think, feel, and motivate themselves to behave (Bandura, 1994; Pender et al., 2006). According to Pender, Murdaugh and Parsons (2006) a person’s past experiences indirectly affect their feelings of self-efficacy. Success or failure in past actions or behaviors leads to either increased feelings of self-efficacy or increased barriers (memory “hurdles”) to action.

Memory hurdles are barriers stored in memory that must be overcome to perform a particular action. Early successes promote self-efficacy and decrease perceived barriers to a course of action, while failure decreases self-efficacy and increases perceived barriers to a course of action. Perceived barriers (mental hurdles) are another major concept of the rHPM that strongly impacts health behavior and is important to the development of this learning module (Pender et al., 2006).

Nursing interventions in the rHPM are aimed at behavior-specific cognitions and affect (Pender et al., 2006). Behavior change can be promoted through interventions designed to improve perceived self-efficacy to perform an action, decreasing perceived barriers to performing an action, and increasing perceived benefits to performing an action. The last concept, perceived benefits to action, is another major concept of the rHPM and came from Expectancy-Value Theory (EVT) (Pender et al., 2006). This
concept evolves from the idea that people will not work towards goals that they personally do not value, and they will not work towards goals that seem too complex or unattainable (Pender et al., 2006). Guided goal setting is one way in which adolescents can be encouraged to participate in positive health behavior change. Adolescents value their independence and by allowing them to make choices the emphasis is on their ability to control their health outcomes (Muscari, 1998). Provider developed goals ensure that the adolescent will not select goals too complex to be successfully implemented. Through interventions designed to promote self-efficacy, decrease perceived barriers, and increase perceived benefits, a plan of action will be developed. Commitment to a plan of action occurs with goal selection. Commitment alone is not enough to change health behavior. There must be a strategy in place to meet the plan of action in order for it to be successful (Pender et al., 2006).

Health behavior in Pender’s rHPM is not influenced by fear or threat, which is one basis of the HBM. Adolescents, who tend to live in the present, are often unable to fathom long term consequences to their current health behaviors (Muscari, 1998). Thus, Pender’s rHPM is more appropriate for adolescents. The rHPM is a competence or approach oriented model versus an avoidance model (Pender et al., 2006). See Pender’s rHPM in figure 2 as adapted for this learning module.
Although goal setting has been found to be effective for making behavioral changes in adults, Shilts, Horowitz, & Townsend (2004) felt that adolescents may not yet have acquired the abstract reasoning skills to set appropriate goals. Thus the authors
proposed guided goal setting. Guided goal setting allows adolescents to select from a variety of provider developed goals. This not only helps the adolescent select appropriate health promotion goals, but leads to successful goal achievement. Meeting goals leads to increased feelings of self-efficacy in the adolescent, which then promotes health behavior change. According to the rHPM, self-efficacy and perceived barriers are inversely related. When self-efficacy increases there is a corresponding decrease in perceived barriers.

The development of interventions that address perceived benefits and barriers to weight bearing physical activity in the adolescent age group are also critical to success (Garcia et al., 1995). Garcia, Norton-Broda, Frenn, Coviak, Pender, and Ronis (1995) used the rHPM to guide a study whose purpose was to identify exercise-related beliefs and determinants of exercise behavior in middle school children. The authors found that girls were not only exercising less than boys, but they had more perceived barriers to exercise. Girls also tended to have less self-efficacy towards exercise than boys (Garcia et al., 1995). Developing self-efficacy is an important part of intervention strategies when working with adolescents, particularly adolescent girls. It is also important to develop strategies to decrease perceived barriers to health behavior change. Both of these components must be addressed in any intervention strategy (Garcia, et al., 1995).

Wu and Pender (2005) addressed the factors that influence health-promoting behavior in a prospective study on physical activity of Taiwanese youth. Selected variables that affected physical activity behavior over a two year period were evaluated in 8th and 9th graders. The behavior specific cognitive variables assessed included perceived
benefits of physical activity, perceived barriers to physical activity, and perceived self-efficacy to perform physical activity (Wu & Pender, 2005). Results showed that girls were less physically active than boys and the strongest predictor of physical activity behavior was self-efficacy. It was also found that girls tended to perceive more barriers to physical activity, saw fewer benefits to participating in physical activity, and had less self-efficacy than boys (Wu & Pender, 2005). This is consistent with the findings of Garcia et al. (1995). Development of self-efficacy in the adolescent is important to effect behavior change. Through implementation of an educational module that provides information about bone health (osteonosis, calcium, vitamin D, weight bearing physical activity), followed by hands-on activities (calcium counter exercise, guided goal setting) adolescents will be able to develop the necessary skills to effect health behavior change. The expected health behavior outcomes of this intervention include: increased osteoporosis knowledge, improved dietary intake of calcium and vitamin D, and increased weight bearing physical activity. The rHPM will be used to guide the intervention plan. The intervention will be based on the concept that improved self-efficacy decreases perceived barriers to change, and that improved self-efficacy can be promoted through the use of guided goal setting. Through guided goal setting adolescents will commit to a plan of action that will be implemented through specific goal directed behavior changes.

Summary

During childhood and adolescence bone modeling accompanies bone growth but ceases when the skeleton reaches maturity at about the age of 18 (Bachrach, 2001). Early
prevention of osteoporosis is critical during this time because proper dietary calcium and vitamin D intake and weight bearing physical activity can maximize peak bone mass, thus decreasing the risk of osteoporosis in the later years. Review of the literature clearly supports that improved calcium and vitamin D intake during the growing years combined with regular weight bearing physical activity improves peak bone mass.

The theoretical model chosen to guide development and implementation of this proposed project is Pender’s rHPM. The rHPM is a competence or approach oriented model to health promotion. Identification of adolescents characteristics and experiences guides educational needs. Guided goal setting will improve targeted behaviors by helping adolescents to not only choose achievable goals, but to meet these goals. This will decrease perceived barriers, increase positive perception of outcomes or perceived benefits and increase goal commitment, thus achieving the desired health promoting behavior change.
CHAPTER III

Learning Module

The primary purpose of this proposal is to promote osteoporosis prevention through the education of adolescents in how to maximize their skeletal growth and bone density through increasing dietary intake of calcium and vitamin D, and increasing weight-bearing physical activity. The proposed learning module will present information about osteoporosis to middle school age children. It will address who is at risk for osteoporosis, what causes osteoporosis, and how to prevent osteoporosis. The module will be given interactively and encourage student participation through a question and answer format. A power point presentation will be used to present key knowledge concepts. Included in the presentation will be a learner activity to evaluate a typical day’s dietary intake of calcium and vitamin D. Evaluation measures include a bone health Knowledge Questionnaire on nutrition and physical activity, a bone health Belief Questionnaire on nutrition and physical activity, a Moderate Vigorous Physical Activity self-report measure, and a Short Food Frequency self-report measure for calcium and vitamin D intake. Measures will be taken at baseline and at six weeks post learning module presentation. The results of the pre and post measures will be examined for changes in scores that indicate the effectiveness of the learning module in promoting health behavior change.

Learning and the Adolescent

Behaviorally based nutrition interventions have been effective in producing dietary changes in the adolescent (Hoelscher, Evans, Parcel, & Kelder, 2002). Hoelscher,
et al. (2002) in their review of 17 adolescent nutrition interventions reported between 1994 and 2000, found that theoretically-based interventions with a behavioral focus versus a knowledge-based focus were the most successful. If additional behaviors, such as weight bearing physical activity, were also targeted the interventions were more successful.

This module is focused on increasing osteoporosis knowledge, improving dietary intake of calcium and vitamin D, and increasing weight bearing physical activity through guided goal setting. This module is consistent with the rHPM in that guided goal setting will enhance perceived self-efficacy, decrease perceived barriers, and enhance perceived benefits to implementing the expected behavior changes.

Intervention

Interventions are guided by the rHPM to increase adolescents feelings of self-efficacy towards changing nutrition and physical activity behavior, decreasing perceived barriers to changing nutrition and physical activity behavior, and increasing perceived benefits to changing nutrition and physical activity behavior. Current knowledge, beliefs and behaviors about nutrition and physical activity will be assessed using the Knowledge Questionnaire (Appendix A), the Belief Questionnaire (Appendix B), the Moderate Vigorous Physical Activity (MVPA) self-measure instrument (Appendix C), and the Short Food Frequency (SFF) self-measure instrument (Appendix D). The mean scores obtained pre-intervention and again six weeks post-intervention will be compared to assess for change in knowledge about bone health (knowledge), change in beliefs about
bone health (beliefs), change in dietary intake of calcium and vitamin D (behavior), and change in weight-bearing physical activity (behavior).

The interventions are designed to change behavior-specific cognition (knowledge), and affect (beliefs) in the adolescent. The calcium counter exercise (Appendix F) gives the student a tool to evaluate their current nutritional intake of calcium and vitamin D, and identify foods high in calcium and vitamin D to augment their daily calcium and vitamin D intake. By providing a tool that is easy and understandable, perceived barriers to change should decrease. The second participatory activity is guided goal setting. Guided goal-setting (Appendix G) allows adolescents to select from a variety of provider developed goals that are specific to the desired behavior change, have a low level of difficulty, and may increase their attainability (Shilts et al., 2004). By helping adolescents select appropriate goals for their ability level, adolescents should meet with successful goal accomplishment. Success leads to increased self-efficacy, decreased perceived barriers, and promotes successful behavior change (Pender et al., 2006). Guided goal setting also provides adolescents with choice. Choice of goals increases the value of those goals for the adolescent. When goals are valued they promote commitment to a plan of action. Commitment to a plan of action (goal), reinforced by strategies that assist the adolescent in meeting the action (goal) should promote behavior change (Pender et al., 2006; Shilts et al., 2004).

The didactic portion of the intervention will be specifically designed to increase adolescents knowledge about bone health, nutrition, and weight-bearing physical activity. Increased knowledge about bone health, nutrition, and weight-bearing physical activity
should increase adolescents perceived benefits to increasing calcium and vitamin D intake and increasing weight bearing physical activity. Improved benefits include better bone health, and improved well-being. The participatory (hands on) components of the intervention (the calcium counter exercise and guided goal setting) facilitate behavior change through improving self-efficacy and decreasing perceived barriers to the desired behavior changes.

The effectiveness of this learning module for promoting nutrition and weight bearing physical activity behavior change in the adolescent will be evaluated by examining changes in the pre and post-test scores. The repetition of the questionnaires and self-measure instruments will also provide an opportunity for the students to evaluate their personal outcomes in meeting their selected goals. See Figure 2 for a visual representation of how the rHPM guides the learning module.

Measures

The module begins with an introduction to the topic of osteoporosis and will include description and administration of the Nutrition and Physical Activity Knowledge Questionnaire, the Belief Nutrition and Physical Activity Questionnaire, the MVPA self-measure instrument, and the SFF self-measure instrument. The questionnaires and self-measure instruments are brief and designed to be completed in a short amount of time. Twenty minutes should be adequate for students to complete these measures. The measures will evaluate the individual characteristics of each adolescent learner (see fig. 2).
Questionnaire Overview

The Knowledge and Belief Questionnaires used in this intervention were taken from a three part Osteoporosis Risk Questionnaire used in a study designed to assess osteoporosis knowledge and beliefs among adolescent girls (Anderson, Chad, & Spink, 2005). The three part Osteoporosis Risk Questionnaire assesses knowledge and beliefs about the following lifestyle risk factors for osteoporosis: nutrition, physical activity and cigarette smoking. Questions adapted for use in this learning module were left unchanged from the original study; however, questions about smoking were left out. The three part questionnaire was evaluated prior to data collection for comprehension (ten females aged 12 to 16 years), then followed by test-retest reliability (27 females aged 12 to 16 years). The researchers determined the Osteoporosis Risk Factor Questionnaire to be a reliable instrument (Anderson et al., 2005). Only two parts of the osteoporosis risk questionnaire will be used, the Knowledge Questionnaire and the Belief Questionnaire.

Knowledge Questionnaire

The Knowledge Questionnaire contains six physical activity questions (true/false), three nutrition questions (true/false) and one multiple choice nutrition question (yes/no). Each correct answer is worth one point and total correct answers are summed. Higher scores indicate a higher level of knowledge. Smoking questions from the original instrument were left out of this revised questionnaire. Test-retest reliability for the knowledge questionnaire after two trials one week apart were; physical activity knowledge ($r = .65$, $p < .01$); nutrition knowledge ($r = .75$, $p < .01$) (Anderson et al., 2005). See the Knowledge Questionnaire in Appendix A.
Belief Questionnaire

The Belief Questionnaire consists of seven statements, three about physical activity, and four about nutrition (smoking questions from the original questionnaire were left out). Statements were designed to assess lifestyle beliefs and behavioral modeling associated with osteoporosis. Responses are on a five-point Likert type scale that ranges from strongly disagree (5 points) to strongly agree (1 point). The authors of the questionnaire used a Pearson Product Moment Correlation to evaluate the test-retest reliability of the Belief Questionnaire and test-retest reliability was significantly correlated \( r = .79, \ p < .01 \) (Anderson et al., 2005). See Belief Questionnaire in Appendix B.

Moderate Vigorous Physical Activity (MVPA) Self Measure

The 60 minute Moderate to Vigorous Physical Activity (MVPA) self measure instrument is a brief self-report screening tool designed to measure if adolescents are getting enough weight bearing physical activity as defined by Healthy People 2010 (Prochaska, Salis, & Lang, 2001). The authors of the self measure instrument found reliability (intraclass correlation coefficient [ICC] = 0.77) and validity (\( r = 0.40 \)) of the MVPA comparable to the literature in which a review of 17 self-report instruments showed reliabilities ranging from 0.60 to 0.98 and validity correlations ranging from 0.20 to 0.88 (Prochaska et al., 2001).

The MVPA is a two-item self-assessment instrument that asks adolescents to answer how many days out of the past seven days were they physically active for a total of 60 minutes, and over a typical week how many days during the week were they
physically active for a total of 60 minutes. The maximum score possible for each question is seven points. Scores for each question are added and the sum is divided by two. A score of less than five means that weight bearing physical activity does not meet a minimum of 150 minutes of moderate to vigorous weight bearing physical activity per week (“Healthy People 2010”, 2000). See the MVPA instrument in Appendix C.

Short Food Frequency (SFF) Self Measure

The Short Food Frequency (SFF) self measure instrument, derived from the Health Habits and History Questionnaire (HHHQ), is designed to assess dietary intake of calcium and vitamin D (Blalock, Norton, Patel, Cabral, & Thomas, 2003). Participants in the SFF development study were assessed through a seven day food diary, the HHHQ, and the SFF questionnaire. They found that the SSF for calcium and vitamin D intake significantly correlated ($r = 0.66$ and $0.72$) to the seven day food diary ($p < .001$).

Though not a replacement for more comprehensive nutritional assessments, the SSF used as a screening tool can not only identify individuals with low nutrient intakes, but has a predictive value when compared to the seven day food diary of 91.7% for calcium intake, and 100% for vitamin D intake (Blalock et al., 2003). Total calcium intake in mg is calculated through addition of all food items. See the SFF self measure instrument in Appendix D.

Procedures

The testing and didactic portions of this learning module will require approximately two 50 minute class periods to present and one 50 minute class period six weeks later to evaluate results. The initial 25 minutes of the first class will be spent in
instrument testing. The informational portion of the module will follow, and will be presented to the class through use of a narrated Power Point presentation. The narrated presentation should be approximately 25 minutes in length. It will be given in an interactive fashion with students encouraged to ask and answer questions. The Power Point presentation will consist of 20 slides providing information on osteoporosis, bone growth, calcium, and weight bearing physical activity. The Power Point content was reviewed by a sixth grade science teacher for grade level congruency. The second 50 minute class period will be directed towards didactic and participatory activities including the calcium counter activity, guided goal setting, and use of the goal progress chart. Evaluation of the learning module will require one additional 50 minute class period scheduled six weeks post intervention. Evaluation will include module review, goal review, and repetition of initial questionnaires and self report measures.

Didactic Content

Initial discussion will include the definition of osteoporosis as porous bone; porous bone is weaker and at greater risk for fracture (National Institutes of Health Osteoporosis and Related Bone Diseases National Resource Center, 2005a). An analogy will be used to compare porous bone to pumice stone. A sample of pumice stone and non-porous stone will be passed around for comparison. This will be followed by a discussion of who is at risk for osteoporosis. The following information will be given: one out of two women and one out of four men who are over the age of 50 will have a fracture related to osteoporosis in their lifetime. Ten million people in the U. S. currently have osteoporosis; another 34 million have low bone mass and are at risk for developing
osteoarthritis (National Institutes of Health Osteoporosis and Related Bone Diseases National Resource Center, 2005a). Factors that cannot be changed that put an individual at high risk for osteoporosis will be discussed: age, gender, body size, ethnicity, and family history. Risk factors that can be changed will also be addressed: sex hormones, anorexia nervosa, calcium and vitamin D intake, medication use, lifestyle, cigarette smoking, and alcohol intake (National Institutes of Health Osteoporosis and Related Bone Diseases National Resource Center, 2005a). Additional statistics will be given including that osteoporosis is responsible for more than 1.5 million fractures each year and costs over $14 billion dollars in direct care costs (National Institutes of Health Osteoporosis and Related Bone Diseases National Resource Center, 2005a).

Next, the composition of bone will be identified (collagen and calcium phosphate), and its structure in the human body (the skeleton and teeth) (National Institutes of Health Osteoporosis and Related Bone Diseases National Resource Center, 2005a). Bone growth will be discussed and the analogy of the bone as a bank will be given to help adolescents understand the concept that building bone now can mean healthier bones later (National Institutes of Health Osteoporosis and Related Bone Diseases National Resource Center, 2005b).

Finally, the power point will introduce osteoporosis prevention. This will include a discussion of daily dietary calcium and vitamin D intake requirements, and identification of food sources high in calcium including: milk, dairy products, dark green leafy vegetables, sardines and salmon with bones, tofu, almonds, fortified foods, and calcium supplements (Misner, 2002). Osteoporosis prevention will also include a
discussion of weight-bearing physical activity and Healthy People 2010 weight bearing physical activity guidelines. Guidelines include a minimum of 30 minutes of moderate to vigorous weight bearing physical activity at least five out of seven days each week (“Healthy People 2010”, 2000). See the Power Point presentation in Appendix E. The knowledge component of the learning module is meant to influence adolescents perceived benefits to participating in strategies to improve bone health (Fig. 2).

The next portion of didactic content includes the calorie counter exercise (Appendix F). Each adolescent will review a typical day of food intake and use the calcium counter work sheet to calculate how much calcium they average in a typical day. Through this activity the adolescent will develop an understanding of what the calcium content is of the typical foods they eat each day, how much calcium they are getting each day, and what food choices would be best to increase their daily calcium intake. This is a tool that is easy to use and students should be successful in its application. Success should promote nutritional self-efficacy, and increased self-efficacy will decrease perceived barriers to implementing dietary change (fig. 2). The calorie counter exercise was adapted from The University of Arizona Cooperative Extension “Bone Builders” program. This activity is planned to take approximately 25 minutes. The worksheet is in Appendix F. The last 20 minutes of this classroom experience will be directed towards adolescent guided goal selection and implementation.

Self-efficacy, a primary component of the rHPM, is important for promoting behavior change. Self-efficacy theory states that if a person is confident that he or she can successfully perform a task or activity, fewer barriers to that task will be perceived
and the perception of benefits will increase. This will make the person view this task more favorably, and even anticipate enjoyment (Dishman et al., 2005). This module will assist adolescents in improving self-efficacy through the use of guided goal setting. Implementation of guided goals allows the adolescent to choose a goal that is meaningful to him or her, specific, attainable, and appropriate for the desired outcome (Shilts et al., 2004). The goals are provided by the practitioner and they are designed to be simple, specific and obtainable. Through successful goal attainment self-efficacy will improve, perceived barriers will decrease, perceived benefits will increase, and a positive behavior change will occur. For this module, positive behavior change consists of increased calcium intake and increased weight bearing physical activity.

Nutrition goals and weight bearing physical activity goals will be presented to the adolescent learners. They will be instructed to pick one goal from the nutrition list and one goal from the weight bearing physical activity list. Goals vary in complexity, allowing the adolescent to select a goal that meets their individual needs. The nutrition goals are provided to increase calcium and vitamin D intake, and there are six goals to choose from. The first goal includes selecting and eating/drinking four servings of calcium rich food daily from the food pyramid. The second goal identifies not skipping breakfast and adding at least one calcium rich food or beverage to this meal daily. The third goal directs the adolescent to choose one cup of milk at lunch daily instead of a carbonated and/or high sugar fruit drink. The fourth goal directs the adolescent to eat or drink one calcium rich food at dinner. Adolescents who select the fifth goal agree to add
a high calcium food or beverage snack daily. The sixth goal adds calcium rich foods and beverages by two servings per week until four or five daily servings are reached.

By presenting students with a choice of simple, achievable goals, value in those goals should be encouraged. The simplicity of the goals should make them easy to achieve. This should lead to an increase in dietary self-efficacy and a decrease in perceived barriers to changing dietary behavior. Improved self-efficacy and a decreased perception of barriers should encourage the student to act on his/her commitment (or goal), increasing perceived benefit through improvement of bone health and overall well being (Fig. 2). The Nutrition Goal List is in Appendix G.

Physical activity goals start with activities that increase weight bearing physical activity and decrease sedentary behavior. Goal one decreases television viewing ten minutes daily each week and replaces it with bone building weight bearing physical activity until the goal of 60 minutes (total) each day is attained. The second goal is similar, only it decreases computer and/or video game time. The third goal offers increased weight bearing physical activity through bone building sports activity and increasing participation time weekly. The last two goals are also sports oriented and increase participation to 30 or 60 minutes daily. Again, by presenting students with a choice of simple, achievable goals, value in those goals should be encouraged. The simplicity of the goals should make them easier to achieve. This should lead to an increase in weight bearing physical activity self-efficacy and a decrease in perceived barriers to changing weight bearing physical activity behavior. Improved self-efficacy and decreased barriers should encourage the student to act on his/her commitment (or
goal) i.e., increasing weight bearing physical activity. Successful accomplishment of goals should lead to an increase in perceived benefit i.e., improved bone health and well being (Fig. 2). The Weight-bearing Physical Activity Goal list is in Appendix G.

After students have selected their goals they will be instructed to write them on the top of the appropriate goal and progress charts. The charts provide a graphic visual display for the adolescent to track their progress towards meeting their selected goals over the next six weeks. It is a simple chart and will require very little time each day for the adolescent to complete. The Goal Chart is directed towards decreasing perceived barriers to behavior change (Fig. 2). The adolescent will mark a star (met goal), checkmark (partially met goal), or an X (did not meet goal) at the end of each day. The chart consists of seven horizontal boxes, one for each day of the week, and six vertical columns, one for each week (six). The Goal and Progress Charts are in Appendix H.

At the end of six weeks one more class session will be held. During this class session students will bring in their Goal Charts to share with their peers and instructor. An open discussion will be promoted to discuss what students found effective in promoting behavior change and what they found ineffective in promoting behavior change. Students will be asked to provide feedback on what would make this program more meaningful to them and to assist in future program improvement. Self-evaluation and discussion should take approximately 25 minutes of class time. The last 25 minutes of class will be spent repeating the initial Knowledge and Belief Questionnaires, the MVPA self measure instrument, and the SSF self measure instrument. The data obtained
from both pre and post-intervention testing will then be analyzed using SPSS Version 13 software.

Data Analysis

The pre and post-intervention test instruments provide interval data. These data will be analyzed for central tendencies and normality of distribution. Mean pre and post-intervention scores will be compared using a dependent or paired $t$ test. This is particularly important in analysis of small samples where the family of $t$ should be used. The paired $t$ test compares the average scores of a single sample (same class of students) on two variables (pre and post-intervention test averages). The equation for this is:

\[ t = \frac{\text{difference between pre-intervention test score and post-intervention test score means}}{\text{standard error of the difference between the means}} \]

(Urban, 2001, p.76). These calculations will be made using the SPSS Version 13 computer software. Statistical significance of the $t$ value obtained will depend on the sample size. For example, a class of 25 students will have a $df$ (degree of freedom) of 24. Using the $t$ distribution table for a one-tailed test with an $\alpha$ level of 0.10, a significant $t$ value would have to be greater than or equal to 1.318 (Urdan, 2001, p. 137).

Human Subjects Review

This project will require human subjects review and approval from the institutional review board of the University of Arizona prior to implementation of the module. Written consent from the parents of participating students, permission from school officials, and permission from the participating teacher will also be required.
Summary

This chapter proposes a learning module to promote early osteoporosis prevention in adolescents aged 11 to 14. The didactic component of the learning module will present information about osteoporosis including causes, risk factors, and prevention. It will also include information on factors that promote healthy bone growth. A participatory activity will be provided that instructs adolescents on how to calculate their calcium consumption for a typical day and identify foods and beverages that are high in calcium content.

The outcome expectations for this learning module are improvement in osteoporosis knowledge as measured by the Knowledge and Belief Questionnaires on nutrition and weight bearing physical activity, improved dietary calcium and vitamin D intake as measured on the SFF self-measure, and increased weight-bearing physical activity as measured on the MVPA self-measure. Guided goal setting will be implemented to assist adolescents in selecting simple, specific, achievable goals. Goal achievement will increase adolescent feelings of competence and promote self-efficacy. This in turn will lead to successful behavior changes in dietary calcium intake and weight-bearing physical activity participation.

This intervention is projected to take three 50 minute class periods. The first class session includes pre-intervention testing, and presentation of the didactic component. The second class includes the calcium counter activity and guided goal selection. The third class will occur six weeks post-intervention and includes project discussion and post-intervention testing. The intervention evaluation measures or instruments include
the Knowledge and Belief Questionnaires on nutrition and physical activity, the MVPA self measure instrument, and the SFF self measure instrument. The SPSS Version 13 computer software will be used to evaluate the data collected. A paired or dependent $t$ test will be used to determine if there is a statistical significance between pre and post-intervention test averages (means) within this sample group that would indicate the intervention had a positive effect on health behavior change.
CHAPTER IV
Osteoporosis Prevention

Osteoporosis prevention is of paramount importance not only in the United States, but worldwide. Although osteoporosis begins in childhood, it does not manifest until later in life. Early intervention to improve dietary calcium intake and weight-bearing physical activity in adolescence may result in less future geriatric fragility fractures, improved quality of life, and decreased health care costs. This makes it essential to educate and promote healthy diet and weight bearing physical activity behavior in our children during their growing years. This learning module addresses primary prevention of osteoporosis through health behavior change. Pender’s rHPM provides the theoretical framework chosen to promote this behavior change.

Discussion of Project

Anderson, Chad, and Spink (2005) found no significant correlation between osteoporosis knowledge and beliefs, and calcium intake and weight bearing physical activity. Knowing about a problem does not necessarily promote behavior change to avoid the problem. Pender’s rHPM provides an explanation for this phenomenon. Behavior is affected by more than just knowledge. Personal self-concept about health and illness, influence of family and peers, feelings of self worth or self-efficacy all play a role in determining behavior change (Pender, et al., 2006). A person with high self-efficacy is more likely to perceive fewer barriers to participating in healthful eating and physical activity than someone with low self-efficacy. In this proposal guided goal setting and self management activities will be used to improve self-efficacy in the
adolescent. Goals will be met in incremental steps which will facilitate adolescent success, increase self-efficacy, decrease perceived barriers, and increase the perceived benefits of action; improved bone health and well being. Knowledge about osteoporosis and its causes prepares the way for improving bone health. The calcium counter activity gives the adolescent a tool to determine how much calcium they are actually eating and what foods provide the most calcium. Through selecting a goal the adolescent is expressing a willingness to change. If the adolescent is successful with making a behavior change, as evidenced by progress on their daily goal chart, self-efficacy will be improved, thus reinforcing the desired behavior change. This learning module is designed not only to improve the quality of adolescent bone health, but to continue those benefits throughout the lifespan.

A review of the literature reveals that peak bone mass is obtained during adolescence, with maximum density gained by the late teens to early twenties (Di Rado, 2003). Dietary calcium seems to be the best source of elemental calcium for the body, and for promoting maximum bone mineral content. Current dietary trends show that 90% of healthy adolescent girls, and 50% of adolescent boys are not meeting the minimum requirement of calcium in their diets (Bachrach, 2001). The recommended daily allowance (RDA) for calcium is 1300 mg of calcium per day from ages 9 to 17 (Di Rado, 2003). However, Matkovic et al. (2005) found that 1500 mg of calcium per day during the bone modeling phase of the pubertal growth spurt has a positive influence on bone acquisition. This suggests that a higher RDA for calcium may be appropriate during the adolescent period.
In further review of the literature it is apparent that weight bearing physical activity is also important in the development of maximum peak bone mass. In a study by Sundberg, Gärdsell, Johnell, Karlsson, Ornstein, Sandstedt, and Serbo (2002), weight bearing physical activity yielded the most skeletal benefits before age 13 in both boys and girls. Adolescents who participated in weight bearing physical activity had significantly higher bone mineral content and bone area in the femoral neck than did adolescent controls who had not participated in weight bearing physical activity (Fuchs & Snow, 2002). Weight bearing physical activities most contributory to achieving peak bone mass are activities such as soccer, dancing, weight-lifting, stair climbing and gymnastics (Durst, 2000).

Evaluation

Statistical analysis will be used to evaluate the effectiveness of this learning module to promote behavioral change. Results on pre and post measure data will be entered into the SPSS Version 13 computer software. The interval data will be analyzed for central tendency and normality of distribution. A paired or dependent t test will be used to compare pre and post-intervention means.

Limitations

One limitation of this project is time. This project will need a minimum of three 50 minute class periods to present and evaluate. This may meet with resistance from community educators who may not be willing to give up that much of their classroom instructional time. Time is also a limitation because three 50 minute class periods may not be sufficient to successfully implement this educational module, including assisting
the adolescent learners with goal selection and implementation. Another limitation of
this module is gender based. Girls tend to have lower self-efficacy towards weight
bearing physical activity; perceive fewer benefits to weight bearing physical activity; and
perceive more barriers towards participating in weight bearing physical activity than boys
(Wu & Pender, 2005). They may need more guidance in goal setting and implementation
of steps to behavior change. A mixed learning environment of girls and boys may be
perceived by the girls as an additional barrier. Finally, the instruments being used are
self-report instruments so results are only as accurate as the self-report.

Strengths

Strengths of this proposed learning module include support of adolescents making
choices. This allows the student to be an active participant in the learning experience
which promotes self-efficacy and improves perceived outcomes. Additionally,
interactive learning provides student to student interaction and experience which may
provide peer support for change (Fig. 2).

Relevance to Nursing

Healthy Arizona 2010 identifies that weight bearing physical activity promotes
normal skeletal development in children and adolescents, helps achieve and maintain
peak bone mass in young adults, and helps older adults maintain strength and agility.
Arizonans have decreased their physical activity level from 76.3% in 1994 to 48.7% in
1998. Of the 50 states, Arizona ranks last in its percentage of adults who report leisure
time physical activity (Arizona Department of Health Services Division of Public Health
Services, 2004a).
Healthy Arizona 2010 also reports that a dietary profile for calcium intake done by the University of Arizona Prevention Center in 1995 showed that only 22.5% of Arizonans consumed 100% of the RDA for calcium. Arizonans were also found to have inadequate intake of fruit and vegetable servings, increased amounts of saturated fats, and had almost a 50% rate of obesity (Arizona Department of Health Division of Public Health Services, 2004b).

We are experiencing a potentially devastating health crisis in this country in which current nutrition and weight bearing physical activity behaviors play a very large role. By promoting good nutrition and healthful weight bearing physical activity starting in childhood, many chronic diseases can be prevented, among them osteoporosis. Nurses are expert health educators and believe strongly in disease prevention. Educating individuals, families, and communities on how to improve their health through nutrition and weight bearing physical activity education is well within the nurse’s scope of practice.

Conclusion

Osteoporosis is a disease that has it’s beginnings in childhood. Through early nutrition and weight bearing physical activity intervention we have the opportunity to prevent this geriatric disease that causes decreased quality of life and escalating health care costs. Promoting adequate calcium intake and weight bearing physical activity throughout the lifespan promotes maximum bone health. This is particularly true during the adolescent growing years when bone modeling is occurring. Adequate calcium intake of 1500 mg of elemental calcium per day is essential in obtaining peak bone mass during
the pubertal growth spurt period. Encouraging moderate to vigorous weight bearing physical activity of 30 to 60 minutes each day is equally important in maximizing peak bone density. This learning module proposes one method of promoting effective behavior change in the adolescent for health promotion.
APPENDIX A

KNOWLEDGE QUESTIONNAIRES
Physical Activity

1. Bones are living tissues that need physical activity to be healthy and strong.
   a. True
   b. False

2. High impact physical activity such as soccer is best for your bones.
   a. True
   b. False

3. Regular physical activity helps your body use calcium more efficiently.
   a. True
   b. False

4. Physical activity can help keep you from losing muscle when you’re dieting to lose weight.
   a. True
   b. False

5. Excessive physical activity combined with severe dieting can speed up bone growth.
   a. True
   b. False

6. Irregular and/or complete loss of your periods due to excessive exercise can be good for your bones.
   a. True
   b. False
Nutrition

1. It is difficult to get the calcium you need from vegetables alone.
   a. True
   b. False

2. Adolescents need more calcium than children age 6 or 7.
   a. True
   b. False

3. Drinking too much pop or caffeine can be harmful to your bones.
   a. True
   b. False

4. Which of the following foods are high in calcium?
   - Cherry yogurt
   - Ham and pineapple pizza
   - Butterscotch ice cream
   - Hamburgers and hotdogs
   - Chocolate milk
   - Fruits such as oranges, kiwi, and grapefruit

Adapted from (Anderson et al., 2005).
Physical Activity Answers

1. a
2. a
3. a
4. a
5. b
6. b

Nutrition Answers

1. a
2. a
3. a
4. yes
   yes
   yes
   yes
   no
   yes
APPENDIX B

BELIEF QUESTIONNAIRES
Physical Activity

1. I believe that physical activity helps to build strong healthy bones.
   SA  A  U  D  SD

2. I believe regular physical activity is important at any age.
   SA  A  U  D  SD

3. I believe that physical activity is important for preventing osteoporosis.
   SA  A  U  D  SD

Nutrition

1. I believe that calcium is good for me.
   SA  A  U  D  SD

2. I believe that drinking milk helps to build strong bones.
   SA  A  U  D  SD

3. Getting enough calcium is important at any age.
   SA  A  U  D  SD

4. I believe that drinking milk will reduce my risk of osteoporosis.
   SA  A  U  D  SD

SA = Strongly agree; A = Agree; U = Unsure; D = Disagree; SD = Strongly disagree
Adapted from (Anderson et al., 2005)
APPENDIX C

MVPA SELF MEASURE INSTRUMENT
**PACE + Adolescent Physical Activity Measure**

Physical activity is any activity that increases your heart rate and makes you get out of breath some of the time.

Physical activity can be done in sports, playing with friends, or walking to school.

Some examples of physical activity are running, brisk walking, rollerblading, biking, dancing, skate boarding, swimming, soccer, basketball, football, and surfing.

Add up all the time you spend in physical activity each day (don’t include your physical education class).

**P1** Over the past 7 days, on how many days were you physically active for a total of at least 60 minutes per day?

........0 days........1........2........3........4........5........6........7 days

**P2** Over a typical or usual week, on how many days are physically active for a total of at least 60 minutes per day?

........0 days........1........2........3........4........5........6........7 days

Scoring: \((P1 + P2)/2 < 5\) indicates not meeting physical activity guidelines.

Sixty-minute screening measure for moderate to vigorous physical activity: PACE+ (Patient-Centered Assessment and Counseling for Exercise Plus Nutrition).

Figure 3 PACE+ Adolescent Physical Activity Measure (MVPA), (Prochaska et al., 2001)
APPENDIX D

SHORT FOOD FREQUENCY

SELF MEASURE INSTRUMENT
<table>
<thead>
<tr>
<th>Type of Beverage</th>
<th>How Often: Beverage or Food</th>
<th>How Much Serving Size</th>
<th>S</th>
<th>M</th>
<th>L</th>
</tr>
</thead>
<tbody>
<tr>
<td>Whole milk beverages and beverages with whole milk</td>
<td>Never or less than once a month</td>
<td>8-oz. glass</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>1-3 per month</td>
<td>1 per week</td>
<td>2-4 per week</td>
<td>5-6 per week</td>
<td>1 per day</td>
</tr>
<tr>
<td></td>
<td>8-oz. glass</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2% milk and beverages with 2% milk</td>
<td>8-oz glass</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Skim milk, 1% milk, or buttermilk</td>
<td>8 oz. glass</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Milk in coffee or tea</td>
<td>1 Tablespoon</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Type of Food</td>
<td>Medium Serving</td>
<td>S</td>
<td>M</td>
<td>L</td>
<td></td>
</tr>
<tr>
<td>Broccoli</td>
<td>½ cup</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mustard greens, turnip greens, collard greens</td>
<td>½ cup</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Spaghetti, lasagna, other pasta with tomato sauce</td>
<td>1 cup</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mixed dishes with cheese (such as macaroni and cheese)</td>
<td>1 cup</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cheeses and cheese spreads (including on sandwiches, burgers, tacos and nachos; not including cottage cheese)</td>
<td>2 slices or 2 oz.</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Type of Food</td>
<td>How Often Food</td>
<td>How Much</td>
<td>Serving Size</td>
<td></td>
<td></td>
</tr>
<tr>
<td>----------------------------------------------------------------------------</td>
<td>-------------------------</td>
<td>----------</td>
<td>--------------</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Never or less than once a month</td>
<td>1-3 per month</td>
<td>1 per week</td>
<td>2-4 per week</td>
<td>5-6 per week</td>
<td>1 per day</td>
</tr>
<tr>
<td>White bread (including sandwiches, bagels, burger-rolls, or Italian bread)</td>
<td>2 slices</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Dark bread, wheat, rye, pumpernickel (including sandwiches)</td>
<td>2 slices</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Biscuits or muffins (including fast foods)</td>
<td>Medium pieces</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Ice-cream</td>
<td>1 scoop or 1/2 cup</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Yogurt, frozen Yogurt</td>
<td>1 cup</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Milk on cereal</td>
<td>1/2 cup</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Oysters</td>
<td>6 medium</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Shrimp</td>
<td>3 oz.</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pink Salmon</td>
<td>3 oz.</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Tuna, tuna-salad, tuna-casserole</td>
<td>1/2 cup</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Liver, including chicken-livers</td>
<td>4 oz.</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Eggs</td>
<td>1 egg small, 2 eggs</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>High-fiber bran or granola cereal, shredded wheat</td>
<td>Medium Bowl</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Adapted from the Short Food Frequency Questionnaire, (Blalock, Norton, Patel, Cabral, & Thomas, 2003)

APPENDIX E

POWER POINT PRESENTATION

OSTEOPOROSIS
Osteoporosis

What is it?
What does it have to do with me?

Susan M. Rundle February 27, 2006
Osteoporosis Power Point Outline

What is it?

What does it have to do with me?

What is osteoporosis?

- Osteoporosis means porous bone!
- Have you ever seen pumice or lava rock? It is very light and full of holes
- Compare that to solid rock which is dense and heavy
- In osteoporosis the bone is lighter and less dense than healthy bone; it’s like comparing pumice to rock
- Bones that are porous are fragile....they break more easily!

Who gets Osteoporosis?

- Both men and women get osteoporosis
- Osteoporosis can strike at any age
- One out of every two women and one in four men over the age of 50 will have a fracture related to osteoporosis in their lifetime
- 10,000,000 people in the U.S. have osteoporosis now, and 34,000,000 more have low bone mass increasing their risk to develop osteoporosis

Who is at highest risk?

- Female
- Postmenopausal
- Small skeleton
- Caucasian/Asian
Family History of Osteoporosis and fractures

Advanced age

Risk factors that can be changed…

Medications that negatively affect bone

Inadequate or excessive intake of nutrients

Sedentary----no weight bearing exercise

Low body weight

Cigarette smoking

High level of alcohol consumption

Eating for Bone Health The University of Arizona Cooperative Extension

So what’s the big deal?

Osteoporosis is responsible for more than 1,500,000 fractures each year!

300,000 hip fractures

700,000 vertebral fractures (spine)

250,000 wrist fractures

300,000 fractures at other sites

It costs over $14,000,000,000 (yes, that is 14 billion dollars!!!!!!!) each year to treat fractures related to osteoporosis.

So, what does this have to do with me? I’m a kid……right?

Osteoporosis is Preventable!!!!!!!!

Growing bones can be made Stronger!

And wow, are you guys and gals growing!
My bones are growing!

- Your bone is living tissue.
- Your bone is made from collagen which is a protein that provides a soft framework for the mineral that adds strength and hardens the framework which becomes your skeleton.
- This mineral is Calcium Phosphate
- 90% of the body’s calcium is stored in the skeleton and your teeth
- Collagen and calcium make your bones flexible and strong so that they can withstand stress

My bones are still growing!

- The human body is an incredible machine
- Right now your body is constantly removing old bone and forming new bone to keep your skeleton healthy
- During the teenage years, because you are growing, new bone is being added to your skeleton faster than old bone is being removed
- This is why your bones become larger, heavier, denser, and your new pants that you just got last month are already too short...and your shoes you got for Christmas don’t fit

My bones are still growing....

- Your long bones stop growing at about the age of 18 when you reach your adult height
- Your bones continue to get denser...and you may still grow a little more....until
around the age of 30

After 30, bone resorption (removal of old bone) slowly begins to exceed bone formation

The bone bank

Think of your skeleton like a bank….what you put into it now will help you later on

Larger and denser bones mean more reserve later in life when bone is removed faster than formed…..kind of like taxes

However….you can slow that down too and keep your bones healthy and strong throughout your life…….and how do I do that you ask?

How to make and keep strong bones

Calcium…Calcium….Calcium…..

When you are a growing teen, you need 1500 mg of calcium in your diet every day

The best source of calcium is from low fat milk and dairy products such as cheese, ice cream and yogurt.

How to make bones strong and keep them that way!

Dark green leafy vegetables like broccoli, collard greens, bok choy, and spinach

Sardines and salmon with bones

Tofu

Almonds

Foods fortified with calcium; orange juice, cereals, and breads

Calcium supplements are okay, but food is better, but getting enough calcium each day
is most important

Don’t forget vitamin D

- Vitamin D is essential for your bone health
- Did you know that your body needs vitamin D to absorb calcium in your intestines?
- Usually you get lots of vitamin D from the sun........sunscreen not only blocks ultraviolet rays, but it can also block vitamin D
- You need 400 to 800 IU of vitamin D daily
- That multivitamin daily is sounding better all the time right?

Food’s covered….so what’s next?

- You guessed it! Exercise!!!!!
- Your bone just like muscle becomes larger and stronger with regular weight bearing exercise
- Weight bearing exercise is best because it makes you work against gravity, which increases the force of the muscle contraction, which puts more stress on the bone, so bone formation increases to make that bone stronger
- What’s even cooler is that you can keep your bones healthy throughout your life with just a little regular exercise!!!!

What is weight bearing exercise?

- Walking with weights                Weight training
- Hiking                                        Tennis
- Jogging
- Volleyball
- Stair climbing
- Dancing
- Jumping rope
- Racquetball
- Playing basketball
- Gymnastics
- Playing soccer
- Backpacking

**How much exercise is enough?**

- **According to Healthy people 2010**
  
  - At least 30 to 60 minutes of moderate to vigorous physical activity daily. This is a cumulative total.....5 minutes here, 10 minutes there........for 5 out of 7 days each week
  
  - At least 20 minutes (continuous) exercise 3 times a week that speeds your heart rate up.....it’s good for your heart and lungs

**Now what?**

- Eat more calcium
- Exercise
- Share this with your friends and family
- Habits developed now will keep you healthy all of your life
- Good luck!
The Web

- Milk Matters Web Site Home: NIH, National Institute of Children’s Health and Development (NIHCD) [http://156.40.88.3/milk/milk.cfm](http://156.40.88.3/milk/milk.cfm)

- Bone up on Bone Loss! Exercise to Build Healthy Bones!

- Milk Matters......For Strong Bones..........For Lifelong Health

- Why Milk Matters Now. For Children and Teens.

- National Institutes of Health Osteoporosis and Related Bone Diseases, National Resource Center, Fact Sheets: Osteoporosis: Website.
  [http://www.osteo.org/osteolinks.asp#gen](http://www.osteo.org/osteolinks.asp#gen)

The Web


- Nutrition and the Skeleton. The role of calcium and other nutrients

- Calcium and Vitamin D: Important at Every Age
  [http://www.osteo.org/inetdocs/r301pi.pdf](http://www.osteo.org/inetdocs/r301pi.pdf)


- University of Arizona Cooperative Extension, Bone Builders at
  [http://ag.arizona.edu/maricopa/fcs/bb/osteoporosis.html](http://ag.arizona.edu/maricopa/fcs/bb/osteoporosis.html)
APPENDIX F

THE CALCIUM COUNTER EXERCISE
How much Calcium did you eat yesterday?

**Milk, Yogurt & Cheese Group**

<table>
<thead>
<tr>
<th>Food, serving size#</th>
<th># of servings</th>
<th>X</th>
<th>Mg of Calcium</th>
<th>=</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>yogurt, nonfat, 1 cup</td>
<td>X</td>
<td>490 mg</td>
<td>=</td>
<td></td>
<td></td>
</tr>
<tr>
<td>yogurt, fruited, 2%, 1 cup</td>
<td>X</td>
<td>370 mg</td>
<td>=</td>
<td></td>
<td></td>
</tr>
<tr>
<td>milk, fat-free – 1 cup</td>
<td>X</td>
<td>300 mg</td>
<td>=</td>
<td></td>
<td></td>
</tr>
<tr>
<td>milk, reduced-fat – 1 cup</td>
<td>X</td>
<td>300 mg</td>
<td>=</td>
<td></td>
<td></td>
</tr>
<tr>
<td>pizza, 1/8 of 15”; or quiche, 1/8 of 8” pie</td>
<td>X</td>
<td>250 mg</td>
<td>=</td>
<td></td>
<td></td>
</tr>
<tr>
<td>cheese, Swiss 1 oz</td>
<td>X</td>
<td>270 mg</td>
<td>=</td>
<td></td>
<td></td>
</tr>
<tr>
<td>cheese, Mozzarella, 1 oz</td>
<td>X</td>
<td>210 mg</td>
<td>=</td>
<td></td>
<td></td>
</tr>
<tr>
<td>ice cream, frozen yogurt or milk shake, 1 cup</td>
<td>X</td>
<td>200 mg</td>
<td>=</td>
<td></td>
<td></td>
</tr>
<tr>
<td>cream soup/sauce, 1 cup</td>
<td>X</td>
<td>200 mg</td>
<td>=</td>
<td></td>
<td></td>
</tr>
<tr>
<td>custard, pudding or cream pie, ½ cup</td>
<td>X</td>
<td>150 mg</td>
<td>=</td>
<td></td>
<td></td>
</tr>
<tr>
<td>soy milk, fortified – 1 cup</td>
<td>X</td>
<td>400 mg</td>
<td>=</td>
<td></td>
<td></td>
</tr>
<tr>
<td>cottage cheese, ½ cup 2%, reduced fat</td>
<td>X</td>
<td>80 mg</td>
<td>=</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Total from Milk, Yogurt &amp; Cheese Group</strong></td>
<td></td>
<td></td>
<td>=</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
### Fruits and Vegetables Group

<table>
<thead>
<tr>
<th>Food, serving size</th>
<th># of servings</th>
<th>Mg of Calcium</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>fortified orange juice, 1 cup</td>
<td>X</td>
<td>300 mg</td>
<td>=</td>
</tr>
<tr>
<td>spinach, cooked ½ cup</td>
<td>X</td>
<td>130 mg</td>
<td>=</td>
</tr>
<tr>
<td>cooked greens (beet/turnip greens, kale, collards, spinach), ½ cup</td>
<td>X</td>
<td>100 mg</td>
<td>=</td>
</tr>
<tr>
<td>broccoli, ½ cup</td>
<td>X</td>
<td>50 mg</td>
<td>=</td>
</tr>
<tr>
<td>other vegetables, ½ cup</td>
<td>X</td>
<td>30 mg</td>
<td>=</td>
</tr>
<tr>
<td>fruits, ½ cup or 1 small</td>
<td>X</td>
<td>30 mg</td>
<td>=</td>
</tr>
<tr>
<td><strong>Total from Fruits and Vegetables Group</strong></td>
<td></td>
<td></td>
<td>=</td>
</tr>
</tbody>
</table>

### Bread, Cereal, Rice, Pasta Group

<table>
<thead>
<tr>
<th>Food, serving size</th>
<th># of servings</th>
<th>Mg of Calcium</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>fortified orange juice, 1 cup</td>
<td>X</td>
<td>300 mg</td>
<td>=</td>
</tr>
<tr>
<td>spinach, cooked ½ cup</td>
<td>X</td>
<td>130 mg</td>
<td>=</td>
</tr>
<tr>
<td>cooked greens (beet/turnip greens, kale, collards, spinach), ½ cup</td>
<td>X</td>
<td>100 mg</td>
<td>=</td>
</tr>
<tr>
<td>broccoli, ½ cup</td>
<td>X</td>
<td>50 mg</td>
<td>=</td>
</tr>
<tr>
<td>other vegetables, ½ cup</td>
<td>X</td>
<td>30 mg</td>
<td>=</td>
</tr>
<tr>
<td>fruits, ½ cup or 1 small</td>
<td>X</td>
<td>30 mg</td>
<td>=</td>
</tr>
<tr>
<td><strong>Total from Fruits and Vegetables Group</strong></td>
<td></td>
<td></td>
<td>=</td>
</tr>
</tbody>
</table>
Meat, Fish, Poultry, Dry Beans, Nuts Group

<table>
<thead>
<tr>
<th>Food, serving size</th>
<th># of servings</th>
<th>Mg of Calcium</th>
<th>=</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>sardines with bones, 3 oz.</td>
<td>X</td>
<td>60 mg</td>
<td></td>
<td></td>
</tr>
<tr>
<td>salmon with bones, 3 oz.</td>
<td>X</td>
<td>180 mg</td>
<td></td>
<td></td>
</tr>
<tr>
<td>shrimp, 3 oz.</td>
<td>X</td>
<td>30 mg</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Oysters, 7-9 or 3 oz.</td>
<td>X</td>
<td>80 mg</td>
<td></td>
<td></td>
</tr>
<tr>
<td>tofu, 2-1/2 “ square by 1” thick, calcium treated</td>
<td>X</td>
<td>100 mg</td>
<td></td>
<td></td>
</tr>
<tr>
<td>cooked pinto beans, 1 cup</td>
<td>X</td>
<td>80 mg</td>
<td></td>
<td></td>
</tr>
<tr>
<td>cooked navy, black, or kidney beans, 1 cup</td>
<td></td>
<td>120mg</td>
<td></td>
<td></td>
</tr>
<tr>
<td>almonds, 2 oz.</td>
<td></td>
<td>150 mg</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Peanuts, ½ cup; 1 egg</td>
<td></td>
<td>30mg</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Total from Meat, Fish, Poultry, Dry Beans, Nuts Group</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Calcium Intake for One Day

<table>
<thead>
<tr>
<th>Food, serving size</th>
<th># of servings</th>
<th>Mg of Calcium</th>
<th>=</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total from Milk, Yogurt, &amp; Cheese Group</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total from Fruits &amp; Vegetables Group</td>
<td></td>
<td></td>
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<tr>
<td>Total from Bread, Cereal, Rice, Pasta Group</td>
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<tr>
<td>Total from Meat, Fish, Poultry, Dry Beans, Nuts Group</td>
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<tr>
<td><strong>Total Calcium from Food</strong></td>
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<tr>
<td>Do you take daily calcium supplements? If yes,</td>
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<tr>
<td><strong>Total Calcium in One Day</strong></td>
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</tbody>
</table>
How do your servings compare to the Food Guide Pyramid?

How do you rate on your calcium calculator?

What one habit will you improve?

This Calcium Calculator adapted from the Bone Builders Project in Maricopa County, Az. With the University of Arizona Cooperative Extension and many community partners. Originally adapted from materials from Virginia Cooperative Extension.  

**Building Strong Bones for a lifetime** [www.bonebuilders.org](http://www.bonebuilders.org) 9/2002
APPENDIX G

GUIDED GOALS FOR NUTRITION AND WEIGHT BEARING PHYSICAL ACTIVITY
Nutrition

1. I will eat and/or drink at least 4 servings of calcium rich foods daily from the food pyramid.
2. I will not skip breakfast, and I will choose at least one food or beverage rich in calcium for this meal.
3. Instead of soda or a fruit flavored beverage, I will choose to drink 1 cup of milk at lunch.
4. I will eat or drink at least one calcium rich food at dinner.
5. When I choose a snack, I will include a food or beverage rich in calcium.
6. I will increase my servings of calcium rich foods and/or beverages by 2 servings per week until I meet my goal of 4 or 5 servings daily.

Weight bearing physical activity

1. I will decrease my TV watching time by 10 minutes a day each week and replace it with a bone building weight bearing physical activity. I will do this until I am spending at least 60 minutes each day in bone building weight bearing physical activity.
2. I will decrease my computer and/or video game time by 10 minutes a day each week and replace it with a bone building weight bearing physical activity. I will do this until I am spending at least 60 minutes each day in bone building weight bearing physical activity.
3. I will start a bone building weight bearing physical activity for 10 minutes each day and increase this by 5 minutes each week until I am spending at least 60 minutes a day in bone building activities.

4. I will spend at least 30 minutes daily participating in a bone building sports activity.

5. I will spend at least 60 minutes daily participating in a bone building sports activity.
APPENDIX H

GOAL AND PROGRESS CHARTS
NUTRITION

MY GOAL IS TO: ________________________________________________________

<table>
<thead>
<tr>
<th>WEEK</th>
<th>SUN</th>
<th>MON</th>
<th>TUE</th>
<th>WED</th>
<th>THUR</th>
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<td>ONE</td>
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</tr>
</tbody>
</table>

1. Choose one nutrition goal.

2. Record your progress daily.

3. Key: Goal met ★
   Goal partially met ✔
   Goal not met X
WEIGHT BEARING PHYSICAL ACTIVITY

MY GOAL IS TO: _______________________________________________________

<table>
<thead>
<tr>
<th>WEEK</th>
<th>SUN</th>
<th>MON</th>
<th>TUE</th>
<th>WED</th>
<th>THUR</th>
<th>FRI</th>
<th>SAT</th>
</tr>
</thead>
<tbody>
<tr>
<td>ONE</td>
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<tr>
<td>SIX</td>
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</tr>
</tbody>
</table>

4. Choose one weight bearing physical activity goal.

5. Record your progress daily.

6. Key: Goal met ★
   Goal partially met ✔
   Goal not met X
APPENDIX I

MATERIALS FROM THE “BONE BUILDERS” PROGRAM
Calcium and Calorie Content of Selected Foods

Healthy bone growth and maintenance requires adequate calcium intake. You can meet your calcium needs from foods, beverages, and, if necessary, supplements.

How much calcium do I need each day?

Adequate Intake for calcium, according to the Dietary Reference Intakes (DRIs), is 500 milligrams (mg) per day for children 1-3 years old, 800 mg per day for children 4-8 years old, adolescents and teenagers 9-18 years old need 1300 mg per day, and adults 19 and older need at least 1000-1200 mg per day.

How do I find the calcium content of a labeled food?

Use the Percent Daily Value listed on the Nutrition Facts panel of a food label to find the milligrams of calcium per serving. See the highlighted portion of the sample label on the right for Vanilla Lowfat Yogurt.

To find the milligrams of calcium in a standard serving of a food, drop the % sign from the Percent Daily Value for calcium and add a zero. For example: 40% Daily Value = 400 mg. This is the amount of calcium in an 8 oz serving of Vanilla Lowfat Yogurt. (Note: this only works with calcium)

How can I tell if a food is a good source of calcium?

A good source of calcium contributes at least 100 milligrams of calcium in a standard serving. Reduced fat milk, calcium fortified orange juice, canned salmon, and Blackstrap molasses are examples of foods that are rich sources of calcium and relatively low in calories.

What are some good food choices that contain calcium?

You can get the calcium you need by consuming a variety of foods from each of the food groups in the Food Guide Pyramid. This handout contains the calorie and calcium content of some foods from each group of the Food Guide Pyramid. (Bread, Cereal, Rice, & Pasta Group; Vegetable Group; Fruit Group; Milk, Yogurt, & Cheese Group; Meat, Poultry, Fish, Dry Beans, Eggs, & Nuts Group; and Fats, Oils & Sweets).

---

Vanilla Lowfat Yogurt

<table>
<thead>
<tr>
<th>Nutrition Facts</th>
</tr>
</thead>
<tbody>
<tr>
<td>Serving Size: 8 oz (227 g)</td>
</tr>
<tr>
<td>Servings Per Container: 1</td>
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</table>

<table>
<thead>
<tr>
<th>Per Serving</th>
<th>Calories: 210</th>
</tr>
</thead>
<tbody>
<tr>
<td>Calories from Fat: 30</td>
<td></td>
</tr>
<tr>
<td>% Daily Value: 5%</td>
<td></td>
</tr>
<tr>
<td>Total Fat: 3 g</td>
<td></td>
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<tr>
<td>Saturated Fat: 2 g</td>
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<tr>
<td>Cholesterol: 15 mg</td>
<td></td>
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<tr>
<td>Sodium: 160 mg</td>
<td></td>
</tr>
<tr>
<td>Total Carbohydrates: 35g</td>
<td></td>
</tr>
<tr>
<td>Dietary Fiber: 5g</td>
<td></td>
</tr>
<tr>
<td>Sugars: 34 g</td>
<td></td>
</tr>
<tr>
<td>Protein: 15g</td>
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</table>

<table>
<thead>
<tr>
<th>Vitamin A</th>
<th>2%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Vitamin C</td>
<td>4%</td>
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</table>

<table>
<thead>
<tr>
<th>Calcium</th>
<th>40%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Iron</td>
<td>0%</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>In 1 serving: Calcium: 200 mg</th>
</tr>
</thead>
<tbody>
<tr>
<td>Carbohydrates: 14 g</td>
</tr>
<tr>
<td>Protein: 4 g</td>
</tr>
</tbody>
</table>

---

Vanessa Stanford, M.S., R.D.
Research Specialist, Senior
Linda Houkoop, Ph.D., R.D.
Nutrition Specialist
Department of Nutritional Sciences

This information has been reviewed by University faculty.

AG.arizona.edu/public/health/Va1128.pdf

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### Bread, Cereal, Rice, & Pasta Group

**Food** | **Serving Size** | **Calcium Content (mg)** | **Calorie Content**
--- | --- | --- | ---
Biscuit | 1 medium | 105 | 195
Bread, Cornbread | 1 slice | 110 | 173
Bread, Spoonbread | 1 slice | 135 | 159
Bread, White | 1 slice | 26 | 65
- calcium fortified | 1 slice | 190 | 25
- calcium fortified, diet | 1 slice | 180 | 48
Bread, Whole Wheat | 1 slice | 20 | 70
- calcium fortified | 1 slice | 170 | 40
Cereal, Raisin | 1 cup | 345 | 140
Muffin, English | 1 whole | 100 | 135
Pancake, homemade | 1, 4 inch | 110 | 40
Rols, Hamburger | 1 | 63 | 120
Spaghetti, calcium fortified | 2/3 cup | 300 | 210
Fettuccine, Corn | 1 1/6 inch | 45 | 60
Waffles | 1 medium | 20 | 60

### Vegetable Group

**Food** | **Serving Size** | **Calcium Content (mg)** | **Calorie Content**
--- | --- | --- | ---
Broccoli | 1/2 cup | 45 | 25
- raw | 1/2 cup | 29 | 10
- cooked | 1/2 cup | 25 | 15
-钙 | 1/2 cup | 15 | 10
Cabbage, Bok Choy | 1/2 cup | 80 | 10
- raw | 1/2 cup | 35 | 5
Celery, raw | 1 each | 15 | 5
Chard | 1/2 cup | 50 | 20
- raw | 1/2 cup | 10 | 5
Greens, Beet | 1/2 cup | 100 | 15
- raw | 1/2 cup | 55 | 5
Greens, Collard | 1/2 cup | 20 | 25
- raw | 1/2 cup | 5 | 5
Greens, Mustard | 1/2 cup | 105 | 15
- raw | 1/2 cup | 40 | 5
Greens, Turnip | 1/2 cup | 100 | 15
- raw | 1/2 cup | 40 | 5
Kale | 1/2 cup | 90 | 20
- raw | 1/2 cup | 50 | 10

### Fruit Group

**Food** | **Serving Size** | **Calcium Content (mg)** | **Calorie Content**
--- | --- | --- | ---
Fig, dried | 5 each | 135 | 240
Grapefruit | 1/2 fruit | 15 | 40
- section | 1 cup | 30 | 75
Orange | 1 medium | 50 | 60
- juice, calcium-fortified | 1 cup | 295 | 105
- slices | 1 cup | 70 | 85

### Milk, Yogurt & Cheese Group

**Food** | **Serving Size** | **Calcium Content (mg)** | **Calorie Content**
--- | --- | --- | ---
Cheese, American | 1 oz | 200 | 45
- fat free | 1 oz | 140 | 105
- reduced fat | 1 oz | 130 | 60
Cheese, Cheddar | 1 oz | 150 | 115
- natural | 1 oz | 120 | 50
Cheese, Cottage | 1 oz | 70 | 80
- 3% lowfat | 1 oz | 50 | 70
- 2% reduced fat | 1 oz | 65 | 100
- 4% fat (regular) | 1 oz | 60 | 110
Cheese, Mozzarella | 1 oz | 205 | 80
- part skim | 1 oz | 160 | 90
Cheese, Muenster | 1 oz | 200 | 105
- reduced fat | 1 oz | 205 | 80
Cheese, Parmesan, grated | 2 T | 140 | 45
Cheese, Romano, grated | 2 T | 140 | 45
Cheese, Ricotta | 1/6 cup | 200 | 100
- part skim | 1/6 cup | 35 | 170
- whole | 1/6 cup | 255 | 215
Cheese, Swiss | 1 oz | 270 | 105
- natural | 1 oz | 350 | 90
- reduced fat | 1 oz | 85 | 135
- 2% fat, light | 1 oz | 85 | 140
Milk Upsets My Stomach

If drinking milk or eating foods made from milk, like cheese, yogurt, or ice cream, upsets your stomach then you may be lactose intolerant.

How many people have trouble drinking milk?
- 25% of all Americans
- 15% of White Americans
- 70% of African Americans
- 74% of Native Americans
- 53% of Mexican Americans
- 90% of Asian Americans

Why does milk or foods made from milk upset my stomach?
Milk and foods made from milk contain a sugar called lactose (milk sugar). Our bodies have an enzyme, lactase, that breaks this milk sugar down so we can absorb it. Some people make too little of this enzyme. Their bodies cannot break down the sugar in milk all the way. If this is the case, then a person may have:
- Gas
- Bloating (swollen stomach)
- Diarrhea

As you age your body may make less lactase. If this happens, you may start to feel upset to your stomach after drinking milk or eating foods made from milk.

Can I still drink milk even if it upsets my stomach?
YES! Even if milk upsets your stomach, most people can drink 1 cup a day with a meal and may not feel sick.

Drinking 1 to 2 cups of milk each day can help your body make more lactase to break down the sugar (lactose) in milk.

Tip: Start with low-fat milk on your cereal!

Based in part by a cooperative extension work, 1986, in cooperation with the U.S. Department of Agriculture. James A. Cohoon, Director, Cooperative Extension, College of Agriculture, The University of Arizona. The University of Arizona College of Agriculture is an equal opportunity employer authorized to provide research, educational information, and services only to individuals and institutions that function without regard to race, color, national origin, age, disability, or sex.
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