PROMOTING EXERCISE IN POSTMENOPAUSAL WOMEN TO DECREASE OSTEOPOROTIC FRACTURE RISK: THE ROLE OF NURSE PRACTITIONERS

By

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BScN, University of Northern British Columbia, 2013

PROJECT SUBMITTED IN PARTIAL FULFILLMENT OF THE REQUIREMENTS FOR THE DEGREE OF MASTER OF SCIENCE IN NURSING: FAMILY NURSE PRACTITIONER

UNIVERSITY OF NORTHERN BRITISH COLUMBIA

August 2018

Abstract

Due to the aging Canadian population, the disease of osteoporosis is becoming increasingly prevalent. Postmenopausal women in particular are at heightened risk for osteoporosis due to their depleting estrogen levels and subsequent declines in bone density. Exercise is recognized as a key preventative measure for osteoporosis progression in this at-risk population. However, there is limited information available to provide insight into how health care providers can promote exercise behaviours which help to maintain the muscle strength and bone health of postmenopausal women and decrease the likelihood of osteoporosis related fractures. Nurse practitioners, as primary care providers, are in an ideal position to provide health promotion for the prevention of osteoporosis in their postmenopausal patients. An integrative literature review was conducted to identify which strategies nurse practitioners within the primary care setting can use to promote exercise behaviours in postmenopausal women in order to reduce their future osteoporotic fracture risk. Through guidance of Whittemore and Knafl's integrative literature review approach and incorporation of a Health Belief Model perspective, an analysis of the literature was conducted and revealed the complexity of behaviour change with respect to osteoporosis prevention. Results highlighted significant influencing factors related to behaviour change, including individual knowledge about bone health, perceived risk for osteoporosis, and motivation to engage in exercise behaviours. Findings from the literature review suggest that personalized education, bone mineral density result provision, and subsequent reinforcement of educative interventions are important strategies that nurse practitioners can provide in the primary care setting. These recommendations for clinical practice are discussed, in addition to suggestions for future nurse practitioner education and research.

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Acknowledgements

I would like to express my gratitude to my advisory committee members Sylvia Barton and Rosemary Graham for their guidance and contributions to this paper.

Thank you to Lori Borchert for her inspiration when needed the most, and Jennifer Borchert for her endless encouragement. Thank you to Tyler Pfanner for his unwavering love and support.

Glossary of Terms

Bone Mineral Density: a measurement of bone density and mass which reflects the strength of bone (Buttaro, Trybulski, Polgar-Bailey, & Sandberg-Cook, 2017).

Nurse Practitioner: a registered nurse who has completed graduate studies and obtained advanced knowledge to practice autonomously. Competencies achieved include health management provision, ordering and interpreting diagnostic tests, diagnosing and treating, and providing disease prevention and health promotion (Canadian Nurses Association [CNA], 2010).

Osteoporosis: the deterioration of bone density, related to increased resorption of bone relative to bone formation, which leads to low bone mass (Buttaro et al., 2017).

Osteoporotic Fracture: a fracture related to low density of bone, which results from minimal trauma and is indicative of poor bone quality (Brown & Josse, 2002). This term is used interchangeably with *fragility fracture*.

Postmenopause: a stage that occurs in middle-aged women due to changes in hormone levels and is characterized by the absence of menstruation for a prolonged period (Harlow et al., 2012).

Primary Care: health services that often provide the initial patient contact for disease management by a health care provider. This care involves a holistic patient approach, with emphasis placed on continuity of care and supporting patients in their health promotion and disease prevention.

Primary Care Provider: a health care provider, often a physician or nurse practitioner, who provides primary care to a patient over an extended period of time.

Primary Health Care: a framework for health care services that encompasses primary care and addresses health, social, and economic needs to promote positive health outcomes.

Chapter 1

Introduction

The prevalence of osteoporosis is increasing as a result of the aging population. The World Health Organization [WHO] (2007) has predicted that the incidence of osteoporosis and related fractures will increase three times that of the current incidence over the next 50 years. Many risks are associated with osteoporosis and correlated fractures, such as previous history of a fracture, increased age, and physical inactivity (WHO, 2007). Postmenopausal women in particular are at a heightened risk for osteoporosis due to their depleting estrogen levels, and subsequent declines in bone density (Buttaro et al., 2017). As women age, they participate in less physical activity (Seguin et al., 2012). This has a direct effect on the future physical function of these individuals, leading to increased risk of falls and fractures (Seguin et al., 2012).

In Canadian guidelines, the definition and diagnostic criteria of osteoporosis have evolved over the last 10 years. There is now less focus on the density of bone as a primary influencing factor, and greater recognition of lifestyle related risk factors and the subsequent fracture outcomes that contribute to disability and mortality (Papaioannou et al., 2010; WHO, 2007). Osteoporosis related fractures are known as fragility fractures or osteoporotic fractures. A fragility fracture is defined throughout the literature as a fracture that occurs due to minimal trauma or without an identified injury (Brown & Josse, 2002). A fragility fracture indicates poor bone quality and is a clinical indicator of osteoporosis (Buttaro et al., 2017; Papaioannou et al., 2004). Thus, the terms osteoporotic fracture and fragility fracture can be used interchangeably. For the purposes of this paper, the term osteoporotic fracture is used.

Pharmacological antiresorptive agents are approved in Canada for the treatment of osteoporosis and prevention of fractures in adults with and at-risk for a decline in bone density. These medications inhibit bone resorption, preventing deterioration of bone mass (Brown & Josse, 2002). Nutritional supplementation is also suggested for bone health maintenance (Papaioannou et al., 2010). However, these recommendations should not overshadow the importance of exercise in modifying some individual risk factors for osteoporotic fractures. Maintained or enhanced physical activity has been shown to improve bone density, which protects against the progression of osteoporosis (Siris et al., 2011). Physical activity also contributes to muscle mass, which enhances the strength and balance required to decrease the risk of falls associated with age progression. The literature suggests that the at-risk population, postmenopausal women, underappreciate their risk for osteoporosis and subsequent fractures (Siris et al., 2011). This deficiency of risk recognition results in women lacking adequate incentive to positively modify their exercise behaviours, which otherwise could prevent bone deterioration and support the muscle strength necessary to prevent future debilitating fractures.

The long-term trusted relationship that develops between a primary care provider (PCP) and their patient provides the ideal environment to collaboratively identify patient health risks and support healthy lifestyle changes. As part of a team, PCPs are aware of the resources available to patients and are educated and informed on the disease of osteoporosis. There is a major opportunity for PCPs to identify postmenopausal women at risk for osteoporosis, and to provide primary prevention strategies to reduce future osteoporotic fracture risk. Nurse practitioners (NPs) as PCPs are ideally positioned, as part of the team-based approach to health care, to provide disease prevention and health promotion to

postmenopausal women. Each individual contact with a patient provides an opportunity for education that addresses a woman's risk for osteoporosis, and for the promotion of healthy lifestyle changes, including exercise. By focusing on physical activity during encounters with postmenopausal women, NPs can promote lifestyle modifications to further decrease their future risk of fractures.

It is important to recognize that exercise is one factor of many to consider in the holistic prevention of fractures in postmenopausal women with osteoporosis. However, the overall prevention of osteoporotic fractures is enhanced when individuals are able to maintain their physical strength and lessen the deterioration of their bone quality (Howe et al., 2011). An enhanced understanding of effective strategies to promote exercise behaviours in postmenopausal women in the primary care (PC) setting is needed, in order to provide insight into how NPs as PCPs can play a key role in the prevention of fractures and significant morbidity in the aging Canadian population**.**

Project Purpose

The selection of this integrative literature review stemmed from my professional experiences working in the hospital. While working as a registered nurse in the emergency department, I saw elderly patients admitted to hospital with debilitating osteoporotic fractures, often of the hip. These fractures significantly impacted patient quality of life, causing chronic pain and contributing to adverse outcomes, such as pneumonia. Such outcomes led to decreased independence. These patients often had pre-existing risk factors for osteoporotic fractures, such as previous fractures and mobility issues, in addition to their increasing age. Frequently, these individuals were not previously screened and assessed for osteoporosis, and had no relevant therapeutic interventions established. I observed the

challenges of implementing interventions to maintain strength and mobility following a fracture. Decreased independence and increased pain and emotional stress became huge barriers for these patients to adequately implement preventative measures for the future.

Through my experiences, I gained an awareness of the missed opportunities in primary health care (PHC) for early screening of women at-risk, and of the need to provide interventions for the prevention of subsequent fractures. Postmenopausal women innately compose a high-risk group for osteoporosis (North American Menopause Society [NAMS], 2010), and compound their risk with sedentary lifestyles and lack of insight into the maladaptive effects of physical inactivity (Seguin et al., 2012; Siris et al., 2011). Exercise is globally recognized as a key intervention for health promotion with respect to osteoporosis (NAMS, 2010; Papaioannou et al., 2010). It is essential that physical activity is introduced and maintained in order to avoid the debilitating consequences of osteoporotic fractures in postmenopausal women in the PC setting.

Although there are clear North American guidelines suggesting the implementation of exercise as a preventative measure for osteoporosis and fracture risk (NAMS, 2010; Papaioannou et al., 2010), there is no clear guidance on how PCPs can best promote exercise in their postmenopausal clients. This project aims to answer one question: "What strategies can NPs in the PC setting use to promote exercise behaviours in postmenopausal women to reduce their future osteoporotic fracture risk?" The methodology used is in the form of an integrative literature review which details the preliminary search, the application of inclusion and exclusion criteria to focus the literature search, and the provision of a methodological plan that results in a comprehensive analysis of the selected literature. A visual representation of selected articles displayed as a matrix presents an evaluation of individual articles,

including information highlights, strengths and limitations. An analysis and discussion of the findings provide practice recommendations for NPs that include clinical implications and potential areas for future research. These key findings are based on the identification of factors that influence exercise behaviours related to osteoporosis and subsequent fracture prevention in postmenopausal women. The insight provided by this literature review, outlining how NPs can integrate strategies to promote preventative exercise behaviours in their practice, can benefit future efforts to decrease the occurrence of osteoporotic fractures within the postmenopausal population.

Chapter 2

Background

Osteoporosis in postmenopausal women can be disabling as a result of subsequent osteoporotic fractures. These fractures are preventable and are a significant health concern within the public health sector. In this chapter, I discussed the disease process of osteoporosis and the associated outcomes and economic burden within Canada. Following this, Canadian practice guidelines for osteoporosis are discussed, including the recent guideline changes and management recommendations that incorporate exercise as a nonpharmacological prevention strategy. This is then followed by a discussion of the disease of osteoporosis, osteoporotic fractures, and barriers to osteoporosis prevention with respect to postmenopausal women. Last, I provide a discussion of the Health Belief Model (HBM) related to behaviour change and the NPs role as a PCP working with postmenopausal women at-risk for osteoporotic fractures.

Osteoporosis

Osteoporosis is a disease characterized by deterioration of bone tissue and low bone mineral density (BMD) mass (Buttaro et al., 2017). Bone remodeling occurs through bone resorption by osteoclasts, causing bone breakdown, and by osteoblasts that produce osteoid, resulting in bone formation (Buttaro et al., 2017). In normal bone remodeling, this process is balanced; bone resorption and formation occur equally. Osteoporosis occurs when there is a loss in bone density, due to increased bone resorption relative to that of bone formation (Buttaro et al., 2017).

In developed countries, the prevalence of osteoporosis is close to that of cardiovascular disease (WHO, 2007). Osteoporosis is often referred to as a silent disease,

progressing insidiously without symptoms (Buttaro et al., 2017; NAMS, 2010; WHO, 2007), and causing a heightened risk for fractures (WHO, 2007). Sites of these fractures often include the "spine, hip, forearm, and proximal humerus" (WHO, 2007, p. 7). The risk for fracture increases with age, and fractures are associated with morbidity and increased mortality (WHO, 2007). Due to the aging Canadian population, an increase in osteoporotic related fractures is becoming an economic burden. In 2011, it was reported that 81% of fractures in men and women older than 50 years of age were caused by osteoporosis (Hopkins, 2016). In addition, women had twice the fracture rate of men, this rate increasing with age. It was reported by Hopkins et al. (2016) that in 2011, the cost of osteoporosis related incidences in acute care cost the Canadian health care system $1524 million. The total cost of osteoporotic fractures in Canada has increased by 83% since 2008. In 2011, the total cost was 4.6 billion, with long-term care costs largely contributing to this amount.

Practice Guidelines

Practice guidelines related to disease management are a valuable resource for dissemination of information. These guidelines provide an easy reference for best practice application in the PC setting. Current practice guidelines related to osteoporosis address the assessment and diagnosis of the disease, in addition to the pharmacological and non-pharmacological prevention measures that can be provided.

Assessment. Women and men over the age of 65 are at greatest risk for osteoporotic fractures (Brown & Josse, 2002). The most recent Canadian osteoporosis guidelines recommend that postmenopausal women, and men over age 50, be assessed for osteoporosis (Papaioannou et al., 2010). A diagnosis of osteoporosis is characterized as femoral neck BMD that is 2.5 or greater standard deviations below the average peak bone mass of a young

adult (Papaioannou et al., 2010; WHO, 2007). The measurement of BMD is done through dual energy x-ray absorptiometry (WHO, 2007).

Past Canadian osteoporosis guidelines, published in 2002, emphasized the use of BMD measurements in the diagnosis and management of osteoporosis (Brown & Josse, 2002). There has been controversy about the value of BMD measurements used to detect osteoporosis; the WHO (2007) does not consider BMD measurements, used in isolation, to be satisfactory for identifying individuals at heightened risk for fractures. Although BMD measurements can identify those at increased risk for a fracture, a normal BMD does not guarantee lesser risk (WHO, 2007). In Canada, the newer 2010 guidelines no longer focus on treating osteoporosis based on BMD, but instead emphasize the comprehensive assessment of an individual's risk for fracture in order to decrease the burden of fractures associated with osteoporosis (Papaioannou et al., 2010). Several risk factors for osteoporosis have been identified in the literature. These include family history, physical inactivity, weight loss, excessive alcohol consumption, glucocorticoid therapy, smoking, history of fracture, female gender, and increased age (Brown & Josse, 2002; WHO, 2007). The WHO (2007) indicates that the age of an individual can be as great of a risk factor for osteoporosis as a low BMD measurement. Considering all relevant risk factors independently, along with BMD measurements, could provide greater insight into an individual's risk for osteoporotic fractures (WHO, 2007).

Two algorithms have been developed and approved in Canada to assess a patient's 10-year absolute risk for osteoporotic fracture including the Canadian Association of Radiologists and Osteoporosis Canada Fracture Risk Assessment (CAROC) and the Fracture Risk Assessment Tool (FRAX) (Papaioannou et al., 2010). These tools incorporate pertinent

risk factors for osteoporotic fractures and BMD. In Canada, both the CAROC and FRAX tools are used to assess men and women greater than 50 years of age for osteoporotic fracture risk. The main difference between these two assessment tools is that the FRAX can be used without BMD measurements and the CAROC cannot (Papaioannou et al., 2010; WHO, 2007).

Pharmacological Management. Many antiresorptive agents have been approved for the treatment of osteoporosis. In particular, commonly used medications recommended by the 2002 and 2010 guidelines include bisphosphonates (Brown & Josse, 2002; Papaioannou et al., 2010). These medications inhibit osteoclast recruitment and bone resorption (Brown & Josse, 2002). However, bisphosphonates have been associated with poor gastrointestinal absorption, with the kidney clearing 40-80% of the absorbed medication, and only the remainder being absorbed by the bones (Brown & Josse, 2002). Further, the Canadian guidelines highlight that a common side effect of bisphosphonate therapy is gastrointestinal irritation (Brown & Josse, 2002; Papaioannou et al., 2010). In addition, approved antiresorptive agents have varying degrees of efficacy at decreasing the risk of non-vertebral fractures, vertebral fractures, and hip fractures (Brown & Josse, 2002; Papaioannou et al., 2010).

Non-pharmacological management. The Canadian 2010 osteoporosis clinical practice guidelines provide non-pharmacological recommendations for the treatment and prevention of osteoporosis, including physical activity, and calcium and vitamin D intake (Papaioannou et la., 2010). Both the 2002 and 2010 Canadian guidelines highlight the importance of these nonpharmacological treatments. However, calcium and vitamin D intake dosage recommendations for women greater than 50 years have changed. Although these

dietary supplements still remain within the Canadian guidelines, the newer 2010 guidelines indicate that there is controversy surrounding the value of calcium supplementation to reduce the risk of osteoporotic fracture. Some concern arises that there may be adverse outcomes associated with high doses of calcium, including an increased risk for cardiovascular events and renal calculi (Papaioannou et al., 2010). In addition, a recent systematic review conducted by Zhao, Zeng, Wang, and Liu (2017) indicated that calcium and vitamin D consumed by adults greater than 50 years old was not associated with a decreased risk for osteoporotic fractures.

While skepticism exists regarding the efficacy of calcium and vitamin D supplementation in the prevention of osteoporosis and osteoporotic fractures, exercise has been consistently recognized as integral to the prevention and management of osteoporosis. Physical exercise is associated with reduced bone density loss (Howe et al., 2011), and is an early intervention that can be implemented before pharmacological therapy is recommended (Papaioannou et al., 2010). It improves not only bone mass, but also overall physical function and muscle strength. Improving muscle strength is included within the management of osteoporosis as muscle strength helps to reduce the likelihood of falls, which are often associated with osteoporotic fractures (Brown & Josse, 2002; Papaioannou et al., 2010).

Postmenopausal Women and Osteoporosis

Women over the age of 50 will all eventually experience menopause (Buttaro et al., 2017). Before the 21st century, the phases of menopause and postmenopause were poorly defined (Buttaro et al., 2017). The Stages of Reproductive Workshop +10 Staging System, classifies women into three phases, including the reproductive phase, the menopausal transition phase, and the postmenopause phase (Harlow et al., 2012). Menopause, or

perimenopause, is characterized by fluctuations in hormonal levels and irregular menstrual cycles. Menopause transitions to the postmenopause phase, following amenorrhea for greater than 60 days (Harlow et al., 2012). About one third of women's lives are spent in this postmenopausal phase (Buttaro et al., 2017).

The burden of osteoporosis is felt most in women 50 years and older (Papaioannou et al., 2004). Brown and Josse (2002) reported that in postmenopausal women, there is approximately 0.5-2% bone loss annually. This change in bone formation is most pronounced in the 10 years following menopause, due to estrogen deficiency (Buttaro et al., 2017). As a result of their rapid decline in BMD, postmenopausal women are at increased risk for fractures (NAMS, 2010). The deterioration in bone strength leads to increased fracture risk with low trauma. In addition, reduced physical activity, that tends to occur in women as they age, has direct negative effects on physical function, including in the maintenance of mobility and strength (Seguin et al., 2012). This leaves postmenopausal women increasingly vulnerable to falls and resultant fractures.

Within developed countries, women 50 years and older have a greater than 40% chance of obtaining an osteoporotic fracture within their lifetime (WHO, 2007). These fractures are associated with disabling health outcomes and reduced quality of life related to inhibited mobility and subsequent difficulties with self-care (Adachi et al., 2010). Prevention of osteoporosis related fractures, and maintaining physical function, is key to suppressing this significant risk evident among postmenopausal women.

Exercise

With a decrease in bone mass, the frail bones of postmenopausal women are susceptible to fracture. The risk of osteoporotic fractures can be prevented through regular

exercise regimes. In a recent Cochrane systematic review, non-weight bearing exercise of low and high force, dynamic weight bearing exercise of low and high force, and static weight bearing, including standing on one leg, contributed to decreasing BMD loss in various sites, including the femur, neck, spine, hip and trochanter, and wrist (Howe et al., 2011). Howe et al. (2011) suggested that inactivity increases bone mass loss, and physical activity decreases the progression of the osteoporotic disease process (Howe et al., 2011). Postmenopausal women who exercise have been reported to have 0.85% less bone loss of the spine, compared to postmenopausal women who are not physically active (Howe et al., 2011). In the study by Howe et al. (2011), those who performed exercise, including strength training, further contributed to 1.03% less bone loss of the hip relative to the inactive postmenopausal population. Postmenopausal women that participated in a combination of exercises, had 3.2% decreased bone loss overall (Howe et al., 2011). In conclusion, Howe et al. (2011) indicated that although there is a relatively small decrease in decline of BMD in postmenopausal women who exercise, the protective effects of exercise should still be recognized as significant. Further this physical exercise is not only important for bone strength, it is essential for maintaining muscle mass in the postmenopausal population, in order to maintain strength and function with age.

Barriers to Effective Osteoporotic Fracture Prevention

In Canada, those who have had an osteoporotic fracture are not consistently being provided health promotion strategies by health care professionals for their underlying osteoporosis (Papaioannou et al., 2004). Less than 50% of PCPs are investigating their patients' osteoporotic fractures, and thus these patients do not receive BMD evaluation (Papaioannou et al., 2004). Papaioannou et al. (2004) indicated that 50-98.3% of patients do

not receive treatment for osteoporosis after having an osteoporotic fracture. The absence of screening by PCPs has likely contributed to the missed implementation of preventative measures for osteoporosis related fractures. Those patients that sustain an osteoporotic fracture may have long-term mobility impairment, reducing their quality of life.

Aside from lack of prioritization by PCPs, research has highlighted that postmenopausal women do not recognize their increased risk for osteoporosis and subsequent fracture (Siris et al., 2011). A global longitudinal study was conducted to address osteoporosis and perceived fracture risk in women in developed countries, including North America (Siris et al., 2011). While advanced age and female gender both present important risk factors for osteoporotic fractures, Siris et al. (2011) highlighted that only 20% of women greater than 55 years of age perceived themselves at heightened risk for fracture. Perhaps of greater concern, of the women in this cohort who had been diagnosed with osteoporosis, 57% did not report a heightened awareness of their risk for fractures despite their diagnosis. In light of this disconnect with inadequate postmenopausal perceived risk for osteoporotic fracture and concurrent increased need for osteoporotic fracture preventative measures, it becomes increasingly essential to identify those women at risk and to implement management and preventative measures for osteoporotic fractures.

Health Belief Model

The health beliefs and knowledge of an individual are predictive motivators of positive health change (Rosenstock, Strecher & Becker, 1988). The HBM is a theory used to understand and promote behavioural change. Although health care has evolved since the HBM was developed in the 1900s, its core message, that the promotion of behaviour change is essential for positively impacting health outcomes, has been recognized consistently. The

most recent adaptation of the HBM by Rosenstock et al. (1988) continues to be an influential model used in current medical practices. The HBM consists of three components, including: (a) an individual's existing motivation, (b) the belief that one is susceptible to a condition and their vulnerable state, and (c) the understanding and belief that health recommendations would reduce their vulnerable position (Rosenstock et al., 1988). Active preventative behaviours and success in maintaining long-term behaviour change, is additionally supported by the competence felt by the individual to conduct behaviour change in addition to the HBM components outlined above. Self-efficacy has thus been suggested as an extension of the HBM by Rosenstock et al. (1988).

Research has highlighted that postmenopausal women lack a sense of vulnerability and knowledge related to osteoporosis (Siris et al., 2011). This emphasizes the importance of considering the HBM when promoting osteoporosis preventative behaviours in postmenopausal women. In those patients with a chronic illness, such as osteoporosis, long-term interventions including exercise are necessary for health promotion and disease prevention. Strategies to promote exercise behaviours through a HBM lens will provide the greatest understanding of how to influence behaviour change within the postmenopausal population.

Primary Health Care and Primary Care

The WHO (2008) has identified PHC as the foundation for optimal health care services. PHC is driven by a patient-centered approach with values of health equity and social inclusion (WHO, 2008). In Canada, PC fits within the PHC framework as the initial step taken towards community health (Muldoon, Hogg, & Levitt, 2006). Within this system, the health of individuals and populations is positively impacted when providers, patients, and

health care teams collaborate and effectively use technology and resources to address health determinants through health promoting activities (WHO, 2008). As part of teams, nurses are ideally situated to address health determinants, including the social and economic needs that greatly influence health outcomes (CNA, 2005).

PCPs often work in PC within the PHC system. They are the initial contact with a patient where clinical diagnosis, treatment, and management occurs (CNA, 2005). Understanding patients and their individual experiences with health problems is a key component of PC (WHO, 2008). Reflective of PC, the HBM focuses on the individual and includes a patient-centered understanding. Through the incorporation of the HBM, an understanding of the individual's experience of illness can support health care providers to better promote behaviour change in their patients. Within PC, PCPs provide a patient-centred holistic approach that engages patients in health promotion strategies. Thus, PCPs encompass an important role in the PC setting, to provide early health promotion and preventative health care in postmenopausal women to reduce their osteoporosis risk.

Nurse Practitioners as Primary Care Providers

With the evolution of the health care system, Canada has faced challenges in providing efficient and timely health care (CNA, 2008). NPs are essential members of the PHC team in Canada, providing greater access to health care services necessary for the Canadian population. The regulation of NPs in Canada began in 1997 (Canadian Institute for Health Information, 2017). By 2010, 2,554 NPs were registered within Canada (CNA, 2012). The highest number of employed NPs reside in Ontario, followed by Alberta and British Columbia (CNA, 2012). In Canada, NPs are registered nurses that have furthered their education, working autonomously as PCPs (CNA, 2010). Within the legislated scope of NP

practice, NPs have the competencies to provide health management, diagnose, order and interpret diagnostic tests, prescribe pharmaceuticals, and provide disease prevention and health promotion strategies (CNA, 2010). The use of NPs within the PHC sector will increase patient access to essential comprehensive health care services.

The basis of NP practice is a collaborative approach that works to provide optimal health promotion and illness prevention (College of Registered Nurses of British Columbia [CRNBC], 2017). NPs working in the PC setting strive to promote health equity in marginalized populations and provide services that are focused on individual patient needs. NPs as PCPs develop long-term therapeutic relationships with their patients. This allows NPs to ideally provide health promotion strategies as part of the continuity of care initiated in the PC setting. With an increased scope of practice, NPs have had the opportunity to be more involved in osteoporosis screening and prevention. Thus, NPs as PCPs bear an important responsibility to initiate early interventions within their postmenopausal population to reduce the prevalence of osteoporotic fractures in the aging Canadian population.

Chapter 3

Methods

An integrative literature review was conducted to evaluate factors that influence exercise behaviours in postmenopausal women. The purpose of this review was to provide further insight into how NPs can decrease the risk of osteoporotic fractures in their postmenopausal client population. An integrative review incorporates a broad range of literature to provide a greater understanding of an area of clinical concern (Whittemore & Knafl, 2005). Whittemore and Knafl's (2005) methodological strategies for conducting an integrative review were used to guide this paper, starting with the identification of a clinical problem and purpose for the review. A preliminary literature search was conducted, reviewing the literature addressing exercise strategies to prevent osteoporosis in postmenopausal women. The initial search revealed that although best practice guidelines recommend exercise as a preventative behaviour for osteoporosis in postmenopausal women, there lacks literature guiding PCPs to promote preventative behaviours in this patient population. Through this literature search, the following question was produced: "What strategies can NPs in the PC setting use to promote exercise behaviours in postmenopausal women to reduce their future osteoporotic fracture risk?"

Literature Search

The available literature was searched using a systematic approach within databases, followed by a secondary search of individually selected articles. Inclusion and exclusion criteria were identified, to ensure a wide range of literature was collected while still focusing on the relevant topic of the literature review. Following the Whittemore and Knafl (2005)

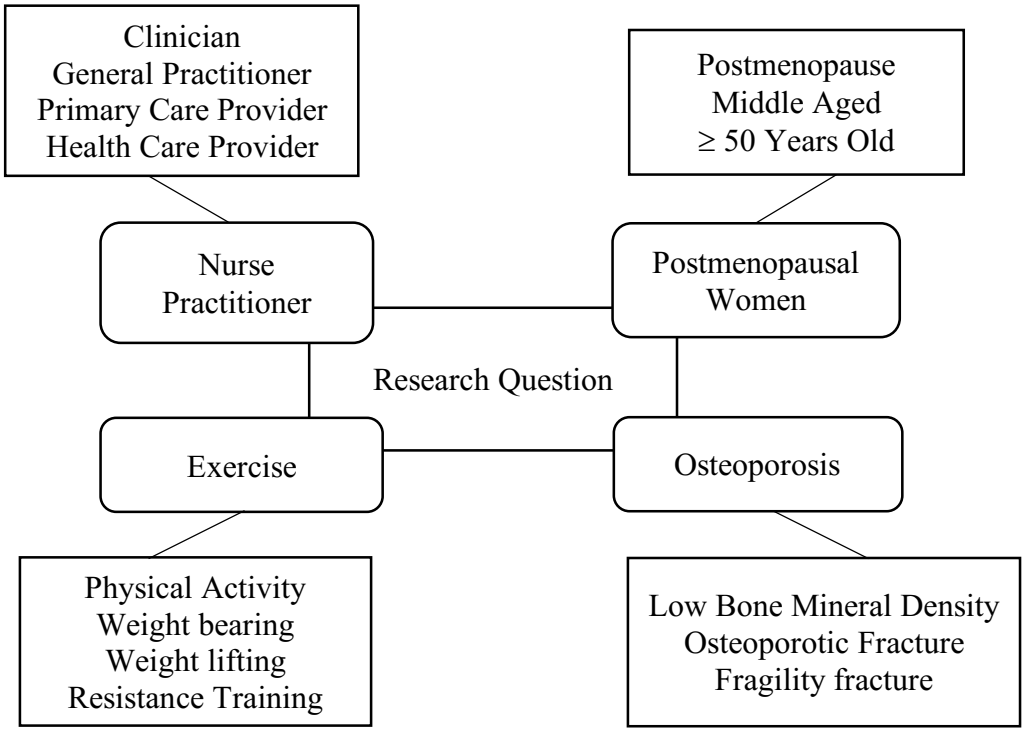
methodology, a descriptive analysis of the literature search methods is presented, followed by the data evaluation and analysis.

Preliminary Search

To support a structured and thorough literature search, a broad initial search of the literature was conducted within Google Scholar, including an analysis of the relevant keywords and medical subject heading (MeSH) terms used in the articles available for the research topic. This was to ensure that the relevant keywords and MeSH terms selected for this literature search were appropriate and would not limit the types of literature found relevant to the research subject. In addition, a concept map including important keywords was created to evaluate the research question and guide research strategies. The concept map is presented in Diagram 1.

Diagram 1

Concept Map



Primary Search Strategies

From the preliminary literature search, keywords and MeSH terms were searched within CINAHL, PsychINFO, PubMed, Cochrane Databases, and Medline (Ovid). The following search terms were used in each database, presented in Table 1. Within each database the search terms were used, when available, and combined with the Boolean operators "AND" and "OR" when appropriate. This search strategy is presented in Table 2.

Table 1

Search Terms Utilized in Specified Databases to Extract Articles for Review

CINAHL	PsychINFO	PubMed	CDSR	Medline (Ovid)
Postmenopause	Postmenopause	Postmenopause	Postmenopause	Postmenopause
Osteoporosis	Osteoporosis	Osteoporosis	Osteoporosis	Osteoporosis
	Postmenopausal	Postmenopausal		Postmenopausal
	Weight bearing	Weight bearing	Weight bearing	Weight bearing
Weight lifting	Weight lifting	Weight lifting	Weight lifting	Weight lifting
Resistance training	Resistance training	Resistance training	Resistance training	Resistance training
Physical activity	Physical activity		Physical activity	
Exercise	Exercise	Exercise	Exercise	Exercise

Table 2

Sequential Search Strategy Utilized for the Database Search

Search	Search Terms
#1	"Postmenopause"
#2	"Osteoporosis"
#3	#1 AND #2
#4	"Osteoporosis, Postmenopausal"
#5	#3 OR #4
#6	"Exercise (+)" OR "Weight Lifting" OR "Resistance Training" OR "Physical Activity" OR "Weight Bearing"
#7	#5 AND #6

Inclusion and Exclusion Criteria

Eligibility criteria were created to identify relevant literature that addressed factors influencing exercise behaviours for osteoporosis prevention in postmenopausal women. The inclusion and exclusion criteria are presented in Table 3.

Table 3

Inclusion and Exclusion Eligibility Criteria for the Selected Literature

Inclusion Criteria	Exclusion Criteria
The study contained a study group consisting of postmenopausal women	The study focused on other comorbid conditions (e.g. cancer, diabetes)
The population of study aged ≥50 years	The study focused on a specific population with unique cultural concerns
The study examined factors that influence exercise behaviours	The study focused on the effects of exercise on BMD
The study focused on the prevention of osteoporosis	The study focused on the efficacy of specific exercise programs on osteoporosis prevention (e.g. water aerobics, golf)
The study was published since the year 2000	
The study was published in English language	

For articles to be included within the review, the study had to include a study population of postmenopausal women of at least 50 years old. As the median age of menopause is suggested to be 50 (HealthLinkBC, 2016; Ruth et al., 2016), with natural menopause occurring approximately between 45 and 55 years of age (Ruth et al., 2016), it was appropriate to include women greater than or equal to 50 to ensure all literature relevant to postmenopausal women was included. Further, this age group was appropriate to include, as North American osteoporosis guidelines recommend assessing and providing interventions for postmenopausal women greater than 50 years old (NAMS, 2010; Papaioannou et al., 2010). Articles included had to discuss factors that influence exercise behaviour. Also, all articles had to focus on the prevention of osteoporosis to ensure the focus of the review remained relevant to this condition. Those articles published in English were included. Literature was limited to those published in 2000 or later, to provide information that was relatable to the progression of current osteoporosis treatment and prevention.

Articles that discussed populations with specific comorbid conditions such as diabetes and cancer were excluded to prevent differing cases from potentially complicating and altering the results of the study. Those articles that discussed osteoporosis exclusive to specific cultural contexts were eliminated due to their lack of generalizability and relatability to the Canadian context. Studies focusing on the effects of exercise on BMD were eliminated as they did not address strategies to implement and promote exercise preventative behaviours. Last, studies that focused on the efficacy of specific exercise programs for the prevention of osteoporosis were excluded as they did not address behaviours of postmenopausal women.

Secondary Search Strategies

Following the application of exclusion criteria related to date range and English language requirements in the database searches, the cumulative search yielded 961 articles. Duplications of articles were removed and a total of 590 unique articles were identified. Each article title and abstract was initially reviewed for relevance, using all inclusion and exclusion criteria (Table 3). This intensive search yielded 21 articles for full text review. Through review of the reference lists of these articles, three additional articles, which had not been highlighted by the initial database searches but were nevertheless highly relevant, were selected for full text review. These 24 full articles were thoroughly evaluated for the inclusion and exclusion criteria and a total of nine articles were selected for inclusion in the literature review. The diagram corresponding to this literature search is presented in Appendix A.

Data Evaluation and Analysis

The selected literature was evaluated and categorized within a review matrix. Such quality evaluation of literature is necessary within an integrative literature review (Whittemore & Knalf, 2005). The Critical Appraisal Skills Programme (CASP) systematic review, randomized controlled trial, qualitative study, and case control checklist was utilized to evaluate the quality of the literature (CASP, 2017). As there was no quasi-experimental research quality evaluation tool, the CASP randomized controlled trial checklist was utilized. Through evaluation of each article an assigned quality rating was given. These ratings are presented within the literature review matrix in Appendix B.

Data analysis requires a synthesis of the literature and a systematic review, to ensure no bias is introduced by the evaluator (Whitemoore & Knalf, 2005). As highlighted by

Whitemoore and Knalf (2005), the first step of data analysis is data reduction. For the literature review, this was done through classification of the methodologies from the obtained literature. Two classifications were created: (a) primary studies, which included randomized controlled studies, quantitative studies, a quasi-experimental study, and a qualitative study, and (b) systematic reviews. Details of the literature within the literature review matrix were described under the headings: “aim”, “study design”, “sampling”, “methods and analysis”, and “strengths and limitations”. Further, results particular to exercise behaviours were extracted from the literature and displayed under a separate column within the literature review matrix. As indicated by Whitemore and Knalf (2005), verifying and drawing conclusions from condensed data can help to interpret findings. The final step of analysis, data comparison, provided insight into patterns formed with the literature. The following section discusses the synthesis of these findings within the literature.

Chapter 4

Findings

Through a comprehensive search, nine articles were identified addressing exercise behaviours for the prevention of osteoporosis in postmenopausal women. The literature set was comprised of four randomized controlled trials, two quantitative studies, one quasi-experimental design, one qualitative study, and one systematic review. As articles were selected to provide relevance to the Canadian context, 77% of the selected literature was conducted in the United States (US) and 11% was conducted in Western Europe. One systematic review included a majority of literature from the US, Canada, and Europe. Each article's methods, key findings, strengths, and limitations were reviewed and presented in the literature review matrix in Appendix B. The CASP tool was utilized and adapted to provide guidance for the critique of each article, and to further provide insight into the quality of the literature. Three themes emerged within this literature review matrix, providing insight into factors that influence exercise behaviours for osteoporosis prevention in postmenopausal women. These themes were:

1. Preventative interventions
2. Health beliefs of postmenopausal women
3. Clinical approaches

The articles included in this review directly addressed the research question and focused on four elements of preventative interventions (education, BMD results, promoting self-management, follow-up reinforcement), three elements of health beliefs of postmenopausal women (knowledge, perceived risk, motivation and self-efficacy), and four elements of clinical approaches (breadth of osteoporosis education, methods of delivery,

individualized prevention plans, and frequency of interventions). The following sections discuss these identified themes.

Preventative Interventions

Common interventions arose in the literature related to osteoporosis preventative behaviours in postmenopausal women. The interventions that emerged included education, BMD results, promoting self-management, and follow-up reinforcement.

Education

The provision of education that focuses on osteoporosis was a common intervention identified within the literature for the prevention of osteoporosis (Alp, Kanat, & Yurtkuran, 2007; Lia, Chua, & Chan, 2009; Rolnick, Kopher, Jackson, Fischer, & Compo, 2001; Schousboe et al., 2005). The literature highlighted that providing osteoporosis education supported motivation for exercise behaviours in postmenopausal women. Generalized education addressing osteoporosis risks, outcomes and prevention was associated with an increase in osteoporosis preventative measures (Lia, Chua, & Chan, 2009). However, research suggested that osteoporosis education was most influential, having the largest impact on the promotion of preventative exercise behaviours, when provided through an individualized approach (Rolnich et al., 2001; Schousboe et al., 2005).

In the randomized controlled trial by Schousboe et al. (2005), postmenopausal women who received one-to-one education via phone, addressing osteoporosis risks and prevention, had a two-fold increase in exercise frequency relative to women who received education through a brochure. In the study conducted by Rolnick et al. (2001), more than half of the women who received a two-hour education session in-person, to address osteoporosis and lifestyle modifications to improve their bone health, increased their exercise behaviours.

Further, the systematic review by Lia, Chua, and Chan (2009) highlighted that osteoporosis education that was not individualized showed minimal impact in the improvement of patients' level of knowledge and efforts to prevent osteoporosis. Education interventions that were tailored to individual risk factors and existing knowledge base were more effective in establishing preventative behaviours (Schousboe et al., 2005; Rolnick et al., 2001).

In contrast, Sedlak, Doheny, Estok, and Zeller (2005) found that participants who received tailored education through the mail, related to individual BMD results and osteoporosis prevention, decreased their weight bearing exercises and did not report an increase in osteoporosis knowledge compared to the control group. This suggests that verbal communication provided by the educator can positively influence the implementation of exercise behaviours in postmenopausal women (Rolnick et al., 2001; Schousboe et al., 2005). Osteoporosis education that is patient-specific and conducted in-person or over the phone has great potential to be an effective mode for motivating postmenopausal women to engage in exercise behaviours.

Bone Mineral Density Results

Providing BMD results, and educating patients about the findings of these results, was a common intervention found in the literature for the prevention of osteoporosis (Lia, Chua, & Chan, 2009; Marci, Viechnicki, & Greenspan, 2000; Rolnick et al., 2001; Schousboe et al., 2005; Sedlak et al., 2005). In Marci et al.'s (2000) study, providing patients with their BMD results was associated with increased preventative behaviours in postmenopausal women. In particular, participants with moderate to severe bone loss showed greater engagement in exercise programs following education regarding their BMD results, relative to women with normal BMD who were similarly educated. Similar results were seen

in Rolnick et al.'s (2001) study, where those who were informed of their below normal BMD were more likely to increase their physical activity than those with normal BMD. In contrast to these studies, Schousboe et al. (2005) found that postmenopausal women who were educated about their low BMD level were not more likely to increase their exercise frequency. Lia, Chua, and Chan (2009) also concluded that the discussion of an individual's BMD results minimally impacted the participant's knowledge of osteoporosis. However, Schousboe et al. (2005) indicated that in one-to-one education sessions, where the consequences of low BMD were discussed, there was an increase in exercise frequency.

It appears that within the literature BMD results may be more influential if accompanied by additional education. The women in Rolnick et al.'s (2001) study who received BMD results in addition to an education session, compared to the control group, were more likely to increase their physical activity. These improvements were also seen in the research conducted by Sedlak et al. (2005), where those who received BMD results, and a letter interpretation of these results, increased their weight bearing exercise.

Promoting Self-Management

Promoting self-management was identified within the literature as positively influencing exercise measures for osteoporosis prevention in postmenopausal women (Alp et al., 2007; Schousboe et al., 2005). In Alp et al.'s (2007) study, the participants in the intervention group were taught how to develop a plan to improve their bone health. Participants that received encouragement and support for self-management, through instruction to create an individualized plan to promote healthy bones, increased their preventative health behaviours related to osteoporosis, including weight bearing exercises. Within Schousboe et al.'s (2005) study, postmenopausal women were encouraged to develop

a plan to reduce their risk for osteoporotic fracture. Additional personalized education was provided, addressing osteoporosis and individual risk factors. This influenced the participant's perception of their risks and positively motivated postmenopausal women to participate in self-management and osteoporosis prevention.

Follow-Up Reinforcement

As an important component of promoting healthy behaviours in postmenopausal women, Alp et al.'s, (2007) and Schousboe et al.'s (2005) studies provided insight into the influence of multiple follow-up interventions addressing osteoporosis prevention. Alp et al.'s (2007) intervention program included multiple interactive sessions providing education on osteoporosis and prevention measures, including exercise. Within this study, 74% of participants increased their physical activity. In Schousboe et al.'s (2005) study, participants received follow-up appointments to address their osteoporosis risk and prevention measures on three separate occasions over a nine-month period. Those that received these follow-up appointments were significantly more likely to increase their frequency of exercise than those who did not. Schousboe et al. (2005) suggested that follow-up reinforcement of osteoporosis education and prevention measures positively influences exercise behaviour in postmenopausal women. This was reinforced by Lai, Chua, and Chan's (2009) systematic review, which highlighted that counseling with subsequent follow-up is associated with increased exercise behaviours.

Health Beliefs of Postmenopausal Women

Postmenopausal women's health beliefs and knowledge became a theme within the reviewed literature. Personal health beliefs were associated with facilitating or inhibiting individual exercise behaviours related to osteoporosis prevention. The common moderating

components regarding the personal health beliefs of postmenopausal women included knowledge, perceived risk, and motivation and self-efficacy.

Knowledge

Within the literature, participant knowledge regarding osteoporosis became a predictor of exercise behaviours. In Estok, Sedlak, Doheny, and Hall's (2007) study, those with a greater understanding of osteoporosis were more motivated to participate in exercise behaviours (Estok et al., 2007). They were more likely to understand the benefits of exercise and the types of exercises they ought to perform, and this increased awareness was associated with participation in weight bearing exercise. However, in Reventlow's (2007) qualitative interview-based study, postmenopausal women who received a report that they had normal BMD level did not participate in increased physical activity to reduce their future osteoporotic fracture risk. This suggests these postmenopausal women lacked an understanding of their susceptibility of declining bone density, regardless of their current BMD status, and were thus less motivated to participate in preventative exercise behaviours.

Perceived Risk

It became apparent within the literature that perceived risk for osteoporosis was associated with decreased exercise behaviours for osteoporosis prevention in postmenopausal women. In Marci et al.'s (2000) study, after receiving results of a low BMD, women's worries associated with osteoporosis increased. Those who were aware of their moderate to severe decrease in BMD were more likely to have a fear of falling, as well as a perceived heightened risk for fracture associated with physical activity. This barrier to exercise was also seen in Sedlak et al.'s (2005) study, where women reported an increase in perceived barriers to exercise after receiving their bone density results. In the qualitative study

conducted by Reventlow (2007), postmenopausal women expressed uncertainty in their understanding of the benefits of exercise and the progression and prevention of osteoporosis related risks. Women reported that they reduced their physical activity due to their perceived risk for osteoporosis and the related fragility of their bones. This perception was related to the uncertainty of what their bones could endure and resulted in the avoidance of weight bearing activities. This highlights that postmenopausal women's perceived risks of osteoporosis has negatively impacted their exercise behaviours due to misinformation with respect to exercise and osteoporotic fracture risk.

Motivation and Self-Efficacy

Self-efficacy was highlighted as an important factor influencing exercise behavior in postmenopausal women (Swaim, Jamie, Barner, Carolyn, & Brown, 2008). Those postmenopausal women already confident in their exercising were more likely to improve their exercise behaviours to prevent osteoporosis (Swaim et al., 2008). Further, decreased self-efficacy was seen as a barrier to engaging in physical activity (Swaim et al., 2008). In Marci et al.'s (2000) study, women who were aware of their low bone density mass were more likely to be motivated to participate in exercise programs for the prevention of osteoporosis, ultimately leading to increased confidence in exercise abilities. In addition, Estok et al.'s (2007) study found that postmenopausal women who were internally motivated to exercise, an important outcome of self-efficacy, had statistically significant increases in weight bearing exercise for the prevention of osteoporosis. Once again, the literature emphasized the important responsibility PCPs have to motivate their postmenopausal patients, through educative interventions, to perform positive exercise behaviours.

Clinical Approaches

Common clinical factors that reinforced exercise behaviours in postmenopausal women emerged within the literature. These factors, which are described and discussed with respect to their effects on behaviour change in postmenopausal women, included breath of osteoporosis education, methods of delivery, individualized prevention plans, and frequency of interventions.

Breadth of Osteoporosis Education

Many of the reviewed studies utilized generalized education that addressed risks, outcomes and prevention of osteoporosis, resulting in increased exercise behaviours in postmenopausal women (Alp et al., 2007; Marci et al., 2000; Schousboe et al., 2005). Alp et al. (2007) provided education not only addressing prevention of osteoporosis through exercise, but also incorporating teachings on adequate calcium intake, pain management, and reduction of falls. The participants in this study were reported to participate in increased physical activity relative to those that received no education. In Rolnick et al.'s (2001) study, postmenopausal women received education addressing lifestyle factors to improve bone health and prevent osteoporosis. This osteoporosis education resulted in participants increasing their exercise frequency relative to those who did not receive this education. Similar increases in exercise behavior were seen in Schousboe et al.'s (2005) study, which provided education that addressed multiple strategies to promote bone health. In Marci et al.'s (2000) study, an educative video regarding osteoporosis risk factors was provided to patients, in addition to reports of their bone density. This generalized education about risk factors, along with patient-specific indicators of osteoporosis risk through BMD results, resulted in improved exercise behaviours in the postmenopausal participants. Increased

exercise behaviour was also seen in Rolnick et al.'s (2001) study, where participants received an osteoporosis education session and BMD results. In contrast, Estok et al. (2007) provided education focusing only on bone density, and this intervention was not associated with increased osteoporosis preventative behaviours. The results in the literature highlighted that with increased breadth of education addressing osteoporosis and its prevention, increased exercise behaviour in postmenopausal women occurs.

Methods of Delivery

Interventions that were conducted in-person positively influenced postmenopausal women to exercise (Rolnick et al., 2001; Schousboe et al., 2005). A two-hour in-person education session conducted by Rolnick et al. (2001) influenced participants to increase their exercise. This was also seen in Schousboe et al.'s (2005) study where postmenopausal participants who received a one-to-one education session were highlighted as having a two-fold increase in exercise frequency compared to those that only received education through a brochure. This was supported by Lia, Chua and Chan's (2009) systematic review, which indicated that counseling and one-to-one sessions addressing osteoporosis, positively influenced osteoporosis preventative behaviours. The studies that provided interventions through the mail were not found to promote exercise behaviours (Estok et al., 2007; Sedlak et al., 2005). Estok et al. (2007) only provided education material through the mail that discussed postmenopausal women's bone density scan results. These researchers determined that this intervention was not associated with increased exercise behaviour change. This was also seen in Sedlak et al.'s (2005) study, where education material was mailed to the study subjects addressing osteoporosis prevention. Although tailored to the individual, this educative intervention was not associated with improved engagement in osteoporosis

preventative behaviours. The reviewed literature highlighted the influence of in-person interactions as positively impacting health behaviour change in postmenopausal women.

Individualized Prevention Plans

Developing an individualized osteoporosis prevention plan was associated with improved preventative behaviours in postmenopausal women. Alp et al. (2007) provided multiple education sessions to postmenopausal women, with a final session that taught participants to develop a personalized plan to improve their bone health. This study resulted in a large number of the participants increasing their physical activity. In Schousboe et al.'s (2005) study, the educators encouraged the postmenopausal participants to create a personalized plan outlining how they would reduce their osteoporotic fracture risk. These participants increased their exercise frequency relative to those participants who did not create a plan to self-manage their osteoporosis outcomes. These results highlighted the significance of an individualized approach to planning; positive behavior change evolves when postmenopausal women are involved in their own osteoporosis management.

Frequency of Interventions

Throughout the literature, interventions to promote exercise behaviours were best provided at various intervals. Interventions provided on multiple occasions were associated with positive exercise behaviours in postmenopausal women (Alp et al. 2007; Schousboe et al., 2005). Alp et al. (2007) provided osteoporosis education sessions once per week for five weeks. This positively influenced participants to engage in physical activity, including balancing and weight bearing exercises, for the duration of the six-month study. This was also seen in Schousboe et al.'s (2005) study, where postmenopausal participants received an education session regarding osteoporosis, with follow-up education sessions at three, six and

nine months. Lia, Chua and Chan (2009) further indicated that interventions involving multiple exchanges with participants reinforced exercise behaviours in postmenopausal women. A lack of engagement in exercise behaviour was seen in Sedlak et al.'s (2005) study, which provided a single intervention of tailored education through the mail. In Estok et al.'s (2007) study, a single intervention of education through mail related to BMD results was also not associated with increased behavioural change. However, there was an associated increase in exercise in those participants who received an additional education session addressing osteoporosis. These results suggested that with increased frequency of interventions, there is positive reinforcement of exercise behaviours in postmenopausal women.

Chapter 5

Discussion

Through an integrative literature review, themes that influence exercise behaviours for the prevention of osteoporosis were identified. These included preventative interventions, health beliefs of postmenopausal women, and clinical approaches. NPs have the competencies and knowledge to provide disease management (CNA, 2017; CRNBC, 2017), and an awareness of the themes influencing exercise behaviours can better inform the NP role.

The findings from the literature highlighted the complexity of promoting behaviour change related to exercise to reduce the risk of osteoporosis and its detrimental outcomes. It was suggested in the literature that multiple factors influence these behaviour changes, including postmenopausal women's knowledge, perceived risks, and motivation. Such factors are also reflective of important components of the HBM. As discussed, the HBM suggests that behaviour change is influenced by an individual's existing motivation, their understanding of a health concern, their perceived vulnerability, and their understanding that an intervention is beneficial, all of which leads to self-management (Rosenstock et al., 1988). Reflecting on the findings in the literature and incorporating a HBM perspective can provide insight into the ways in which NPs can sustainably promote exercise behaviours in their postmenopausal patients to reduce their future osteoporotic fracture risk. The findings in the literature are discussed, highlighting their relevance for NPs within the PC setting. A discussion includes the proposed recommendations for NP clinical practice, as well as recommendations for education, finally concluding with a discussion of the limitations and future research recommendations.

Theme One: Preventative Interventions

Osteoporosis, referred to as a silent disease, is often not recognized until an osteoporotic fracture has occurred (Buttaro et al., 2017; NAMS, 2010; WHO, 2007). Thus, postmenopausal women are increasingly susceptible to fractures when they are unaware of their heightened risk. Counseling and educating postmenopausal women on their risk for osteoporosis is an important intervention to support positive long-term behaviour change. As evident in the literature, education addressing osteoporosis and preventative lifestyle changes to improve bone health resulted in increased preventative behaviours, including exercise, in postmenopausal women (Rolnick et al., 2001; Schousboe et al., 2005). Providing education that addresses osteoporosis expands the knowledge postmenopausal women need to understand their risks, the impact of osteoporosis on their health, and the consequences of a sedentary lifestyle. Such informative teaching motivates healthy lifestyle changes, like increased exercise, to prevent the progression of osteoporosis and subsequent outcomes of frailty and osteoporotic fractures.

BMD can be used as a tool to educate postmenopausal women on their osteoporosis risk. Within the literature, this was a common intervention and was associated with increased preventative exercise behaviours in postmenopausal women (Marci et al., 2000). Although BMD results are suggested as an important component in educating postmenopausal women about their osteoporosis risk, the literature suggests that a discussion of BMD results alone is not enough to influence behaviour change; additional education is required (Rolnick et al., 2001; Sedlak et al., 2005).

A personalized education approach was identified as an influential factor for the self-management of osteoporosis (Schousboet et al., 2005). Through the exploration of a

postmenopausal woman's osteoporosis knowledge and perception of their risk, tailored education and development of an individualized plan can be provided to support self-management. In addition, the literature suggested that follow-up reinforcement of osteoporosis education in postmenopausal women solidifies their awareness of individual risk and further promotes positive behaviour change (Schousboe et al., 2005). Thus, PCP interventions of osteoporosis education that are individualized and encourage patient self-management can be beneficial, but reinforcement with repeated education at subsequent appointments encourages sustainable behavior change related to osteoporosis prevention.

Theme Two: Health Beliefs of Postmenopausal Women

The literature indicated that postmenopausal women are uncertain about their risk for osteoporosis (Reventlow, 2007). As discussed, preventative exercise behaviours can be supported when postmenopausal women understand their susceptibility to osteoporosis and subsequent fractures, and perceive physical activity as beneficial for their bone health. Within the literature, those with low BMD levels were more likely to be motivated to increase their exercise frequency (Schousboe et al., 2005; Rolnick et al., 2001). In contrast, the literature also suggested that although women who received their BMD results reported an increased perceived risk of osteoporosis, they also decreased their physical activity and reported increased perceived barriers (Marci et al., 2000; Sedlak et al., 2005). These conclusions highlighted that an awareness of low BMD does in fact influence perceived risk and behavior. However, there continues to be a gap in knowledge that prevents postmenopausal women from understanding how preventative exercise behaviours can ameliorate their risk for osteoporosis regardless of BMD.

Postmenopausal women who lack self-efficacy and motivation to exercise are less likely to engage in physical activity (Swaim et al., 2008). The literature indicated that internal barriers to exercise result in decreased motivation and confidence in exercise behaviours (Swaim et al., 2008). For example, postmenopausal women expressed perceived barriers, like fear of frailty, that arose when they were informed of their moderate to severe decrease in BMD (Marci et al., 2000). However, through increased awareness and knowledge of osteoporosis, postmenopausal women can be motivated to participate in exercise behaviour changes (Estok et al., 2007). Postmenopausal women require a clear understanding of their risks, as well as an understanding of the benefits of physical activity and the fact that insufficient physical activity presents a risk factor for osteoporosis (WHO, 2007). Such information can reduce potentially discouraging concerns that postmenopausal women may have regarding exercise and their bone health, and provide the motivation necessary to confidently participate in exercise.

Theme Three: Clinical Approaches

As discussed, education interventions play an important part in adequately informing postmenopausal women about osteoporosis risks and prevention and motivating them to exercise (Alp et al., 2007; Marci et al., 2000). Nevertheless, the content and extent of this education about risk is of the utmost importance. As found in the literature, individual perceived susceptibility to osteoporosis should not rely solely on the translation of BMD (Marci et al., 2000; Rolnick et al., 2001). It should include education regarding risk factors independent of low BMD which can contribute to postmenopausal women's risk for fractures, including previous history of fracture, increased age, female sex, and lifestyle factors, including decreased physical activity levels (Buttaro et al., 2017; WHO, 2007). Such

comprehensive education is essential, as unlike many other health conditions, osteoporosis is asymptomatic until the progression of the disease causes significant disability for the individual (Buttaro et al., 2017; NAMS, 2010; WHO, 2007). Those who work as PCPs, including NPs, are in an ideal situation to inform their postmenopausal patients of the disease of osteoporosis, their varied risks, and the preventative measures that are available to them.

Within the literature, postmenopausal women that received education through impersonal avenues, such as a written brochure, were not provided with the knowledge necessary to support behaviour change (Schousboe et al., 2005). Postmenopausal women increased their exercise frequency when they participated in personal conversations related to their osteoporosis risks (Schousboe et al., 2005; Rolnick et al., 2001). In postmenopausal women, such individualized clinical approaches allow for the required extent of health concern understanding to facilitate behavior change (Rolnick et al., 2001; Rosenstock et al., 1988). It can be concluded that education has the largest impact on postmenopausal women's understanding of their health risks and motivation to change when provided through personalized educative interventions by their PCP.

Promoting motivation for self-management is an important component of long-term behaviour change, and individualized approaches and involvement of the patient are essential (Alp et al., 2007; Schouseboe et al., 2005). Practitioners can develop a personalized plan with their postmenopausal patients to reduce individual risks. Such collaborative plans can further establish confidence in the patient's self-management of their bone health. In the PC setting, the NP as a PCP can initiate this dialogue and explore the patient's perceived risks and understanding of osteoporosis. By tailoring interventions to reflect the needs of the

individual, and involving patients in their management, the NP can better motivate successful behaviour change in postmenopausal women.

Within the literature, interventions that motivated preventative exercise behaviours were more successful when provided on multiple occasions or with follow-up (Alp et al., 2007; Schousboe et al., 2005; Lai et al., 2009). This suggested that postmenopausal women are more likely to incorporate successful behaviour changes with repeated interventions and reinforcement. Health care providers are in an opportune position to recognize those who require exercise instruction, to motivate patient self-management, and to facilitate confidence and adherence to an osteoporosis preventative exercise regimen. Supported by insight from the literature, this patient engagement should occur at each contact with a postmenopausal patient, to reinforce behaviour and foster continued dialogue at subsequent appointments.

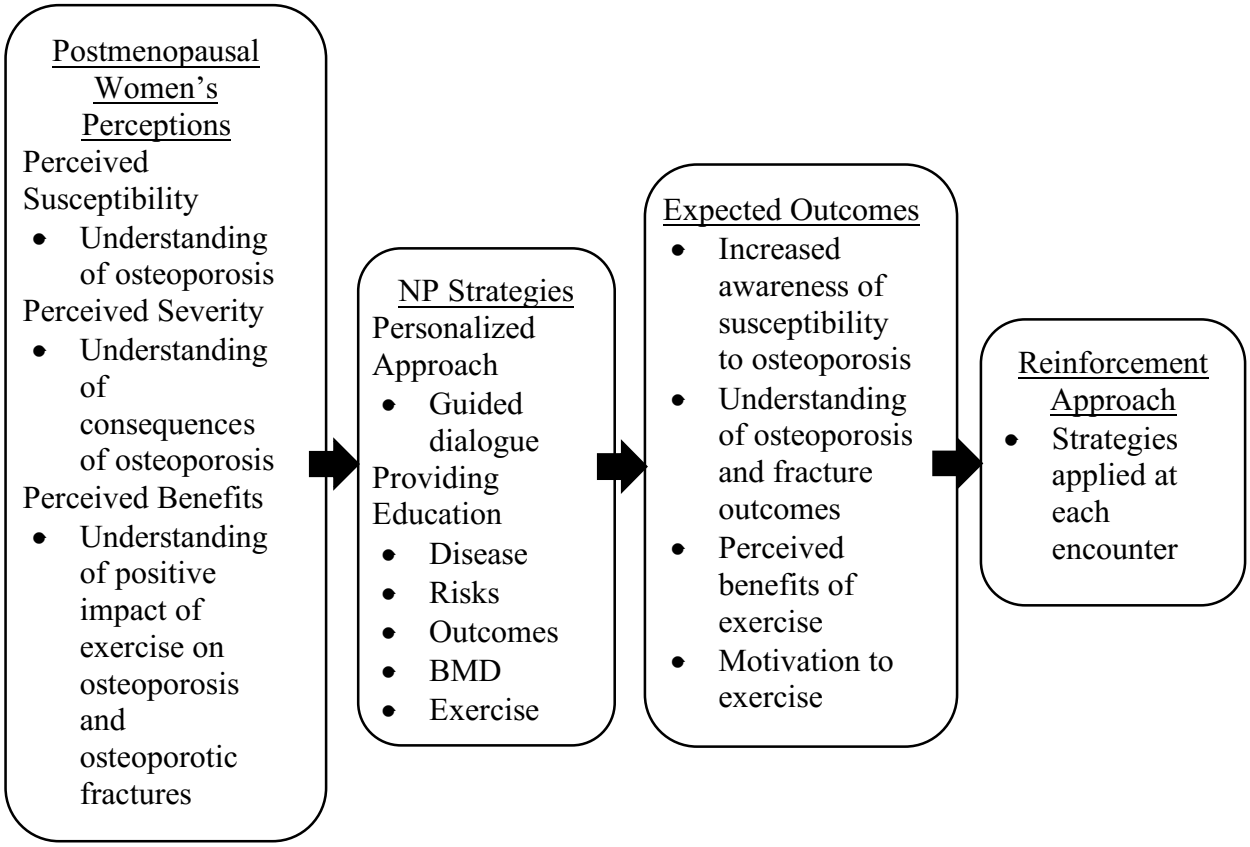
Recommendations for Practice

Through evaluation of the findings of the integrative literature review, recommendations are discussed that provide strategies for NPs to promote osteoporosis preventative exercise behaviours in their postmenopausal population. Postmenopausal women acquire substantial risk for osteoporosis as they age (Buttaro et al., 2017; NAMS, 2010). Due to the insidious progression of this disease, early preventative measures that can be facilitated by NPs are of increased importance within the postmenopausal population. Current evidence suggests that there is insufficient PCP identification and management of osteoporosis in the PC setting (Papaioannou et al., 2004). Additional strategies are required to support PCPs in evaluating and addressing osteoporosis in their postmenopausal patients. In collaboration with the HBM, strategies supported by the literature have been created for NPs within the clinical setting. As outlined in Diagram 2, these strategies for application by

NPs are interconnected with key issues related to behavior change, including individual patient perceptions. These strategies, in addition to the reinforcement approach, which allows for the maintenance of expected health outcomes are discussed below.

Diagram 2

The Path to Behaviour Change in Postmenopausal Women: Perceptions, NP Strategies, Expected Outcomes, and the Reinforcement Approach



Personalized Approach

A personalized approach provided to postmenopausal women optimizes their behaviour change (Alp et al., 2007; Schousboe et al., 2005). Within the literature, interventions had the greatest success when provided in-person (Rolnick et al., 2001). To have the greatest impact on postmenopausal behaviour change in the PC setting, NP strategies to promote behaviour change should be provided through a dialogue during patient

contact. NPs as PCPs are in an opportune position to promote osteoporosis exercise behaviours during their clinical one-to-one postmenopausal patient encounters.

As discussed within the literature, the postmenopausal patient's perceived risk for osteoporosis and osteoporotic fracture influences their behaviour change. Thus, evaluating the understanding postmenopausal women have related to their risks and preventative behavior, and educating them accordingly, is crucial in promoting positive behaviour change. As a NP within the PC setting, promoting a greater understanding in postmenopausal women of osteoporosis, their perceived risks, their susceptibility, and the benefits of exercise, begins with an exploratory conversation related to each woman's current understanding and perceptions. Questions to facilitate a personalized dialogue about osteoporosis with postmenopausal women are presented in Table 4.

Table 4

Questions to Facilitate a Personalized Osteoporosis Dialogue with Postmenopausal Women

Topics	Suggested Questions
Disease	Can you tell me what you know about osteoporosis?
Population Risks	What factors place you at increased risk for osteoporosis?
Outcomes	What does osteoporosis put you at increased risk for? Do you know what an osteoporotic fracture is? How do you think you can lessen your risk for osteoporosis?
Bone Mineral Density	Have you ever had BMD screening? Do you know what your BMD results mean?
Exercise	Do you currently participate in strategies to improve your bone strength? Are you physically active? What types of exercise do you participate in? How does exercise reduce your risk of osteoporosis and subsequent fractures?

Through exploring postmenopausal women's perceived risks and understanding of osteoporosis and preventative measures, a NP can tailor osteoporosis discussions to meet the needs of the individual. This personalized approach will guide conversations to optimize the knowledge translation necessary for behaviour change.

Providing Education

To promote exercise behaviours and motivate behavior change in postmenopausal women, they need to understand their risk for osteoporosis and the benefits of exercise. As suggested in the literature, the more postmenopausal women are informed of osteoporosis and its relevance to their overall health, the greater the impact on their preventative behaviour. Postmenopausal women need to be educated about their health risks, the outcomes of osteoporosis, their BMD screening results and interpretation, and the benefits of physical activity on osteoporosis and the prevention of osteoporotic fractures. They will then have the knowledge necessary to make well-informed decisions and the motivation to engage in positive exercise behaviours. Guided by the questions outlined to facilitate a personalized osteoporosis dialogue, Table 5 highlights the key education topics required to increase postmenopausal women's perceived susceptibility for osteoporosis and to help elicit the motivation necessary for behaviour change.

Table 5

Education Topics to Guide the NP in Promoting Behaviour Change: Postmenopausal Women and Osteoporosis

Topics	Education
Disease	• Osteoporosis disease process
Population Risks	• Age • Gender • Postmenopause
Outcomes	• Frailty • Osteoporotic fractures • Disability
Bone Mineral Density	• Results • Interpretation
Exercise	• Effects on balance and strength • Reduced progression of osteoporosis • Reduction of falls and subsequent fractures

Disease, population risks, and outcomes. The literature highlighted that postmenopausal women with an inadequate understanding of osteoporosis, their risks, and the outcomes related to osteoporosis exhibit decreased confidence in their exercise behaviour (Viechnicki & Greenspan, 2000; Sedlak et al., 2005; Reventlow, 2007). NPs are required to be knowledgeable about different populations and to provide education that is relevant, informative, and evidence-based (CNA, 2010). Postmenopausal women may lack an understanding of their risks, and thus NPs must adopt an important role as PCPs to relay to their postmenopausal patients accurate information about the disease process of osteoporosis, their risk for osteoporosis, and the potential health outcomes related to this disease. In such postmenopausal women, a better understanding of osteoporosis and their risk factors will

further motivate preventative behaviours to decrease the progression of osteoporosis and the likelihood of osteoporotic fractures.

Bone mineral density. BMD results can be utilized by NPs to educate patients about their risk for osteoporosis. As discussed, screened postmenopausal women should be informed of their BMD results, with thorough discussion and interpretation of these results included. As highlighted in the literature, a discussion of an individual's low BMD heightens their perception of risk for osteoporosis (Vicchnicke & Greenspan's, 2000; Sedlak et al., 2005). It is worth noting that based on current North American clinical practice guidelines (NAMS, 2010; Papaoioannou et al., 2010), not all postmenopausal women will have BMD screening. Regardless, an education approach should include the population risks and outcomes of osteoporosis for all postmenopausal women, and the addition of BMD results should be included when applicable.

Exercise. The final component of education provided by NPs should include a discussion of the importance of physical activity, specifically weight bearing and strength exercises, for the prevention and progression of osteoporosis. As highlighted within the literature, education addressing prevention, exercise, and osteoporosis risks will support positive exercise behaviours in postmenopausal women (Rolnick et al., 2001; Schousboe et al., 2005). This discussion by NPs with their postmenopausal patients should emphasize the impact of physical activity on the progression and prevention of osteoporosis. In addition, the importance of muscle strengthening to support balance and decrease risk of falls should be included.

Reinforcement Approach

A common theme that emerged within the literature focused on the potential impact of interventions on preventative behaviours. Interventions provided on multiple occasions enhanced postmenopausal women's perceptions and motivation to change (Alp et al., 2007; Schousboe et al., 2005; Lia, Chua & Chan, 2009). Since increased frequency of interventions reinforces exercise preventative behaviours in postmenopausal women, the NP should take advantage of opportunities during each patient contact in the PC setting to reinforce osteoporosis preventative behaviours. These patient-provider encounters provide important opportunities to provide healthy lifestyle counseling.

Behaviour interventions should involve follow-up discussions at each opportunity or appointment (National Institute for Health and Care Excellence, 2013). At each visit, the NP should reinforce postmenopausal women's knowledge of osteoporosis and the benefits of exercise in reducing osteoporotic fractures as they age. Within the PC setting, NPs have a responsibility to initiate conversations with their postmenopausal patients and provide the education necessary to support informed positive exercise behaviour changes. It is evident that if a NP can reinforce this knowledge during repeated patient encounters, postmenopausal women will be more likely to be motivated to participate in osteoporosis preventative exercise behaviours.

Recommendations for Education

NPs must maintain their clinical skills to ensure that they are competent to provide appropriate care to their patients. As highlighted within the literature, educating patients is a key strategy to promote behaviour change. This requires NPs to be up-to-date in their knowledge of osteoporosis and the factors that put the postmenopausal population at

increased risk. Postmenopausal women are in a vulnerable position due to the potential for the accuracy of information that they receive by a NP to impact their motivation to engage in osteoporosis preventative exercise behaviours. NPs are in an ideal position to provide accurate information to their postmenopausal patients at each appointment in order to promote bone health strategies. Recent guidelines in Canada have changed related to osteoporosis screening and treatment (Papaioannou et al., 2010). It is essential that NPs further their education so that they stay current with the new evidence-based information.

NPs require the necessary training to understand the current recommendations for osteoporosis management in postmenopausal women. This begins with recognizing this population as at-risk and appropriately using BMD screening. The prevention of osteoporosis and subsequent fractures through physical activity which focuses on weight bearing and strengthening exercises is unique to this disease (Howe et al., 2011). The focus of this type of exercise is to maintain bone strength and muscle mass. Advising postmenopausal patients about the appropriate exercise necessary for bone health can be challenging. NPs require the necessary training to provide this information confidently and to successfully promote behaviour change. Within Canada, exercise training workshops are available for health care professionals to stay current with these guidelines (Osteoporosis Canada, 2017).

Caring for postmenopausal women also requires an awareness of this population's needs in order to build the strong patient-provider relationships necessary to support positive lifestyle changes. NPs as PCPs will be better able to prevent and reduce the disability of osteoporotic fractures by tailoring education to patient needs and maintaining competencies related to bone health, through continuing education. As leaders versed in osteoporosis

preventative behaviours, NPs can influence their postmenopausal patients individually to participate in osteoporosis preventative measures through exercise.

Limitations and Future Research

The integrative literature review findings had various limitations, including the selection of research participants. Within the literature selected, most primary studies used convenience sampling or hand-selection of participants, highlighting a risk for researcher bias. All literature included postmenopausal women greater than the age of 50. However, the literature varied in age of focus, with one article focusing only on postmenopausal women greater than 65 (Swaim et al., 2008). The differing age requirements could be problematic, since differing age groups may have unique experiences with behaviour change. In addition to further exploring how behaviour change can be promoted in postmenopausal women, future research that examines age-dependent factors affecting osteoporosis preventative exercise behaviours in postmenopausal women is warranted.

In this literature review, there was one qualitative study included that examined postmenopausal women's perceptions of behaviour change related to osteoporosis prevention (Reventlow, 2007). While this research was informative, future research that examines postmenopausal women's perceptions would help to validate these researcher's findings and provide valuable insight into the unique barriers faced by the postmenopausal population.

As per current recommendations, BMD measurements alone are an inadequate evaluation of individual risk for osteoporotic fractures (WHO, 2007). Many of the reviewed articles used BMD results as an intervention to influence behaviour change (Estok et al., 2007; Marci et al., 2000; Rolnick et al., 2001; Schousboe et al., 2005; Sedlak et al., 2005). Current recommendations suggest the use of the FRAX tool and CAROC tool to assess an

individual's 10-year risk for future osteoporotic fracture, with the incorporation of an individual's BMD results when appropriate (WHO, 2007; Papaioannou et al., 2010). Risk assessment tools can potentially be used to provide awareness to an individual of their risk for disease outcomes. Yet, none of the reviewed literature addressed the use of these tools. To progress with the current evidence-based guidelines in Canada, future research is warranted to assess the use of these tools as a primary intervention for PCPs to promote behaviour change in postmenopausal women.

Within the PC setting a collaborative approach can be used to strengthen interventions provided to patients. The available research was limited to brief interventions and lacked insight into strategies to promote exercise behaviour at the community level, such as provisional resources or the utilization of other health care members. Future research is recommended to explore community tools for exercise promotion and the use of supportive collaborative approaches to promote osteoporosis self-management and adherence to exercise in postmenopausal women.

One qualitative study discussed barriers to exercise behaviour in postmenopausal women, such as the associated costs of exercise programs (Reventlow, 2007). Future literature is necessary to evaluate external factors that affect changes in postmenopausal women's exercise behaviour. PCPs fulfill an important role to support postmenopausal women to overcome barriers to exercise. By having a greater understanding of the external barriers that postmenopausal women experience, NPs can acquire greater insight into effective individualized management strategies for their patients.

Creating an individualized plan was highlighted in the literature as a self-management strategy. However, the literature included limited discussion and description of this goal-

oriented plan, providing little guidance into how this intervention would unfold in the PC setting and be utilized by a NP. Research expanding on methods for developing individualized plans would provide valuable information for PCPs, helping them to implement effective long-term self-management plans for exercise promotion in postmenopausal women.

Although the findings from the literature provided insight into the influential factors related to behaviour change within the postmenopausal population, a major limitation was the lack of literature that related to the specific role of a PCP. Although the results of the research can be discussed within the context of a PC setting, more research that specifically examines the role of a PCP in influencing the exercise behaviours of postmenopausal women is needed. Such research would provide greater insight into strategies that are relevant to the patient-provider context.

The recommendations stemming from a synthesis of the integrative literature review were derived from analysis of the literature findings and related to NP practice. Although the recommended strategies are based on literature findings, a critical analysis of the effectiveness of these strategies is beyond the limits of this paper. The concept of behaviour change with respect to osteoporosis in postmenopausal women is complex. Further research is required to elaborate on a systematic approach that can be facilitated by PCPs to promote such change.

Conclusion

Promoting exercise behaviours to prevent osteoporosis and subsequent osteoporotic fractures is complicated. Osteoporosis presents as a unique disease that is insidious, presenting without symptoms. With a lack of awareness of the risk factors and outcomes of osteoporosis, individuals are reluctant to participate in preventative behaviours. The debilitating consequences of osteoporotic fractures increase the necessity of PCPs to incorporate strategies into their practice to prevent such life-altering outcomes. This integrative literature review examined strategies for NPs to promote exercise behaviour in postmenopausal women to reduce their risk for osteoporosis and subsequent fractures. Through a comprehensive literature search, relevant articles were reviewed with nine applicable articles selected. The analyzed findings of these selected articles provided insight into how the promotion of behaviour change in postmenopausal women can be most effective and how such interventions can be applied to the PC context.

A synthesis from the findings of this research highlighted the importance of evaluating postmenopausal women's perceived risk and individual perspectives regarding osteoporosis. Through guidance of the HBM, a greater understanding of the importance of postmenopausal health beliefs was achieved. Key findings within the literature highlighted the importance of an individualized approach and the use of education to inform postmenopausal women of their risks. This begins with a dialogue that evaluates the needs of the postmenopausal women in order to adequately guide the discussion and tailor teaching. Within the education provided, BMD results can be utilized as a tool to promote behaviour change. However, it is clear that this intervention alone is not sufficient. Postmenopausal women require a greater understanding of their osteoporosis than that provided by BMD

results. The interpretation of this osteoporosis screening, and comprehensive teaching about personal osteoporosis risk, is key to establishing the basis of knowledge required for sustainable motivation and behaviour change. As evident in the literature, behaviour change cannot be achieved by a singular brief intervention. Strategies to promote behaviour change in postmenopausal women should be implemented at each opportunity that becomes available. With each reinforcement, greater exercise behaviour can be achieved.

Important opportunities for future research were identified through this integrative literature review. It was evident that additional research should address strategies to promote exercise behaviour in postmenopausal women for the prevention of osteoporosis. Exercise is a key nonpharmacological intervention that promotes positive long-term health outcomes, yet there was an apparent lack of research to evaluate exercise behaviour change specific to postmenopausal women managing osteoporosis. Although important influencing factors of behaviour change were identified, there lacked research into how to support postmenopausal women at a community level and how to develop an individualized plan to promote self-management. Further, there was limited research on the perspectives of postmenopausal women and the barriers that they face to enhance exercise behaviours. These are all important components that need to be better understood in order to comprehend postmenopausal women's perceptions of osteoporosis susceptibility, severity, and the benefits of exercise in preventing osteoporosis. In establishing an understanding of postmenopausal patient needs, PCPs can optimize the strategies they provide.

This integrated literature review has highlighted the influential role NPs can adopt to promote healthy lifestyle changes in postmenopausal women. Important literature findings have presented how the educational and motivational roles of health care providers can be

applied to practice with postmenopausal women in order to support behaviour change. Early interventions are necessary to impact the progression of osteoporosis and prevent the debilitating consequences of osteoporotic fractures. Due to the invisible progression of osteoporosis, it is necessary for PCPs to identify those at risk and emphasize the early promotion of preventative exercise to reduce osteoporosis in postmenopausal women. As the Canadian population continues to age, osteoporosis will continue to be a relevant disease and NPs must actively educate themselves. As supported by this integrative literature review, there exists a great need for NPs to consistently promote healthy exercise practices in the PC setting in order to prevent osteoporotic fractures and improve the long-term bone health and quality of life of postmenopausal patients.

References

Adachi, J. D., Adami, S., Gehlbach, S., Anderson, F. J., Boonen, S., Chapurlat, R. D., . . . Watts, N. B. (2010). Impact of prevalent fractures on quality of life: Baseline results from the global longitudinal study of osteoporosis in women. *Mayo Clinic Proceedings*, *85*(9), 806-813. doi:10.4065/mcp.2010.0082

Alp, A., Kanat, E., & Yurtkuran, M. (2007). Efficacy of a self-management program for osteoporotic subjects. *American Journal of Physical Medicine & Rehabilitation*, *86*(8), 633-640. doi:10.1097/PHM.0b013e31806dd428

Brown, J. P., & Josse, R. G. (2002). 2002 clinical practice guidelines for the diagnosis and management of osteoporosis in Canada. *CMAJ: Canadian Medical Association Journal = Journal De L'association Medicale Canadienne*, *167*(10 Suppl), S1-S34.

Buttaro, T. M., Trybulski, J., Polgar Bailey, P., Sandberg-Cook, J. (Eds.). (2017). *Primary care: A collaborative practice*. St. Louis, MO: Elsevier.

Canadian Institute for Health Information. (2017). *Registered nurses/nurse practitioners.* Retrieved from https://www.cihi.ca/en/registered-nursesnurse-practitioners

Canadian Nurses Association. (2005). *Primary health care: A summary of the issues.* Retrieved from https://www.cna-aiic.ca/~/media/cna/page-content/pdf-en/bg7_primary_health_care_e.pdf?la=en

Canadian Nurses Association. (2008). *Advanced nursing practice: A national framework.* Retrieved from https://www.cna-aiic.ca/~/media/cna/page-content/pdf-en/anp_national_framework_e.pdf

Canadian Nurses Association. (2010). *Canadian nurse practitioner core competency framework.* Retrieved from http://www.cno.org/globalassets/for/rnec/pdf/competencyframework_en.pdf

Canadian Nurses Association. (2012). *2010 Workforce profile of nurse practitioners in Canada.* Retrieved from https://cna-aiic.ca/~/media/cna/page-content/pdf-en/2010_np_profiles_e.pdf

College of Registered Nurses of British Columbia. (2017). *Entry-level competencies for nurse practitioners in Canada.* Retrieved from https://www.crnbc.ca/Registration/Lists/RegistrationResources/806NPEntryLevelCompetencies.pdf

Critical Appraisal Skills Programme. (2017). Retrieved from http://www.casp-uk.net

Estok, P. J., Sedlak, C. A., Doheny, M. O., & Hall, R. (2007). Structural model for osteoporosis preventing behavior in postmenopausal women. *Nursing Research*, *56*(3), 148-158. doi:10.1097/01.NNR.0000270031.64810.0c

Harlow, S. D., Gass, M., Hall, J. E., Lobo, R., Maki, P., Rebar, R. W., & ... de Villiers, T. J. (2012). Executive summary of the Stages of Reproductive Aging Workshop + 10: addressing the unfinished agenda of staging reproductive aging. *The Journal of Clinical Endocrinology and Metabolism*, *97*(4), 1159-1168. doi:10.1210/jc.2011-3362

HealthLinkBC. (2016). *Menopause and perimenopause*. Retrieved from https://www.healthlinkbc.ca/health-topics/hw228763

Hopkins, R. B., Burke, N., Von Keyserlingk, C., Leslie, W. D., Morin, S. N., Adachi, J. D., & ... Tarride, J. (2016). The current economic burden of illness of osteoporosis in Canada. *Osteoporosis International: A Journal Established as Result Of Cooperation Between The European Foundation For Osteoporosis And The National Osteoporosis Foundation Of The USA*, *27*(10), 3023-3032. doi:10.1007/s00198-016-3631-6

Howe, T. E., Shea, B., Dawson, L. J., Downie, F., Murray, A., Ross, C., . . . Creed, G. (2011). Exercise for preventing and treating osteoporosis in postmenopausal women. *The Cochrane Database of Systematic Reviews*, (7), CD000333. doi:10.1002/14651858.CD000333.pub2

Lai, P., Chua, S. S., & Chan, S. P. (2010). A systematic review of interventions by healthcare professionals on community-dwelling postmenopausal women with osteoporosis. *Osteoporosis International: A Journal Established as Result Of Cooperation Between The European Foundation For Osteoporosis And The National Osteoporosis Foundation Of The USA*, *21*(10), 1637-1656. doi:10.1007/s00198-010-1199-0

Marci, C. D., Anderson, W. B., Viechnicki, M. B., & Greenspan, S. L. (2000). Bone mineral densitometry substantially influences health-related behaviors of postmenopausal women. *Calcified Tissue International*, *66*(2), 113-118. doi:10.1007/s002230010

Muldoon, L. K., Hogg, W. E., & Levitt, M. (2006). Primary care (PC) and primary health care (PHC). What is the difference? *Canadian Journal of Public Health = Revue Canadienne De Sante Publique*, *97*(5), 409-411. doi:10.17269/cjph.97.703

National Institute for Health and Care Excellence. (2013). *Physical activity: Brief advice for adults in primary care.* Retrieved from https://www.nice.org.uk/guidance/ph44/chapter/recommendations#recommendations-1-and-2

North American Menopause Society. (2010). Management of osteoporosis in postmenopausal women: 2010 position statement of The North American Menopause Society. *Menopause (New York, N.Y.)*, *17*(1), 25-54.

doi:10.1097/gme.0b013e3181c617e6

Osteoporosis Canada. (2017). *Bone fit*. Retrieved from https://www.bonefit.ca/

Papaioannou, A., Giangregorio, L., Kvern, B., Boulos, P., Ioannidis, G., & Adachi, J. D. (2004). The osteoporosis care gap in Canada. *BMC Musculoskeletal Disorders*, *5*(11), 1-6. doi:10.1186/1471-2474-5-11

Papaioannou, A., Morin, S., Cheung, A. M., Atkinson, S., Brown, J. P., Feldman, S., . . . Leslie, W. D. (2010). 2010 clinical practice guidelines for the diagnosis and management of osteoporosis in Canada: Summary. *CMAJ: Canadian Medical Association Journal = Journal De L'association Medicale Canadienne*, *182*(17), 1864-1873. doi:10.1503/cmaj.100771

Reventlow, S. D. (2007). Perceived risk of osteoporosis: restricted physical activities? Qualitative interview study with women in their sixties. *Scandinavian Journal of Primary Health Care*, *25*(3), 160-165. doi:10.1080/02813430701305668

Rolnick, S. J., Kopher, R., Jackson, J., Fischer, L. R., & Compo, R. (2001). What is the impact of osteoporosis education and bone mineral density testing for postmenopausal women in a managed care setting? *Menopause (New York, N.Y.)*, *8*(2), 141-148.

Rosenstock, I. M., Strecher, V. J., & Becker, M. H. (1988). Social learning theory and the Health Belief Model. *Health Education Quarterly*, *15*(2), 175-183.

Ruth, K. S., Perry, J. B., Henley, W. E., Melzer, D., Weedon, M. N., & Murray, A. (2016). Events in early life are associated with female reproductive ageing: A UK biobank study. *Scientific Reports*, *6*(1)*,* 24710, 1-9. doi:10.1038/srep24710

Sedlak, C. A., Doheny, M. O., Estok, P. J., & Zeller, R. A. (2005). Tailored interventions to enhance osteoporosis prevention in women. *Orthopedic Nursing*, *24*(4), 270-276. doi:10.1097/00006416-200507000-00007

Seguin, R., Lamonte, M., Tinker, L., Liu, J., Woods, N., Michael, Y. L., & ... Lacroix, A. Z. (2012). Sedentary behavior and physical function decline in older women: Findings from the women's health initiative. *Journal of Aging Research*, *2012,* 271589. doi:10.1155/2012/271589

Siris, E. S., Gehlbach, S., Adachi, J. D., Boonen, S., Chapurlat, R. D., Compston, J. E., . . . Greenspan, S. L. (2011). Failure to perceive increased risk of fracture in women 55 years and older: The Global Longitudinal Study of Osteoporosis in Women (GLOW). *Osteoporosis International: A Journal Established as Result Of Cooperation Between The European Foundation For Osteoporosis And The National Osteoporosis Foundation Of The USA*, *22*(1), 27-35. doi:10.1007/s00198-010-1211-8

Swaim, R. A., Barner, J. C., & Brown, C. M. (2008). The relationship of calcium intake and exercise to osteoporosis health beliefs in postmenopausal women. *Research In Social & Administrative Pharmacy: RSAP*, *4*(2), 153-163. doi:10.1016/j.sapharm.2007.03.004

Whittemore, R., & Knafl, K. (2005). The integrative review: updated methodology. *Journal of Advanced Nursing*, *52*(5), 546-553.

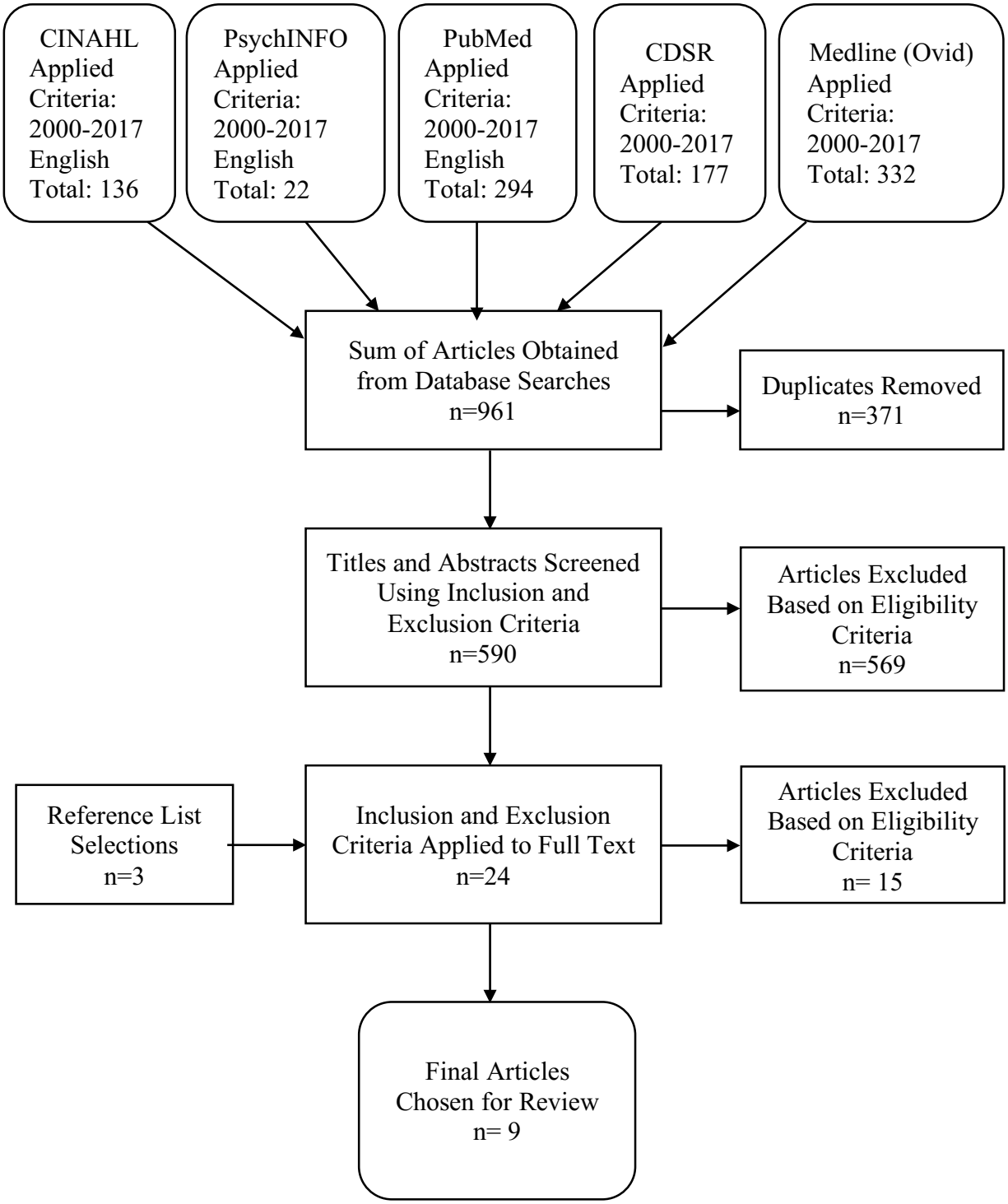
World Health Organization. (2008). *Primary health care: Now more than ever.* Retrieved from http://www.who.int/whr/2008/whr08_en.pdf

World Health Organization. (2007). *WHO scientific group on the assessment of osteoporosis at primary health care level*. Retrieved from http://www.who.int/chp/topics/Osteoporosis.pdf

Zhao, J., Zeng, X., Wang, J., & Liu, L. (2017). Association between calcium or vitamin D supplementation and fracture incidence in community-dwelling older adults: A systematic review and meta-analysis. *Jama*, *318*(24), 2466-2482. doi:10.1001/jama.2017.19344

Appendix A

Search Strategy



Appendix B: Literature Review Matrix

Primary Studies

Author's Date and Title	**Aim**	**Study Design & Location**	**Sample**	**Methods and Analysis**	**Key Findings: Exercise Behaviours**	**Strengths and Limitations**
Alp, Kanat, & Yurtkuran (2007) *Efficacy of self-management program for osteoporotic subjects*	Evaluation of the influence of the program Choices For Better Bone Health on behaviour strategies related to bone health	Single-blind, randomized controlled study USA	Postmenopausal women ≥ 54 with osteoporosis Intervention group n=25 Control group n= 25 Selected from outpatients of a rehabilitation centre	<u>Methods</u> Intervention group received five sessions discussing adequate calcium intake, osteoporosis medications, how to manage pain associated with the disease, and exercise and reducing risk of falls. The last session included developing individualized plans for bone health. Intervention and control group received questionnaires provided at baseline,	1) Self-management program that included multiple education sessions over 6 months discussing preventative behaviours of osteoporosis and included teaching how to develop a personal plan to promote bone health motivated participants to engage in preventive exercise behaviours including weight bearing exercises	<u>Strengths</u> Used validated tools for data analysis Comparison groups with similar demographics <u>Limitations</u> Minimal description of self-management program Hand selected participants that were then randomized into two groups. Risk of researcher bias

				fifth week and sixth months. <u>Analysis</u> Wilcoxon rank-sum test used to assess changes in knowledge and osteoporosis preventative behaviour from baseline to follow-up.		Lacked clear congruence with research aim and results **CASP Rating: Low Quality**
Author's Date and Title	**Aim**	**Study Design & Location**	**Sample**	**Methods and Analysis**	**Key Findings: Exercise Behaviours**	**Strengths and Limitations**
Estok, Sedlak, Doheny, & Hall (2007) *Structural model for osteoporosis preventing behavior in postmenopausal women*	Influence of DXA scan results on health beliefs and osteoporosis prevention behaviours	Longitudinal, randomized clinical trail USA	Healthy postmenopausal women 50-65 years old Convenience sampling through response to media advertisement Experimental group N=101 Control group	<u>Methods</u> Experimental group received personal knowledge of DXA information while the control group did not. Used the Osteoporosis Preventing Behaviours Survey (OPBS), Osteoporosis Knowledge Test	1) Health beliefs and osteoporosis knowledge are associated with positive exercise preventative behaviours 2) DXA screening results were not observed to have an effect on exercise osteoporosis preventative behaviour	<u>Strengths</u> Large sample size Rigorous description of analysis methods Use of longitudinal data collection Congruence of methodology and aim of study

			N=102	(OKT), Osteoporosis Health Belief Scale (OHBS) and Osteoporosis Self-Efficacy Scale (OSES). <u>Analysis</u> Structural equation model evaluated validity of measurements and osteoporosis prevention behaviours. Assessed experimental and control groups health beliefs, knowledge, and osteoporosis prevention behaviours at baseline, 6 months and 12 months.	3) Increased knowledge and health beliefs are associated with increased exercise preventative behaviours in particular self-efficacy, motivation, general knowledge of osteoporosis and specific knowledge of exercise	<u>Limitations</u> Those that exercised intensively at T1, 10% of participants, were already at the upper limit of exercise values. With increased exercise would not show an increased change in exercise health behaviour **CASP Rating: High Quality**

Author's Date and Title	**Aim**	**Study Design & Location**	**Sample**	**Methods and Analysis**	**Key Findings: Exercise Behaviours**	**Strengths and Limitations**
Marci, Viechnicki, & Greenspan (2000) *Bone mineral densitometry substantially influences health-related behaviors of postmenopausal women*	To assess the influence of bone mineral density measurements through DXA on health behaviours associated with osteoporosis	Quantitative Study USA	Postmenopausal women over 50 years old n= 1203 Recruited from those referred to the Osteoporosis Program at a Women's Health Centre	<u>Methods</u> Baseline interview including a 12-minute video of osteoporosis education risk factors. Participant bone mass measurement was taken with a follow up questionnaire mailed. 769 questionnaires analyzed post intervention. <u>Analysis</u>	1) After BMD testing, those with moderate or severe bone density mass was a strong influencer to begin exercising or increase exercise behaviours than those with normal results 2) Those with moderate to severe low bone density more likely to have a fear of falling and limit	<u>Strengths</u> Large Sample Size Rigorous description of analysis methods <u>Limitations</u> At risk for selection bias Did not discuss validating questionnaire or rationale for choosing methods Unable to determine the influence of

				Differences between participant statistical significance calculated through Chi-square testing categorized tables. Continuous variable assessed through t-tests and ANOVA.	physical activity	education video. Focused on the reflection of BMD and did not discuss this intervention. **CASP Rating: High Quality**
Author's Date and Title	**Aim**	**Study Design & Location**	**Sample**	**Methods and Analysis**	**Key Findings: Exercise Behaviours**	**Strengths and Limitations**
Reventlow (2007) *Perceived risk of osteoporosis: Restricted physical activities? Qualitative interview study with women in their sixties*	The relationship between perceived risk and physical activity in women	Longitudinal, qualitative interview based study Denmark	Postmenopausal women 60 years old n=16 Hand selected from an age-specific cohort study of people born in 1936	<u>Methods</u> Conducted 2 interviews. First interview addressed perceptions of health with a specific focus on behaviours and perceptions related to osteoporosis. Two years later second interviews addressed changed behaviours and perceptions of osteoporosis.	1) Participants restricted their physical activity due to their perceived risk of frailty associated with osteoporosis (ex. avoiding weight bearing) 2) Participants had a poor understanding of osteoporosis, bone frailty and the importance of maintaining	<u>Strengths</u> Discussion of results are congruent with the goal of the study Provides a descriptive perception of the participants experience <u>Limitations</u> Small sample size Hand selected participants. Risk

				Analysis Result discussed with fellow researchers to ensure appropriate interpretation and categories created. Summary created of the findings.	physical activity 3) Women with normal bone density did no associate themselves at risk and continued with current physical activity	of researcher bias. Lacked clear description of chosen methods and analysis. Risk of researcher bias Did not discuss rationale for conducting 2 sets of interviews. Did not discuss differences in results of the 2 sets of interviews **CASP Rating: High Quality**
Author's Date and Title	**Aim**	**Study Design & Location**	**Sample**	**Methods and Analysis**	**Key Findings: Exercise Behaviours**	**Strengths and Limitations**
Rolnick, Kopher, Jackson, Fischer & Compo (2001) *What is the impact of*	The influence of education and bone mineral density on lifestyle changes related to osteoporosis prevention	Randomized control-trial USA	Postmenopausal women 54-65 years old Education group n=301 Education + BMD	Methods Participants randomly assigned to an education only group or an education plus BMD results.	1) Behaviour change related to exercise increased in those with Education + BMD compared to education	Strengths Clear and descriptive methods and analysis Strong description of unaccounted for

osteoporosis education and bone mineral density for postmenopausal women in a managed care setting?			n=207 No intervention n=187	Both groups received same education intervention. Follow up survey 6 months post interventions. <u>Analysis</u> Contingency tables used to compare results of each group.	alone 2) Education and BMD testing associated with increased osteoporosis prevention discussion with PCP 3) Women with decreased BMD had greater motivation to exercise 4) Education intervention increased knowledge of osteoporosis and associated risks compared to control group 5) Increased exercise in both groups that received an education intervention	participants Discussion of results are congruent with the goal of the study <u>Limitations</u> Participants were self-selected providing less generalizability to the general population Comparison of two intervention groups with control group provided a lack of clarity of the different intervention influences **CASP Rating: High Quality**

Author's Date and Title	**Aim**	**Study Design & Location**	**Sample**	**Methods and Analysis**	**Key findings: Exercise Behaviours**	**Strengths and Limitations**
Schousboe, DeBold, Kino, Weiss, Chen, & Abbott (2005) *Education and phone follow-up in postmenopausal women at risk for osteoporosis*	To determine the influence of education and phone follow-up on osteoporosis preventative behaviours	Prospective un-blinded randomized controlled trial USA	Postmenopausal women ≥50 years Recruited from a family practice group clinic Participants included those who had a ≥8 Simple Calculated Osteoporosis Risk Estimation Score Questionnaire Treatment group n= 147 Control group n= 140	<u>Methods</u> Participants randomly assigned to receive an education brochure addressing osteoporosis or a brochure plus a one-on-one education session addressing osteoporosis, BMD results, osteoporotic fracture risk, and a personal plan to decrease their risk of fractures at 3, 6, and 9 months. Telephone survey completed at 12 months addressing adherence with osteoporosis prevention. <u>Analysis</u> Survey results were categorized.	1) Those that received one-to one education had a 2-fold increase of self-reported increase in exercise frequency 2) There was no association between BMD level and an increase in exercise 3) Osteoporosis education of BMD measurement with follow-up is associated with increased exercise frequency	<u>Strengths</u> Large sample size Discussed unaccounted for participants <u>Limitations</u> Potential for self-report participant bias Lacked description of intervention phone calls. No comparison between the change seen in each subsequent interview Possibility of selection bias due to volunteer enrollment of participants Risk of interview bias due to

				Intervention and control group results compared with two-tailed t-tests.		singular interviewer following-up with participants **CASP Rating: High Quality**
Author's Date and Title	**Aim**	**Study Design & Location**	**Sample**	**Methods and Analysis**	**Key Findings: Exercise Behaviours**	**Strengths and Limitations**
Sedlak, Doheny, Estok, & Zelelr (2005) *Tailored interventions to enhance osteoporosis prevention in women*	To determine if BMD through DXA increase preventative behaviours, knowledge and health beliefs	Quasi-experimental design USA	Postmenopausal women 50-65 years old Treatment group n= 23 Control group n=101	<u>Methods</u> All participants completed a questionnaire and DXA screening with the results sent to them in the mail. The intervention group received a telephone interview and a tailored intervention was mailed to them. At 6 months all	1) Those that received tailored education material discussed over the telephone did not have reported increased knowledge of osteoporosis 2) Those that received DXA results and a tailored intervention	<u>Strengths</u> Discussion of results are congruent with the goal of the study Incorporated validated tool to develop osteoporosis questionnaire <u>Limitations</u> Treatment and control group were not compared at

				participants received a mailed questionnaire. Used the Osteoporosis Health Belief Scale (OHBS), Osteoporosis Self-Efficacy Scale (OSES), Osteoporosis Preventing Behaviours Survey (OPBS), Osteoporosis Knowledge Test (OKT). <u>Analysis</u> Health belief scores calculated through independent *t* tests.	through mail decreased their weight bearing exercise compared to those that only received DXA and interpretation of results 3) Those that received DXA and mailed interpretation of results increased their weight bearing exercises slightly	baseline Potential for measurement error and validity of results due to significant unequal sample size Did not discuss selection of participants Study reliant on self-reporting. Potential for participation bias and false results Reported difficulties with measuring weight bearing exercises. Possible measurement error affecting the outcomes of the results. **CASP tool: Low Quality**

Author's Date and Title	**Aim**	**Study Design & Location**	**Sample**	**Methods and Analysis**	**Key Findings: Exercise Behaviours**	**Strengths and Limitations**
Swaim, Jamie, Barner, Carolyn, & Brown (2008) *The relationship of calcium intake and exercise to osteoporosis health beliefs in postmenopausal women*	Application of the Health Belief Model to assess the relationship between osteoporosis health beliefs and preventative behaviours	Quantitative cross-sectional survey USA	Postmenopausal women ≥ 65 years old n= 187	Methods Recruited women from a senior nutrition program. Community Health Activates Model Program for Seniors (CHAMPS) Physical Activity Questionnaire used for reporting of physical activity. Osteoporosis health Belief Scale (OHBS) and the Osteoporosis Self-Efficacy Scale (OSES) used to evaluate osteoporosis health beliefs.	1) Higher self-efficacy scores associated with increased exercise behaviours 2) Confidence to perform exercises associated with exercise behaviours	Strengths Large sample size Rigorous methods description with validated tools used Discussed nonresponse bias and loss to follow-up Limitations Convenient sampling of women enrolled in a nutrition program. May not be able to apply to general population due to enrolled participants all interested in health

				Analysis Use of a linear regression to assess the reported responses of health beliefs of calcium intake and exercise related to osteoporosis.		promotion. Decreased generalizability to all populations. Greater than half participant's low annual income. **CASP Rating: High Quality**

Systematic Review

Authors, Date, & Title	**Aim**	**Methods & Quality Assessment**	**Types of Studies, Publication Dates & Number**	**Key Findings: Exercise Behaviours**	**Strengths & Limitations**
Lai, Chua, & Chan (2009) *A systematic review of interventions of healthcare professionals on community-dwelling postmenopausal women with osteoporosis*	To assess nonpharmacological osteoporosis interventions on postmenopausal women provided by healthcare professionals	Systematic Review Studies obtained through PubMed, Web of Science, Evidence-Based Medicine Reviews, International Pharmaceutical Abstracts. Two reviewers extracted information. Classification of outcome measures guidance by the Agency for Healthcare Research and Quality. The two reviewers provided ratings of the analysis and were then discussed	Studies Published between 1990-2009 Randomized controlled trials n=24	1) Patient education that is not individualized showed minimal impact on osteoporosis knowledge level 2) DXA results did not impact knowledge level of participants related to osteoporosis 3) General education on osteoporosis was associated with an increased knowledge level and preventative behaviours 4) Counseling and follow up associated with increased	<u>Strengths</u> Rigorous analysis of literature and study quality. Discussed studies of poor quality. Used validated study design analysis to identify level of evidence and quality of literature. All but one article specified clear instrument use for data analysis. Strong statistical significance due inclusion of only RCT. <u>Limitations</u> Limited description of database searches and terms. Possibility of researcher bias of literature selection

		collaboratively.		exercise preventative behaviours including exercise frequency	Greater than half of literature determined to have high risk of bias **CASP Rating: High Quality**