The Influence of Osteoporosis Education and Bone Mineral Density Testing on Calcium Intake and Exercise in Young Postmenopausal Women

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#### Abstract

For postmenopausal women osteoporosis and fracture are a major threat to functional independence and quality of life that has the potential to precipitate the end of life. Calcium, vitamin D and exercise have been shown to increase bone density, reduce falls and prevent fractures. Studies have shown that personal knowledge of bone density has a positive influence on treatment interventions in postmenopausal women yet studies considering the personal knowledge of bone mineral density (BMD) testing on osteoporosis preventative behaviours (OPBs) are less clear. This paper evaluated the influence of education and knowing personal knowledge of BMD testing on calcium intake and exercise of young postmenopausal women between the ages of 50-65 years of age. The outcomes of the review found education with BMD testing is more effective with influencing an increase intake of calcium and vitamin D. The lower the BMD measurement the more significant the increase was of calcium and vitamin D intake. The findings on the influence of education with BMD on exercise were non-conclusive showing no influence of education and BMD testing on exercise and in one study indicating a negative influence that resulted in lower participation time with exercise.

The outcomes of this project point to a gap in public knowledge of osteoporosis particularly as it relates to the importance of calcium intake and exercise with bone health. As well, the importance of earlier osteoporosis risk screening is highlighted for young postmenopausal women. There is a need to develop a useful clinically based osteoporosis screening survey for this population that addresses not only those at risk for osteoporosis, but also should consider the impact of health beliefs, health screening anxiety and perceived barriers for engaging in preventative health behaviours. Primary care providers should be aware of the positive and negative influences of sharing BMD test results and the importance of follow-up in the primary care setting. Screening for osteoporosis risk is a priority in young postmenopausal women with the ultimate goal of reducing fractures thereby reducing morbidity, mortality and improving quality of life and decreasing the burden on the health care system.

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# THE INFLUENCE OF OSTEOPOROSIS EDUCATION AND BONE MINERAL DENSITY TESTING ON CALCIUM INTAKE AND EXERCISE IN YOUNG POSTMENOPAUSAL WOMEN

#### Osteoporosis: Scope of the Problem

Osteoporosis is a common, chronic bone disease that lies silently in waiting. This disorder is complex and characterized by asymptomatic loss of bone density with structural deterioration of bone tissue that can result in bone fragility and with low impact trauma can lead to fractures (Brown & Josse, 2002). In Canada it is estimated that 1.4 million people suffer from osteoporosis and the estimated cost of treating persons with osteoporosis and resulting fractures is 1.9 billion each year (Osteoporosis Canada, 2008). Osteoporosis is classified as either primary which is caused by advancing age or secondary which is caused by other factors such as medications and disease processes. The focus here is primary osteoporosis in young postmenopausal women.

Although, the prevalent universal risk factor for bone loss and osteoporosis is advancing age, the physiological changes of menopause cause women to be predominantly at higher risk with one in four women developing osteoporosis (Osteoporosis Canada, 2008). At the age of 50, a Caucasian woman has at least a 40% risk of developing a new fracture in her remaining lifetime and women account for 75% of hip fracture cases (Brown & Josse, 2002; National Institute of Health (NIH) Consensus Development Program, 2000) The impact of osteoporosis on mortality and morbidity on aging individuals is high. It has been estimated that osteoporosis attributes to 90% of all hip and spine fractures in older women (The North American Menopause Society [NAMS], 2006). As well, it is estimated that 20% of hip fractures results in death within one year of fracture and 50% of those persons who do survive live with some level of disability (Osteoporosis Canada, 2008).

The Fracture Intervention Trial (FIT) highlights the significance of the higher relative risk of mortality in relatively healthy older women who suffered a clinical vertebral fracture or a hip fracture. This study included 6,457 postmenopausal women age 55-81 years with low bone mineral density (BMD) scores less than 1.6 standard deviations (SD) below the young normal mean of young healthy woman. The study followed women for an average of 3.8 years and showed the relative risk of dying post fracture was almost six-fold greater following hip fracture and nine-fold greater with previous history of vertebral fracture (Cauley, Thompson, Ensrud, Scott, & Black, 2000). The likelihood of surviving a hip fracture is often dependent on the number of pre-existing co-morbidities and there is no clear understanding of whether the hip fracture was the independent cause or the sign in a series of events signifying increasing age related decline (Magaziner et al., 1997; Wolinsky, Fitzgerald, & Stump, 1997). Regardless of which perspective is regarded, it is clear that the impact of a hip fracture is a life altering event.

There is no denying that the mortality risk for hip fractures is substantial yet, spine fractures can result in equally if not more devastating impact on health status. Impaired functioning from vertebral fractures often occurs silently and as many as two thirds of persons with vertebral fractures will not seek medical attention (Gehlbach et al., 2000). Regrettably, the resulting deformities such as thoracic kyphosis, loss of height, and restriction with movement may be perceived as normal consequences of the aging process (Gehlbach et al., 2000). Ross (1997) suggests that as many as half of all patients with clinically identified fractures may be asymptomatic; however, many other individuals may experience acute or chronic back pain and declining physical function that increases progressively with the number of vertebral fracture endured. There is surmounting evidence to show that those individuals with existing vertebral fractures are at increased risk of future fractures. In fact, the literature suggests that those individuals suffering from vertebral fractures have a five-fold increased risk of future vertebral fractures that most often occur within the first year (Black, Arden, Palermo, Pearson, & Cummings, 1999; Lindsay et al., 2001) and as well they have a 2.8 fold increased risk of hip fracture (Lindsay et al., 2001). To compound matters further vertebral fractures are not limited to musculoskeletal discomfort and declining mobility, severe vertebral fractures can also restrict pulmonary function capacity that can contribute to the high mortality outcomes (Schlaich et al., 1998).

There is little doubt that living with osteoporosis fractures is associated with declining health-related quality of life (Silverman, Minshall, Shen, Harper, & Xie, 2001) and not unlike other chronic disorders osteoporosis contributes to negative psychological effects. Living with osteoporosis is associated with higher incidences of loss of self esteem, reduced social activity, poor well-being and depressed mood (Bianchi et al., 2005). Even women with history of wrist fracture, which is viewed as less disabling than hip or vertebral fractures and occur more often in the young postmenopausal woman, report poor health status post fracture (Barrett-Connor et al., 2008). Nevertheless, regardless of fracture site, the impact of osteoporotic fractures for postmenopausal women has implications for future disability and quality of life.

The impact of osteoporosis is a major public health concern and osteoporosis will continue to be more of a burden socially and economically with an aging population. Once osteoporosis is established it is difficult to reverse (Hanley & Josse, 1996) and the mortality and morbidity outcomes only serve to highlight the importance of early prevention interventions. Declining estrogen levels for women during menopause leads to rapid bone loss that is estimated at a rate of 0.3-0.5% beginning at age 40 years with more rapid loss occurring after menopause that is estimated as high as  $\geq 2\%$  per year for the first 6-10 years with bone loss slowing to 1-2% per year into the sixth decade of life (Borer, 2005). For Caucasian women menopause occurs at a mean age 51 years placing women at earlier risk for osteopenia, osteoporosis and fragility fractures (Brown & Josse, 2002). In general, the risk of osteoporosis fractures doubles every seven to eight years after the age of 50 (NAMS, 2006) stressing the importance of early prevention and intervention. Early prevention includes education that focuses on modifiable osteoporosis preventative behaviours (OPBs) with early detection of osteoporosis and treatment interventions that will assist to reduce rate of bone loss and the incidence of osteoporosis and resulting fractures.

Osteoporosis Prevention: Early Detection and Diagnosis

The 2002 Clinical Practice Guidelines for Diagnosis and Management of Osteoporosis in Canada (updated 2006) recognizes the importance of screening before a fracture event and recommends that all women and men over 50 years of age should be assessed for osteoporosis risk factors. Those individuals found to have one major risk factor or two minor risk factors should be referred for BMD testing. Bone mineral density testing establishes the diagnosis of osteoporosis and is used to as a predictor of fracture risk. Advancing age is a major risk factor and routine BMD is recommended for women  $\geq$  65 years for assessment of bone health provided having the BMD screening test will impact medical management (Brown & Josse, 2002). Despite these guideline recommendations for screening osteoporosis beginning at age 50 (Brown & Josse, 2002; NOF, 2008), osteoporosis screening including rates of BMD testing and post fracture assessments are suboptimal in primary care (Gehlbach et al., 2000; Gill & Hoffman, 2003; Port et al., 2003)

# Bone Mineral Density Testing

Bone mineral density testing is an instrument used to measure size, shape and geometry of bones (Nguyen, Center, & Eisman, 2008). Bone mineral density scores correlate with bone strength and diagnose osteoporosis and provide a measurement that can predict risk of fracture (Nelson, Hefland, Woolf, & Allen, 2002). Bone mineral density scores are expressed in units of standard deviation (SD) above or below the norm compared to either the expected BMD for patient's age and sex (Z-score) or the expected BMD for young female adult mean (T-score). The data resource for 'young female adult mean' is the mean BMD of American Caucasian healthy women between the ages of 20-29 (WHO, 2007). It is the dual energy x-ray absorptiometry (DXA) T-score that is recommended for diagnostic use for postmenopausal women and men over 50 years of age whereas, Z-scores are recommended for pre-menopausal women, children and ethnic populations. The World Health Organization (WHO) diagnostic classification establishes normal BMD measurement as within 1 SD above or below that of a young normal adult mean and is recorded as T-score at -1.0 or above. Low bone mass also described as osteopenia is a T-score between -1.0 and -2.5 and osteoporosis is a T-score at or below -2.5 (NOF, 2008; WHO, 2007)

Many techniques are available to assess BMD at different sites however the clinical gold standard for diagnosing and monitoring patients' BMD is dual-energy x-ray (DXA) of the hip and spine or forearm (WHO, 2007). Peripheral dual-energy x-ray absorptiometry (pDXA) measures bone density at peripheral skeletal sites of the forearm, finger, or heel. This technique is limited, one reason is due to a lack of sufficient evidence pDXA is not

recommended for fracture assessment in men and another reason is that pDXA T-scores are not equivalent to the T-scores derived from central DXA (NOF, 2008) thus diagnosis should be confirmed by central DXA. Even so, these instruments are portable and results are reproducible and capable of accurately predicting overall risk of fracture (NOF, 2008). Peripheral DXA devices provide practical alternative as a screening tool for those individuals at risk for low bone mass and because of portability the device could be used in rural settings. As well, these devices are often utilized as a reliable tool of measurement in research studies.

Even though, the WHO's BMD criterion is widely accepted as being diagnostic for osteoporosis, BMD measurement should not be used as the sole indicator of fracture risk (WHO, 2007). There are a variety of concerns with BMD testing, one concern is that BMD measures mineral in bone alone and does not determine bone structure which is also an important component of bone health (BC Ministry of Health, 2005). As well, BMD measurements have a high specificity but low sensitivity meaning that it works well for predicting high risk of fracture when osteoporosis is present; however, there are a substantial proportion of fractures that occur in women who lie in the low risk groups (Kanis & WHO Study Group, 1994; WHO, 2007; Nguyen et al., 2008). This makes BMD an ineffective screening tool for fracture risk for the general population and although BMD is an important determinant in predicting absolute fracture risk, bone fragility is affected by other skeletal and non-skeletal factors. Some of the other risk factors that require clinical screening include fracture history, genetics particularly pertaining to body size (tall and/or low body mass index) and maternal history of fracture after age 50, lifestyle behaviours and assessment for secondary causes (NAMS, 2006; Taylor et al., 2004).

Bone Health: Osteoporosis Preventative Behaviours

Osteoporosis education provides important information that assists health professionals and the public to make informed decisions about bone health and treatment modalities (NOF, 2002). The National Osteoporosis Foundation (2008) includes within their major recommendations counseling individuals age 50 and older on modifiable OPBs. Specifically counseling should address adequate intake of calcium, vitamin D, appropriate exercise and avoidance of tobacco and excessive alcohol intake. For the purpose of this project the focus is on the influence of modifiable risk factors calcium, vitamin D and exercise on bone health.

#### Calcium and Vitamin D

Calcium is a major component of mineralized tissue and optimal bone health is reliant on adequate absorption of calcium. Calcium is required for bone growth and development and it is also critical for normal nerve and muscle function, heart contraction and blood clotting (Kapit, Macey, & Meisami, 2000). Despite being a hard substance bone is active living tissue in which the structure is a result of two counteracting processes of destruction and formation. Osteoclast activity is responsible for resorption of bone and osteoblast activity is responsible for bone formation. This process of bone turnover is a complex process that maintains skeletal strength, enables repair of micro fractures caused by stress and strain and, is critical for calcium homeostasis (Nguyen et al., 2008). Calcium along with phosphate form matrixes that develop into calcification and lead to strong bone structure. Ninety-nine percent of calcium is contained in our bones and teeth and serves as a reservoir to maintain calcium homeostasis when plasma calcium is low (Lanham-New, 2006). Low blood calcium signals a chain reaction that stimulates the parathyroid glands to increase release of parathyroid hormone (PTH) thereby increasing osteoclast (destructive) activity responsible for rate of bone absorption and remodeling.

The preferred source of calcium is from foods as other essential nutrients for bone health are found in calcium enriched foods (Nieves, 2007). Diary products are a primary source of calcium yet, when total intake of calcium is inadequate supplementation can be beneficial and for the postmenopausal woman adequate amounts of calcium can decrease the rate of bone loss by approximately 1% per year (Nordin, 1997). Higher calcium intake equates to high calcium retention that promotes bone gain during growth, maintains bone strength and reduces bone loss in the elderly (Heaney, 2000). Optimal intake of calcium is important across the lifespan and studies have shown that once calcium intake declines the benefits on bone mass also declines (Lee et al., 1997). Adequate calcium intake is crucial yet calcium cannot be discussed without considering the importance of vitamin D.

Vitamin D is integral to the absorption of calcium and calcium homeostasis. Vitamin D is a non-specific term to describe various forms of steroid molecules. The most relevant forms are vitamin D2 (ergosterol) obtained from plant sources, such as mushrooms and vitamin D3 (cholecalciferol) found in foods such as eggs yolks, fish oils and fortified food products. The main source of vitamin D3 is synthesized through the skin when ultraviolet light energy from sunlight is absorbed. In order for the body to utilize these inactive forms of vitamin D, they require metabolizing by the liver to form 25-hydroxyvitamin D (calcifediol) or 25(OH)D that is stored in the liver as a non-active form. This inert form of vitamin D3 requires further conversion by the kidneys to form 1, 25-dihydroxy vitamin D (calcitriol) which is an active, potent form of vitamin D that increases calcium absorption from the intestine (Bowman R., 2007; Kapit et al., 2000). As well, when nutritional calcium intake is

low, vitamin D will increase osteoclast activity thereby increasing bone calcium to the plasma (Wolff, Jones, & Hansen, 2008).

Through out the lifespan calcium demands vary and are influenced by age, hormones, drugs and genetics (National Institutes of Health [NIH] Consensus Development Program, 1994). The highest demand for calcium and vitamin D is for the postmenopausal woman yet studies have shown that the average calcium intake of the North American diet is far below the amount recommended for optimal bone health. Depending on clinical practice guidelines resourced recommended daily calcium intake for postmenopausal women ranges from 1200mg to 1500mg (Brown & Josse, 2002; NOF, 2008); however, the National Health and Nutrition Survey estimated the mean daily calcium intake of women  $\geq$  60 years of age to be 563mg (Ma, Johns, & Stafford, 2007). This nutritional data also examined dietary and supplemental calcium consumption of men and women  $\geq$  19 years as it related to risk of osteoporosis and further analysis found that those individuals with osteoporosis had a higher consumption of daily calcium, which is beneficial yet, the daily reported calcium consumption remained below recommendations at 944mg (Ma et al., 2007).

Low calcium intake for postmenopausal women is compounded by two issues: the first is the amount of calcium absorbed by the body varies widely, 17-58% with an average of 35% (Wolf et al., 2000) and than absorption rates may decline further as estrogen declines in the postmenopausal women (Heaney & Recker, 1986). Secondly, individuals with suboptimal intake of calcium are also likely to have suboptimal intake of vitamin D (Boonen et al., 2004). Insufficient intake of vitamin D correlates with lower calcium absorption and in women with severe vitamin D deficiency only 10 to 15% of dietary calcium ingested is absorbed (NAMS, 2006). Hypovitaminosis D is common in the general population

particularly in postmenopausal women, the older adult, and in people with high melanin skin pigmentation. Insufficient sun exposure related to living in northern latitudes and/or institutionalization are also known contributors, as well as, protective clothing, sunscreen and certain drugs that affect bioavailability of vitamin D (Chapuy et al., 1997; Gaugris et al., 2005; Holick, 2006). Although, optimal serum 25(OH)D (vitamin D) status has yet to be established (Holick, 2007), studies have shown that supplementing vitamin D in individuals with low 25(OH)D is associated with improved body sway and muscle strength that can reduce the risk of falls and ultimately fractures (Jackson, Gaugris, & Hosking, 2007; Pfeifer et al., 2009).

Of note, several recent large studies have suggested that calcium and vitamin D supplementation is not effective in reducing future risk of fractures in community dwelling people  $\geq$  70 years of age (Grant et al., 2005; Porthouse et al., 2005). The conflicting evidence has heightened interest in the significance of vitamin D, particularly as it relates to age, vitamin D thresholds, and the relationship with PTH levels (Adami, Viapiana, Idolazzi, & Rossini, 2008; van Schoor et al., 2008). That being said, consideration should be given to the large body of evidence that suggests that calcium and vitamin D, if taken with sufficient levels of compliance, does reduce the risk of fracture (Rizzoli et al., 2007). As well, it is important to consider that calcium and vitamin D is not recommended as a sole means of treatment for osteoporosis (Brown & Fortier, 2006) and evidence still supports the recommendations to include calcium with vitamin D as adjunct therapy to pharmacological interventions (Brown & Fortier, 2006; Rizzoli et al., 2007).

### Physical Activity/Exercise

Although, bone mass is influenced largely by genetics (Deng et al., 2000; Makovey, Nguyen, Naganathan, Wark, & Sambrook, 2007; Nguyen et al., 2008; Rizzoli, Bonjour, & Ferrari, 2001), physical activity has a significant impact on maintaining skeletal integrity and bone strength through out the lifespan. Physical activity during times of rapid growth, such as during pre- and peripubertal periods, has the effect of enhancing peak bone density (Hind & Burrows, 2006; MacKelvie, Khan, Petit, Janssen, & McKay, 2003) whereas, during adulthood physical activity has a lesser influence and inevitably with progressive aging there is loss in bone density (Karlsson & Ahlborg, 2006). Moderate physical activity during times of peak bone turnover has been shown to have lasting benefits into older age (Pesonen et al., 2005; Rideout, McKay, & Barr, 2006); consequently, those women with low BMD before menopause are at greater risk for developing lower BMD postmenopausally. Essentially, the likelihood that postmenopausal women will develop osteoporosis depends on both optimal peak bone mass, which occurs by the third decade of life and the rate of bone loss in later years (NIH Consensus Development Program, 1994).

The mechanical forces of physical activity cause mechanical strain from muscle contractions and ground reaction forces that affect bone mass. Physical activity that force individuals to work against gravity are referred to as weight bearing exercises and examples include jogging, Tai-Chi, stair climbing, dancing and tennis (NOF, 2008). These forces on bone produce a cellular response that increases bone formation and resistance to bone fracture (Smith & Clark, 2005). There is an understanding that osteoclasts and osteoblasts have genetically predetermined strain thresholds that adapt to the mechanical environment and signal bone formation, removal or repair (Smith & Clark, 2005). When strain thresholds

are surpassed modeling activity occurs increasing bone strength and mass. When mechanical forces are below strain threshold modeling activities are turned off and, in environments where there is a lack of stimulus or disuse, lower remodeling set points are turned on causing loss in bone mass (Rubin & Lanyon, 1984). Remodeling can be controlled by short periods of loading force (Rubin & Lanyon, 1984) and bone mass is maintained when bone formation and resorption are at equilibrium (Gong, Zhang, Zhu, & Yang, 2006). Accordingly, bone fragility is a consequence of bone removal being greater than replacement.

Physical activity and rate of remodeling of bone have implications on the rate of bone loss for postmenopausal women. A meta-analysis review of 16 RCTs and nine non-RCTs suggested that exercise training programs prevented or reversed bone loss up to 1% per year in both the lumbar spine and femoral neck for both pre- and postmenopausal women (Wolff, van Croonenborg, Kemper, Kostense, & Twist, 1999). A more recent non-RCT examined the impact of both low-volume high resistance strength training and high impact aerobics over three years on 48 early postmenopausal women with osteopenia and found that BMD was maintained at spine, hip, and calcaneus but not at the forearm. Also important to note from this was that those women in the exercise group experienced decreased pain frequency and intensity in the spine while women in the control group experienced an increase in pain (Engelke et al., 2006). Exercise is beneficial and has been shown to slow the rate of bone loss for postmenopausal women and in some instances reverse it yet, not all types of exercise have equal bone strengthening outcomes and there is increasing interest in what constitutes optimal exercise strategies for bone health.

Primarily, different types of physical activity produce different straining forces that affect different parts of the skeleton differently (Brown & Josse, 2002). For example, a

Cochrane review of 18 RCTs examining effectiveness of exercise on healthy postmenopausal women showed aerobics, weight bearing and resistance exercises were effective in increasing the BMD of the spine while walking was shown to be effective in both BMD of the spine and hip (Bonaiuti et al., 2002). Conversely, a meta-analysis of eight RCTs showed that walking-only for postmenopausal women had a significant, positive effect on BMD on the femoral neck yet, no significant effect on the preservation of BMD at the spine (Martyn-St. James & Carroll, 2008). Overall there is consensus that evaluating exercise strategies is problematic in that exercise trials tend to be of short duration with small sample sizes and have diverse methodologies, even so, these reviews as well as others (Palombaro, 2005) support the notion that regular physical activity is beneficial for individuals at risk for osteoporosis.

There is no denying that bone quality decreases with age and poor bone quality is an important factor contributing to absolute risk for fracture but, the matter is complicated further because older women also have an increased tendency for falls (Nelson et al., 2002). The aging woman's tendency towards falls is high; falls in women at age 65 years is about 30% per year and increases to 50% per year at age 80 years (Boonen et al., 2006). Taking this into account there has been an increase interest with the benefits of exercise as it pertains to fall prevention. The benefits of physical activity, including resistance training, reaches beyond the skeleton and studies have shown that exercise improves muscle strength, agility, posture and balance (Hourigan, Nitz, Brauer, O'Neill, & Wong, 2008) that ultimately reduce the risk of falls and fractures (Boonen et al., 2007).

#### Changing Health Behaviour

Health education as cited by Griffith (1972) can be defined simply as "attempts to close the gap between what is known about optimum health practice and that which is actually practiced" (Glanz, Lewis, & Rimer, 1997, p. 7). This early definition suggests information concerning beneficial health practices does not necessarily decrease problematic health behaviours. Health information may increase awareness and may motivate individuals to avoid or change health behaviours yet, information alone does not guarantee participation in preventative health behaviours. For example, despite public health campaigns on health risks of smoking that have been ongoing for the last 35 years, less than 20% of smokers are intending to take action and quit smoking within the next 30 days (Prochaska & Prochaska, 1999). Although there has been progress in reducing smoking rates in the general population the knowledge that cigarettes are hazardous to one's health did not prevent, change or stop the problematic health behaviour for those individuals that smoke. Changing health behaviours is complex and additional self-influences evolving from self-efficacy play a central role with motivation and action (Bandura, 2004). Theories on health behaviour serve to explain why people change and maintain preventative health behaviours, as well they assist health care professionals with selecting effective educational interventions and strengthens research applicability to the clinical setting (Glanz et al., 1997; McKenzie, Neiger, & Smeltzer, 2005).

#### Revised Health Belief Model

One of the most frequently and widely used theoretical models for health prevention and modifying health behaviour is the health belief model (HBM). The HBM is founded in value-expectancy theory and was introduced in the 1950's from a need to explain why public health programs were not succeeding in preventing or detecting disease (Glanz et al., 1997). The model has evolved over time and by the 1980's the model was revised to include selfefficacy (Strecher & Rosenstock, 1997). It is self-efficacy that provides incentive to act and is rooted in the core belief that one has the power to produce the desired changes (Bandura, 2004). Rosenstock, Stretcher, and Becker (1988) revised HBM proposes that success for health behaviour change depends on people having:

- 1. sufficient motivation or incentive to make health issue relevant
- belief they are susceptibility to the disease and feel threatened by their current behaviour patterns
- belief that engaging in the health behaviour recommendation is beneficial and will reduce the perceived threat at an acceptable cost financial or otherwise
- self-efficacy, the confidence or conviction to overcome the barriers to implement the change

It is evident that changing problematic health behaviour is complex and multifactorial. People seek knowledge in general to gain understanding, to solve relevant problems and/or simply to know the world around them (Rodgers, 2005). For some people increased health knowledge of risk and benefits of disease may be enough to create a reason for change in their behaviour (Bandura, 2004); yet, increased knowledge and/or insight concerning beneficial preventative behaviours does not necessarily prevent problematic health behaviours or change health beliefs or health behaviours for others (Prochaska, DiClemente, & Norcross, 1992; Sedlak, Doheny, & Jones, 2000). Considering the HBM it is reasonable to postulate that personal knowledge of individual health risk may be more influential at engaging individuals to partake in osteoporosis preventative behaviours. Studies have shown that personal knowledge of bone density may have a positive influence on treatment interventions in postmenopausal women (Fitt et al., 2001; Marci, Viechnicki, & Greenspan, 2000). Marci et al. (2000) also found that BMD testing with osteoporosis risk assessment improved a variety of osteoporosis preventative behaviours (OPBs) including an increase in dietary calcium intake and exercise. Rohr, Clements, and Sarkar (2006) surveyed 234 older women and found that women increased their calcium supplementation after screening with BMD testing and counseling; however, treatment interventions requiring physician prescription did not increase after screening regardless of BMD status. The information pertaining to the influence of BMD testing as a motivating factor for change of OPBs is mixed.

The importance of early detection, adequate intake of calcium and vitamin D and exercise for maintaining or slowing the rate of bone loss in postmenopausal women has been highlighted. There is merit in early osteoporosis risk screening before a fracture occurs. Baseline BMD testing is recommended for women are  $\geq 65$  years of age and as mentioned using BMD testing as a general screening tool is controversial, in part due the inability of BMD testing to identify all individuals at risk for fracture (WHO, 2007); however it can be hypothesized that osteoporosis general knowledge with personalized knowledge of BMD measurement may be more effective with influencing participation with OPBs. The aim of this project was to seek out research articles that would answer the question: for young postmenopausal women between the ages of 50-65 years of age will education interventions with BMD testing be more effective at influencing calcium intake and exercise when compared to educational interventions without BMD testing?

# Review: Influence of BMD on Calcium Intake and Exercise

#### Sources and Search Process

The search included CINAHL, Ovid MEDLINE daily update and Cochrane Library for English language articles with the following headings and text works: osteoporosis, bone health, postmenopausal, education, health education, education strategies, bone density, bone mineral density, densitometry X-ray, osteoporosis prevention, lifestyle, exercise, calcium and calcium supplementation diet and dietary. As well, references from relevant articles were reviewed. The initial search process was expanded to include organization web sites including the National Osteoporosis Foundation and Osteoporosis Canada. Abstracts and articles were reviewed and selected by the writer only. Those articles that did not address the target population of young postmenopausal women between the ages of 50-65 years were eliminated leaving four studies for evaluation.

#### Findings

The longitudinal RCT by Estok, Sedlak C. A., Doheny, and Hall (2007) examined the influence of personal knowledge of osteoporosis status of 203 healthy community based women. Osteoporosis knowledge, health beliefs, self-efficacy scale, calcium intake and exercise levels were pre-assessed in both groups. The experimental group had DXA of lumbar spine and femur and both groups completed additional calcium and exercise intake reports at 6 and 12 months. Both sample groups were relatively similar with a mean age of 57 years, 91% Caucasian, mean body mass index (BMI) 27.80, 87% did not smoke and 76% had some level of post secondary education. Initial mean daily calcium intake for experimental group was 606mg/day and in the controlled group 620mg/day which is within expected reported intakes of others studies. Initial time allocated to weight bearing exercise in the

experimental group was 81minutes/week and in the control group the allocated time for exercise was 65minutes/week. Both groups were well below health maintenance recommendations of 30minutes of activity per day (BC Ministry of Health, 2005). Personal knowledge of BMD testing results were shared with participants and it is unclear what level of counseling occurred with sharing DXA information.

The outcomes showed that women in the experimental group at six months had a significantly higher calcium intake at 916mg/day when compared to the control group at 635mg/day. The greatest change observed was in calcium intake behaviours in those women who were told they had osteopenia or osteoporosis (p < .05) suggesting that personal knowledge of osteoporosis risk does have some partial effect on perceived susceptibility of osteoporosis. However, it is also important to note that by 12 months both groups, control and intervention, had increases in daily calcium intake. Even though, the study concluded that knowing BMD results did not empirically mediate an effect of knowledge or health beliefs of osteoporosis, the details of the statistic models and analysis showed that women in this study who had positive pathways of knowledge and health beliefs of osteoporosis recognized the benefits of calcium and exercise. This certainly has implications for public health policy and mass media concerning closing the gap of what is known about osteoporosis. Also, this study points out that more than half (57%) of these relatively healthy women had low bone density scores. Thirteen percent of these women were diagnosed with osteoporosis and 45% were osteopenic, underscoring the importance of osteoporosis screening in a primary health care setting.

The quasi-experimental pilot study by Sedlak, Doheny, Estok, and Zellar (2005) examined the influence of knowledge of BMD results with tailored or customized

interventions verses knowing BMD results without customized interventions. All 124 postmenopausal women received DXA of lumbar spine and femur, an osteoporosis questionnaire was completed consisting of osteoporosis-preventing behaviours survey, osteoporosis knowledge test, health belief scale and self efficacy scale. Both groups received a follow-up letter explaining results and another osteoporosis questionnaire at 6 months. The intervention group was contacted by telephone and interviewed by a nurse conveying results of BMD, and were assessed for present participation of OPBs and provided with customized plan of intervention to improve OPBs. Although the control group was larger than the intervention group, both groups were representative of each other. Mean age was 56.2 years, BMI 28, 90.3% were Caucasian and 73.4% had some level of post secondary school education. Initial mean calcium intake for intervention group was 587mg/day and the controlled group was 614mg/day. Initial mean weight bearing exercise for intervention group 96 minutes/week and the controlled group was 81.47 minutes/week.

Sedlak et al.'s (2005) study showed both control and intervention groups had significant increase in mean daily calcium intake. Daily calcium intake increased to 1039 mg/day (p = .008) for the intervention group and increased to 916 mg/day (p = .001) for the control group; however, combined prescore/postscore interaction was non-significant (p =0.642). The influence of BMD results with tailored interventions on exercise was surprising, especially considering this population group of 50-65 year olds, the intervention group decreased exercise from 96 minutes/week to 59 minutes/week while the non-tailored group increased exercise slightly from 81 minutes/week to 87 minutes/week. Tailored interventions with BMD measurements had a negative effect by increasing perceived barriers to calcium intake and exercise, particularly exercise. It is unclear from this study if those women with lower bone density were more likely to reduce exercise levels. Seemingly for the reader, the perception of exercise contributing to worry and risk of falling is a real one. Similarly, to the previous study, this study also showed a high rate of bone density loss (59%) in the young postmenopausal woman, 43% of participants were osteopenic and 16% of participants were osteoporotic.

The RCT by Rolnick, Kopher, Jackson, Fischer, and Compo (2001) examined the influence of osteoporosis education with or without BMD testing on postmenopausal women 54-65 years of age. The sample size of 508 postmenopausal women was selected from a large care organization. Measurements included a simple calculated osteoporosis risk estimation (SCORE), osteoporosis knowledge survey and an attitudes test prior to education session and at six months. Although the article does talk to 'beliefs' it was not clear if the HBM has been used as the theoretical foundation, only an assumption can be made that components of HBM were utilized to assess participant's beliefs concerning osteoporosis. Both groups attended a 2-hour nurse practitioner lead education session and 207 participants also received a pDXA of the wrist. Attendance rates were significantly affected with 29% being absent in the education only group and participants expressed disappointed with not being selected for BMD testing. Demographically this group was slightly older than the other sample group presented so far, over half of the women were > 60 years of age, 97% were Caucasian and although no participants were on hormone replacement (HRT) during the study 30% reported being on HRT in the past; up to as early as one month ago.

The findings of Rolnick et al.'s (2001) study showed that regardless of BMD availability more than half of the women in both groups reported OPBs changes pertaining to diet, exercise and calcium intake. Health belief patterns were influenced more in the group with education plus BMD testing. The BMD intervention group were more likely to discuss osteoporosis prevention initiatives with their care provider and showed a significant increase with calcium and vitamin D intake (p < 0.001) and with initiating osteoporosis pharmaceutical interventions (p < 0.001). Similarly, to previous studies those women who were diagnosed with osteopenia or osteoporosis had higher percentages of calcium and vitamin D intake when compared to participants with normal BMD results. Although not empirically significant, this study showed a decrease in exercise (57% to 51%) for participants with osteopenia but slightly increased (57% to 61%) for participants with osteoporosis. As well, the perceived risk of osteoporosis increased as the intervention group with BMD testing was more likely to report taking steps towards preventing osteoporosis was important to their well being.

Rolnick et al. (2001) also reported high rates of suboptimal BMD results, 44% of participants were either osteopenic at (35%) or osteoporotic (9%). The overall rates are lower than the previous two studies reviewed with low bone density rates at 57%-59% and this difference may be attributable to past use of HRT by 30% of participants in this sample group. Also worth noting, out of the 505 fully completed simple calculated osteoporosis risk estimations (SCORE), the results indicated that 358 (71%) participants were at risk of fracture. In some aspects, this is not surprising as this sample group was generally higher at risk population. In review of osteoporosis risk factors of this group three participants had already reported hip fracture, another 35 participants reported wrist fracture, 28 had rheumatoid arthritis and 108 were below 130lbs/57kg which is also a risk factor that correlates with low bone density (Brown & Josse, 2002). In review, 1/3 of participants

already had one major risk factor and the study did not report incidence of maternal history of fracture.

The British article, Wallace, Boxall, and Riddick (2004) reports on three studies of different designs. The intent of the combined studies was to examine the influence of BMD screening on exercise and diet, attitudes of women with osteoporosis and the impact of nurse education on attitudes and dietary self-care. The first study includes 129 outpatient women referred to a bone density clinic and included perimenopausal women under the age of 65. Although, this study did include perimenopuasal women, the study was included in the review because the likelihood of having a large number of women under age 50 being sent for BMD testing is low. This first study in Wallace et al. (2004) was the primary focus for the review and was a before and after design. All participants completed dietary frequency questionnaires (0-3 months), checklists for exercise (0-1-3 months), osteoporosis patient knowledge (0-2 weeks-3 months), health belief scale (0-2 weeks-3 months) and risk assessment scale (within 2 wks). The nutrition survey was mailed out one week prior to BMD scan and it is unclear whether "usual health risk advice" was provided during visit to BMD clinic. Although the other two studies were not the focus of this review they are of interest. Both of those studies included older postmenopausal women  $\geq$  70 years of age, sample sizes that were too small for statistical analysis, different methodologies and focus was directed toward education variances.

Unlike the other studies Wallace et al.'s (2004) study indicated that 57% of women had a high intake of daily calcium of at least 1500 mg/day and this correlated with high knowledge scores concerning calcium sources at 84%. Even so the osteoporosis susceptibility scores in this group showed only 23% believed calcium was a strong influence

on fracture risk. When assessing exercise, the study reported 74% of women participated in weight-bearing exercise of at least 60 minutes/week and the low amount of time allocated for exercising correlated with lower knowledge scores pertaining to the importance of exercise. For example, only 32% of participants knew that walking can decrease the risk of falls and only 40% knew that walking is better for bones than swimming. This is validated in reviewing susceptibility surveys as only 19% thought exercise would be important with preventing risk of fracture. The assessment of health beliefs showed that the perceived overall risk of fracture was low as 61% did not expect a bone fracture in the next five years and they did not expect the risk to change. The study results support the notion that participants did not perceive the disease process a threat serious enough to warrant change in OPBs. The low perception of susceptibility was also supported by the other two studies in this article and one of those studies included 25 women previously diagnosed with osteoporosis. Although, participants reported knowing benefits of calcium intake and exercise in knowledge surveys, the participants' perceptions of personal risk of osteoporosis remained low and OPBs did not change after osteoporosis screening.

The overall conclusions of this first study reviewed by Wallace et al. (2004) were that no significant changes with OPBs following BMD scan. It was unclear how participants were informed of their BMD measurement and how or if there was follow up for those with abnormal results. This study did not report rates of low bone density. In contrast to previous studies reviewed, this study viewed BMD screening alone as a variant and concluded that the action of BMD screening has no impact health behavioural change. The results of all three studies within this article pointed out that women are more willing to change diet than exercise and that perceived low personal risk of fracture as well as, low perception of seriousness of osteoporosis prevents people from adopting more stringent preventative care behaviours.

#### Overview

The purpose of this review was to answer the question, for young postmenopausal women between the ages of 50-65 years of age, will education interventions with BMD testing be more effective at influencing calcium intake and exercise when compared to educational interventions without BMD testing? This review supports the notion that osteoporosis education with BMD is more effective at influencing calcium and vitamin D intake than education alone and the more abnormal the bone density the more significant the increase in calcium and vitamin D intake (Estok et al., 2007; Rolnick et al., 2001; Sedlak et al., 2005). However, the influence of education and BMD on exercise is non-conclusive (Estok et al., 2007; Wallace et al., 2004) having no influence on increasing exercise and in fact knowing bone density may have a negative influence, lowering participation in exercise (Rolnick et al., 2001; Sedlak et al., 2005).

All the articles for review incorporated the essence of the HBM and utilized a number of similar measurement instruments to assess the relationship between BMD screening on generalized knowledge, health beliefs and the two OPBs of exercise and calcium intake for this population group of young postmenopausal women; however, there are differences with quality, quantity and consistencies with their analysis. The mode and quality of knowledge imparted to participants, both generalized osteoporosis knowledge and personal knowledge of BMD results, varied with each review. The study groups were self-selected thus the women who chose to participate may be more interested in their health which may be different from the general population. This review includes only two RCTs that provide the highest level of validity and reliability of evidence; yet, collectively the studies do present clinically relevant considerations that should influence how osteoporosis educational interventions are approached and provides insight to the implications of BMD testing for this specific population.

# Implications for Practice

## Osteoporosis Knowledge Gap

The findings of the review showed that participants' calcium intake increased as osteoporosis general knowledge increased, regardless of knowing BMD measurement. Even though, the increase in calcium intake and vitamin D was statistically significant with abnormal BMD measurements, overall the findings indicate that increasing generalized osteoporosis knowledge does directly influence calcium and vitamin D intake (Estok et al., 2007; Rolnick et al., 2001; Sedlak et al., 2005) suggesting that a lack of knowledge acts as a barrier and constrains participation with OPBs. This finding is also supported by a recent survey examining barriers to calcium supplementation for women 20-64 years of age, the survey suggested that one of the primary reasons women, 55% in this survey, have high rates of non-use of supplementation was not knowing it was necessary (Tyler et al., 2008).

The evidence also points to lack of knowledge pertaining to benefits of exercise for increasing bone strength and prevention of falls (Wallace et al., 2004). There is a gap in information pertaining to the importance of bone health with preventing or reversing bone loss. It would be useful for heath care providers to be knowledgeable or refer to community resources that utilize optimizing exercises that improve balance, strength and agility and

decrease the risk the falls. In the Sedlak et al. (2005) study that included tailored interventions according to the BMD measurement showed a negative association between BMD testing and exercise that elicited worry about the risk of falls. These results suggest that exercise interventions may require more personalized involvement and would also suggest that further research is needed in this area to better understand the relationship between bone fragility associated with osteoporosis, BMD testing and exercise.

Wallace et al. (2004) suggest that despite good intentions low susceptibility and low perception of the severity of osteoporosis constrained actual change in behaviours. The perception that osteoporosis is not preventable and is an older persons disease may contribute to this misconception. Another survey examining health beliefs of 128 women age  $\geq 52$  years about disease screening found that women ranked osteoporosis as lower in severity than colorectal or breast cancer and felt ambivalence towards osteoporosis screening as being able to prevent disease (Dassow, 2005). It is apparent that there is a gap in women's basic knowledge about osteoporosis as well as misperceptions concerning susceptibility and seriousness of osteoporosis as a disabling and deadly disease. Health education both formal and as delivered in the primary care setting should be geared towards increasing osteoporosis general knowledge that addresses the benefits of adequate calcium and vitamin D intake and exercise for preventing falls and fractures.

Individuals have a responsibility to improve their own bone health through proper nutrition and exercise. As well, primary health care providers also have a role to educate themselves and their patients about prevention, detection, diagnosis and treatment of osteoporosis (U.S. Public Health Service, 2004). There is a multitude of ways to connect to up to date information. One way is by accessing on line information such as Osteoporosis Canada's web site that allows access to free downloads of their journal *Osteoporosis Update* and other reference resources. As well, health care providers can take the opportunity to attend an osteoporosis conference or make note of information sessions from specialist related to bone health that can be teleconferenced to various communities in the region.

In the primary care setting, a multi-disciplinary approach is beneficial, both for the health care providers and high risk populations. Primary care providers, nurses, physiotherapists, dietitians and pharmacists have contact with clients and families at different points of entry into the health care system, a drop in group medical appointment (DIGMA) connects them together as a team. This model provides an opportunity for clients to have their questions answered accurately and consistently. As well, they have the opportunity to share and listen to each others experiences and coping strategies that promotes self-management skills. The opportunity to provide health education to groups provides an avenue to narrow the osteoporosis information gap that could service not only, women in this target population but, also to different age groups across the lifespan.

### Personalized Feedback

Undoubtedly, how the BMD result is shared with clients does influence their decision on whether to engage in QPBs and osteoporosis preventative therapies. Wallace et al. (2004) as well as, another study by Kirk, Nichols, and Spangler (2002) indicates that BMD testing alone does little to motivate engagement with OPBs. The other three studies in this review included BMD testing with personalized feedback, osteoporosis information pamphlet and/or educational sessions and were more effective at influencing calcium and vitamin D intake (Estok et al., 2007; Sedlak et al., 2005; Rolnick et al., 2001). As well, both RCTs indicated with statistical significance that those postmenopausal women with an abnormal BMD were more likely to increase their calcium intake than those women with a normal BMD result (Estok et al., 2007; Rolnick et al., 2001). Women need to understand the implications of their BMD measurement. Fitt et al. (2001) reported a positive influence of BMD on increasing osteoporosis preventive therapy and highlighted the importance of patient understanding and discussing the results with a primary care provider as critical components with initiating osteoporosis preventative therapy. Individuals knowing BMD measurement does not equate to understanding their susceptibility and the seriousness of osteoporosis. The more the patient understands and appreciates the benefits of the recommended health behaviour as it relates to their own health, the more likely they are to change the at risk behaviour.

# Health Screening Anxiety

The findings of increasing worry in these studies poses unanswered questions concerning the impact on BMD screening on exercise behaviours. Sedlak et al. (2005)'s study showed that individualized feedback on BMD and customized intervention strategies increased the perception of barriers, particularly to exercise. The intervention group was small (n = 23); however, these findings are supported by other studies (Marci et al., 2000; Rubin & Cummings, 1992) that suggested that fear and worry of falling may only increase after knowing results of BMD and lead women, even young women < 65 years of age, to limit activities. Health care providers should be aware of the possibility of negative influence of BMD testing. Counseling approaches should balance both positive and negative attributes of BMD result and recommendations (Wroe, Salkovskis, & Rimes, 2000). The worry of falls also highlights the importance of discussing fall prevention by reducing hazards and problem solving safe ways to participate in increasing activities.

Rimes and Salkovskis (2002) add another perspective in regards to patient anxiety and action on OPBs. This study incorporates the cognitive-behaviour model of health anxiety and was developed based on a previous study by Rimes, Salkovskis, and Shipman (1999) that found similar outcomes relating to women who received low BMD results, these women were inclined to be more anxious at three months post screening than women who received normal BMD results. Rimes and Salkovskis (2002) propose that certain people have preexisting "maladaptive" assumptions about health and interpret health information as threatening and participating in health screening tests only increases those anxieties. This study's purpose was to examine the possibility of developing ways of predicting which people are likely to experience anxiety so that health care providers are in a better position to offer interventions aimed at reducing those anxieties.

As expected those women with pre-existing high health anxiety indicators showed "an increase in worry about osteoporosis, perceived likelihood and need for reassurance between the three and fourteen-month follow-ups, unlike those with low levels of preexisting health anxiety" (Rimes & Salkovskis, 2002, p. 366). Rimes and Salkovskis (2002) conclude that variables derived from the cognitive-behavioural health model of health anxiety are significant predictors in identifying differences in reactions to BMD screening. Indicators related to specific illness beliefs and general health anxiety measures correlated with increasing distress after BMD testing suggesting that these individuals would require further follow-up. Also of interest, was the group of women with low health anxiety indicators and low BMD results minimized the seriousness of the test result yet, they showed higher levels of OPBs after three months post BMD testing suggesting that their anxieties needed to be overcome before acting on recommended behaviours. The findings from the Rimes and Salkovskis (2002) study are insightful and support the evidence in this review. Primary care providers should be aware of the potential for increasing anxieties after BMD screening and that the results may have either a positive or negative effect on health beliefs and OPBs.

# Perceived Barriers

It can be surmised from the evidence that making changes in calcium intake takes less effort and perceived barriers are easier to overcome. Wallace et al. (2004) points out that "exercise was perceived to be the least comfortable change to make, with some regarding their dietary changes as sufficient to justify no change in exercise" (p. 108). Generally, calcium intake either through diet or supplementation is not time-consuming, is relatively inexpensive and requires minimal level of commitment to change behaviour; whereas, adopting exercise as a new health pattern can be time consuming, expensive and overall requires a high level of personal commitment. The benefits of increasing calcium intake verses engaging in exercise may have been perceived as less of a threat to their present behaviour patterns and required lower confidence to succeed. The belief that participating in exercise may increase the risk of falls and fractures only serves to reduce confidence for incorporating exercise as a lifestyle change. Also of interest the second study in Wallace et al. (2004) examining postmenopausal women with osteoporosis demonstrated low self-care behaviours because they had little confidence that the changes were worthwhile. An effort should be made to explore perceived barriers that may include lack of readiness, misconceptions and gaps in knowledge. Collaboratively with clients, the objective should be to explore effective strategies that reduce barriers and increase client confidence to move towards participating with OPBs.

#### Osteoporosis Risk Screening

The high rates of low bone density, 57%-59% in relatively healthy women, is alarming and highlights the value of early osteoporosis risk screening for women 50-65 years of age (Estok et al., 2007; Sedlak et al., 2005). The below normal bone density rates in the Rolnick et al. (2001) study were 44%, somewhat lower but may be attributed to past use of HRT by a portion of these women. The prevalence of osteoporosis in Canadian women at age 50 is approximately 6% (Brown & Fortier, 2006) and varies from 16% to 30% in the postmenopausal Caucasian women (Kanis & WHO Study Group, 1994) thus, the findings in these two studies showing rates of osteoporosis at 13%-16% may be in line or marginally above expectations (Estok et al., 2007; Sedlak et al., 2005). The startling results are the findings of osteopenia with rates at 43%-45%. It can be argued that together these two studies screened a small sample (n = 225) of young postmenopausal women and the studies should not be generalized to the public. However, selection for the FIT II study, recruited 25, 864 women between 54-81 years of age who volunteered to be screened with BMD and the outcomes showed 16, 594 (64%) of these women had low bone density scores of T scores ≥ -1.6 below the young normal adult (Cummings et al., 1998). Although, the mean age of the FIT II study was older at 68 years, it is difficult to dispute that generally there is a higher prevalence of low bone density for Caucasian postmenopausal women who express interest in their bone health. There is potential bias in these studies given that these women volunteered to be screened and may have an increased interest in their health and/or preexisting health concerns related to osteoporosis.

Even though, the rates of low bone density are higher in these studies than what is expected in the general population, it is important to revisit the issue that osteoporosis screening rates are suboptimal in primary care (Gehlbach et al., 2000; Gill & Hoffman, 2003; Port et al., 2003). Gehlbach, Fournier, and Bigelow (2002) estimate that physicians are only identifying fewer than 10% of the women who have osteoporosis or vertebral fracture. pointing out that a large proportion of postmenopausal women who are at risk for low bone density are being missed. The implications of this review suggest that osteoporosis risk screening for women age 50 and older should be viewed as part of best practice in the primary care setting. As well, the writer would suggest osteoporosis screening should be viewed as a priority for this population, in much the same way as breast and colorectal cancer screening. It is acknowledged that for various reasons routine BMD testing is not recommended for women < 65 years of age (BC Ministry of Health, 2005); however, osteoporosis risk assessment screening and counseling is recommended beginning at age 50 (NOF, 2008). The Canadian Task Force on Preventative Health (2004) conclude that there is fair evidence to recommend screening postmenopausal women in order to identify women with low BMD and that treating osteoporosis can reduce the risk of fractures (Cheung et al., 2004). If, primary care providers and the public are not thinking osteoporosis prevention then fractures, resulting disabilities, mortality and health care costs will continue to rise. Public health policy, mass media and primary care providers need to acknowledge osteoporosis as important and prevention initiatives as relevant.

# Recommendations for Northern Health

#### Develop Osteoporosis Screening Survey

Ideally, osteoporosis screening tools should provide standardization and clinical objectivity on which postmenopausal women should be selected for BMD screening. To date, despite many small comparative and validation studies of osteoporosis screening tools there

is a lack of good discriminatory performance and they have not found widespread clinical application (Nelson et al., 2002; O'Neill, 2007). The better known risk assessment tools such as the Simple Calculated Osteoporosis Risk Estimation (SCORE), Osteoporosis Risk Assessment Instrument (ORAI) and the Osteoporosis Self-assessment Tool (OST) set out rules for determining who may be appropriate for BMD testing (Gourlay, Powers, Lui, & Ensrud, 2008; Nelson et al., 2002; O'Neill, 2007). These assessment tools have been primarily studied pertaining to older postmenopausal women  $\geq 65$  years and are not inclusive with the most recent evidence pertaining to risk predictors. Although, SCORE and ORAI are recommended for use in the primary care setting (Cadarette et al., 2000; Cheung et al., 2004) both tools include HRT as a variable; HRT has become less relevant with declining use since the adverse outcomes of the Women's Health Initiative study (Gourlay et al., 2008). Gourlay et al. (2008) conducted an accuracy analysis of all three risk assessment tools and individual risk factors (age, weight and prior fracture) to identify low BMD in 7,779 American women  $\geq$  67 years of age. The article concluded that weight identified those with low BMD as accurately as the ORAI and SCORE and there was no advantage to using a risk assessment tool over assessing for low weight in older women > 65 years of age (Gourlay et al., 2008). As well, Rolnick et al. (2001) in this review also pointed out that SCORE tended to overidentify many women at risk.

Recently, the WHO has developed the Fracture Risk Assessment Tool (FRAX) which calculates individual's 10-year absolute fracture risk and can be used with or without BMD results. The risk factors include prior fracture, age, weight, family history, smoking, alcohol intake, as well as secondary causes of osteoporosis and known T-score of the femur which modestly improves the predictability of the risk (O'Neill, 2007). The FRAX model allows categorization of risk from low to high and targets people for economical cost-effective interventions. The tool is available online at <u>http://www.shef.ac.uk/FRAX</u> and is incorporated into the *National Osteoporosis Foundation (2008) Clinician's Guide to Prevention and Treatment of Osteoporosis* (Watts, Lewiecki, Miller, & Baim, 2008). Although, this tool is more comprehensive and can be useful when assessing the older high risk postmenopausal woman and assist with decision making on related interventions, it does not fill the need for a standardized approach for selecting clients for BMD screening. There is a lack of appropriate osteoporosis screening tools for the young postmenopausal woman and this project points to a need to develop a useful clinically based osteoporosis screening survey for this population.

# Adopt Implications for Practice

The implications outlined in this project highlight the importance of including more than predictors for BMD screening in a risk assessment survey. Recognizing who is most at risk is an important component and osteoporosis risk predictors do assist with the decision making process on who would benefit from BMD screening; however, the survey should also include an assessment of osteoporosis general knowledge, present levels of OPBs, health beliefs and health anxiety predictors. The client should be able to prioritize which questions are of importance to them ensuring that the client's needs are met and will determine if there is a need for follow-up visits.

Besides standardizing care for osteoporosis the introduction of an osteoporosis assessment survey is a preventative measure that provides an opportunity for primary care providers to be proactive with providing self-management support to clients. Selfmanagement has been receiving increasing attention with a shift from a paternalistic care

model towards patients being more actively involved with their care needs (Barlow, Sturt, & Hearnshaw, 2002). This is in line with Provincial directives from the Centre on Aging; resource reference www.coag.uvic.ca/cdsmp. The Centre on Aging is promoting a training program for allied health care professionals that recommends the five A's approach that encourages motivational interviewing. This approach includes strategies to assess, advise, agree, assist and arrange with intention of promoting day to day self-management skills for clients coping with chronic conditions. An osteoporosis risk survey enhances a consistent, best practice approach that incorporates assessing for osteoporosis as part of routine care for young postmenopausal women while highlighting osteoporosis as a priority. Considering that mailed reminders significantly improve osteoporosis screening rates (Lafata et al., 2007), osteoporosis risk surveys could be sent out via posted mail or on-line which can be completed at specific age intervals for women  $\geq$  50 years or are flagged to be completed at well women appointments. Osteoporosis screening surveys also serve to provide a guided visit agenda which is also one of the objectives for promoting the self-management care approach.

It is acknowledged that patients may not view osteoporosis as a priority health issue however, primary care providers not highlighting osteoporosis education contributes to the overall belief that osteoporosis is not preventable and is an acceptable part of aging. The osteoporosis screening survey provides an opportunity to assess knowledge gaps and misconceptions that may require clarification or advice on recommendations for behaviour change. This project indicates that increasing knowledge pertaining to the benefits of adequate intake of calcium and vitamin D does increase the intake of calcium and vitamin D. As well, an osteoporosis risk survey indicating at risk predictors will assist with selection for BMD referral. Asking about the clients concerns highlights the patient's interests and provides opportunities to collaboratively discuss which OPBs behaviours they are motivated to change. The process of setting goals the client agrees to or wishes to move forward with is part of the motivational process and includes exploring perceived barriers, problem solving and enhancing self-efficacy. The primary care provider has a role with assisting clients by increasing motivation and developing action plans. Arranging follow-up is an essential part of the process and is important particularly for at risk client that have been referred for BMD testing. Consideration of the implications of osteoporosis risk screening and BMD testing has been highlighted in this project and are outlined as follows:

Overview of Implications for Practice:

- Increasing osteoporosis risk screening, a priority high rates of abnormal bone density in relatively healthy women demonstrating value of early osteoporosis risk screening beginning at age 50.
- Increase osteoporosis knowledge knowledge gap concerning adequate calcium and vitamin D intake and importance of exercise for bone health. Lack of generalized knowledge of osteoporosis as a disabling and deadly disease.
- Provide personalized feedback increase level of understanding of BMD result and provide balanced explanation of personal susceptibility and seriousness of osteoporosis
- Assess health screening anxiety negative influence of BMD screening on exercise, potential fear of falling/worry resulting in decreasing activity
- Explore perceived barriers assess health beliefs, knowledge gaps, misconceptions, readiness to change, develop strategies to reduce barriers and increase confidence

# Offer BMD Testing

It should be considered that availability of BMD scanning does influence women's interest in participating in osteoporosis prevention programs. A screening and bone maintenance program can serve as a resource for clients, and provides invaluable support for professionals (Galsworthy, 1990). Rolnick et al. (2001) indicated that women were disappointed when selected for the education session without BMD testing and this may have contributed to the 29% absenteeism rate when compared 10% absenteeism rate in the education plus BMD testing group. The findings of the Osteoporosis Population-Based Risk Assessment (OPRA) Trial, also supports having BMD availability, this trial of 3,167 older women compared strategies for how to allocate BMD testing and found that when BMD testing was offered universally, with no limitations, in a fracture prevention program the more influence there was on fracture rates, change in fracture risks and knowledge about fracture (LaCroix, Buist, Brenneman, & Abbott III, 2005). Although, the OPRA trials recruitment rates were low (21%-42%) across intervention groups and the focus was on older women (60-80 years) the women who participated overwhelmingly indicated a desire for fracture prevention programs that offered BMD testing (LaCroix et al., 2005). This has implications for group educational strategies for enhancing recruitment and increasing attendance, access to BMD testing influences women's decisions to participate in osteoporosis prevention programs and is effective at influencing OPBs.

# Conclusion

For postmenopausal women osteoporosis and fracture are a major threat to functional independence and quality of life that has the potential to precipitate the end of life. Calcium, vitamin D and exercise have been shown to increase bone density, reduce falls and prevent

fractures. Studies have shown that personal knowledge of bone density has a positive influence on treatment interventions in postmenopausal women yet, the studies considering the personal knowledge of BMD testing on OPBs are less clear. This project evaluated the influence of education and knowing personal knowledge of BMD testing on calcium intake and exercise of young postmenopausal women between the ages of 50-65 years of age. The review found a positive influence of education and BMD that increased calcium and vitamin D intake. It also showed that the intake of calcium and vitamin D was significant with decreasing BMD measurements. The findings showed no influence of education and BMD testing in lowering levels of exercise or activity participation. The limitations of this project are the review included four studies of which only two were RCTs. This review does suggest that further research is warranted to better understand the relationship between osteoporosis, BMD screening and exercise.

Personal knowledge of BMD does influence OPBs and all four aspects of the HBM need to be in motion in order for health behaviours to be successful. The findings in this review are supported by other studies and have implications for practice in the primary care setting. The outcomes of this project point to a gap in public knowledge of osteoporosis particularly as it relates to the important benefits of adequate calcium and vitamin D intake and exercise for bone health. As well, the outcomes stress the importance of increasing osteoporosis risk screening to identify those at risk and who would benefit from osteoporosis medical interventions. There is a need to develop a useful clinically based osteoporosis screening survey for this population group and a screening survey should address osteoporosis predictors of risk, knowledge, health beliefs and pre-existing anxiety associated with health screening interventions. Health care providers should be aware of the impact of personalized feedback, potential client anxiety and the importance of follow-up post BMD testing in the primary care setting. Osteoporosis prevention should be a priority for young postmenopausal women with the ultimate goals of reducing fractures thereby reducing morbidity, mortality while improving quality of life and decreasing the burden on the health care system.

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