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The Effects of Hormone Replacement Therapy and Exercise on Osteoporosis in Postmenopausal Females

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THE EFFECTS OF HORMONE REPLACEMENT THERAPY
AND EXERCISE ON OSTEOPOROSIS
IN POSTMENOPAUSAL FEMALES

by

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Bachelor of Science in Physical Therapy
University of North Dakota, 1999

An Independent Study
Submitted to the Graduate Faculty of the
Department of Physical Therapy
School of Medicine
University of North Dakota
in partial fulfillment of the requirements
for the degree of
Master of Physical Therapy

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2000
This Independent Study, submitted by Sara L. Glas in partial fulfillment of the requirements for the Degree of Master of Physical Therapy from the University of North Dakota, has been read by the Faculty Preceptor, Advisor, and Chairperson of Physical Therapy under whom the work has been done and is hereby approved.

Cindy Florn-Meland  
(Faculty Preceptor)

(Graduate School Advisor)

(Chairperson, Physical Therapy)
PERMISSION

Title The Effects of Hormone Replacement Therapy and Exercise on Osteoporosis in Postmenopausal Females.

Department Physical Therapy

Degree Master of Physical Therapy

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ABSTRACT

Osteoporosis is a debilitating and life-threatening disease affecting millions of people in the United States yearly, but most notably menopausal females. The lowered estrogen levels associated with menopause increase the chances of developing osteoporosis. Hormone Replacement Therapy (HRT) has been found to be one of the most beneficial therapies for slowing the progression of the disease. While some women are not candidates for this care and others take HRT solely for the relief of postmenopausal symptoms, studies have proven HRT has a long-term advantage against osteoporosis. Weight-bearing exercise has established efficacy through research proving its positive effect on bone formation and reducing bone resorption. Using the knowledge gained from accredited Physical Therapy schools, an appropriate postural training and exercise regiment along with HRT prescription can greatly decrease the negative effects of osteoporosis.
CHAPTER I

INTRODUCTION

Menopause is a natural and normal change that occurs in all reproductive females. Not only is a woman's reproductive ability lost, but many other body alterations also occur. Women must be informed of all these potential changes and made aware of steps that can be taken to reduce the severity of these effects. This is especially important at this time, as many of the Baby Boomers are reaching menopausal age.

The original and obvious advantage of postmenopausal women who use estrogen replacement therapy was to relieve symptoms of menopause, like hot flashes, depression, and vaginal atrophy. It was also discovered that hormone replacement therapy slows bone loss due to osteoporosis. In statistics from 1992, it was reported that 16-25 per cent of all postmenopausal females were taking some form of estrogen therapy.

Due to an expected life span of roughly 80 years for Caucasian women born in the United States with a median age at menopause of 48-52 years, women are living close to one-third or 30 years of their lives after menstruation has ceased. As estrogen levels fall, the rate of bone loss rises and postmenopausal females are at an increased risk for fractures and disability.

Physical therapists, trained in exercise and strengthening techniques, can work with postmenopausal women to help reduce the effects of osteoporosis. Past studies and
research have proven that moderate weight-bearing exercises performed on a regular basis helps to significantly slow the rate of bone loss. In addition, instruction in correct body mechanics and proper posture help relieve some of the forces on the vertebrae. People of all ages should maintain an active, healthy lifestyle, but especially women in the postmenopausal population. The purpose of this literature review is to educate physical therapists on the importance of osteoporosis prevention for postmenopausal women.
Menstruation is the human female body's monthly reminder of the potential reproduction of offspring. This cyclic process begins around the ages of nine to twelve years and is called menarche. The next 40 years are potential child bearing years when menstruation is a regular, monthly life experience. The entire menstrual cycle is completely regulated by hormones, especially estrogen. The following paragraphs will discuss the effects of estrogen on the menstrual cycle.

The 28-day menstrual cycle has two distinct phases that are separated by ovulation. As menstruation is a continuous, cyclic process, a general point of time will be selected as the beginning for a discussion. The proliferative or follicular phase lasts from the first day of the menstrual period until ovulation. This phase is usually the first 14 days of the cycle. At day 14, the egg is released from the ovary, which is called ovulation. The second phase is called the progestational or luteal phase. It comprises days 14 through 28 of the cycle that constitutes ovulation through the sloughing off portion of menstruation.

As stated in the previous paragraph, this discussion of hormonal control will begin during the sloughing off portion of menstruation at the start of the follicular phase. At this time, Follicle Stimulating Hormone (FSH) is released by the pituitary gland causing follicles to develop in the ovary. This phase is characterized by the secretion of
estrogen by the theca and granulosa cells in the developing follicles. This influx of estrogen causes the thick superficial layer of the endometrium of the uterus to grow. This is the layer of the uterus that is sloughed off at menstruation.\(^4\)\(^6\)

Next, ovulation occurs. This is the midpoint of the cycle when there is an increase in estrogen secretion from the follicles. The increased estrogen levels cause the anterior pituitary gland to be more responsive to Lutenizing-Releasing Hormone (LRH) that is released by the hypothalamus. The hypothalamus is the coordinating center for all endocrine function. Because of the secretion of LRH from the hypothalamus, the anterior pituitary gland produces Lutenizing Hormone (LH) that works with FSH synergistically to cause the follicle to swell, resulting in ovulation. During this time, the ovum or egg is released from the ovary and begins traveling down the fallopian tube towards the uterus.\(^4\)\(^6\)

Lastly, the post-ovulatory or luteal phase occurs. At this time, the ruptured follicle in the ovary turns into the corpus luteum, which secretes estrogen and progesterone. The elevated levels of these hormones cause increased endometrial thickening. At this point, the corpus luteum cells grow in size; and fatty areas develop, causing the yellowish color representative of the corpus luteum. If the egg in the uterus is not fertilized, degeneration of the corpus luteum occurs; consequently, levels of estrogen and progesterone significantly decrease. Low levels of these hormones trigger spinal arteries in the uterine wall to constrict, which causes the parts of the endometrium receiving nutrients from the spinal arteries to become ischemic. The hormonal support of the endometrium then decreases, and with the lack of nutrients and blood flow, the endometrial cells perish, resulting in a menstrual period.\(^4\)\(^6\) The cycle then begins again as
the pituitary gland releases FSH to stimulate follicular development for another monthly period.

The above sequence of events occurs monthly, beginning at menarche and ending at menopause. The different phases of the years around menopause have been defined.

"In 1981, the World Health Organization (WHO) offered the following definitions of menopause and the years surrounding it. Premenopause: reproductive years before menopause. Menopause: permanent cessation of menstruation. Perimenopause: period beginning with signs of approaching menopause and ends after 12 months of menopause. Postmenopause: begins 12 months after last period."³

The WHO definition is rather broad. Another definition views menopause as "the gradual cessation of ovarian function and resultant decreased levels of estrogen."⁵

Anywhere between the ages of 47-54 years marks the natural non-surgical menopause for women. This is due to a decreased number of viable ovarian follicles available, that, in turn, cause a decrease in the secretion of estrogen and progesterone. When estrogen levels are too low, endometrial growth and proliferation ceases and menstruation ends permanently.⁴⁻⁶

Decreased amounts of estrogen in the blood have other important physiological effects on the body in addition to ending menstruation. It is essential to be aware that not all women will experience signs and symptoms associated with decreased estrogen levels.⁴ However, for those women who do suffer, their problems are very real and can be life threatening. With many more women living greater than 30 years after the so-called great change, these problems must be addressed.³⁶ Menopause can have some very detrimental physical, psychological, and health risks associated with it.
The most frequently reported physical symptoms are as follows: hot flashes/flushes, sweats, dizziness, palpitations, migraine headaches, atrophic vaginitis, urethral syndrome, and joint pains and stiffness. A vast majority of these symptoms are due to the decreased levels of estrogen in the blood. The most consistently reported problems of menopausal women are hot flashes/flushes. While the flash/flush may appear to be similar, a true differentiation has been medically noted. The difference between the two is based on vasomotor instability. The hot flash is described as an unpleasant sensation of sudden warmth sweeping up over the upper trunk into the neck and face with corresponding tachycardia, palpitations, and feelings of faintness. The flush characteristically has a warm sensation for a longer duration, is visible to others due to skin color changes and perspiration secondary to vasodilation, and the heat travels from one body part to another. Hot flushes also have related symptoms of vertigo, weakness, palpitations, and migraine headaches.

A decrease in estrogen also results in decreased vaginal lubrication and blood flow, increased thinning of vaginal walls, and a related loss of sexual desire. The bladder and urethra share the same embryonic beginnings as the vagina, and they also have estrogen receptors that are affected by falling estrogen levels that change urinary function. In addition, low estrogen levels make the body unable to maintain secondary sexual characteristics, so breast tissue, body hair, subcutaneous fat, and skin elasticity all decrease; the ovaries and uterus shrink, and the cervix and vagina become pale and friable. Although joint pains and stiffness cannot be directly associated with estrogen deficiency, it is a major problem for the aging population.
Many times the focus of patient's treatments are on the physical symptoms of menopause, but just as important is the addressing of the psychological symptoms. The symptoms vary among women, with no one person having the exact similar problems of another. Some major emotional/mental effects are as follows: loss of libido, nervousness, anxiety, depression, fatigue, poor concentration, loss of confidence, irritability, insomnia, moodiness, and poor self-esteem.\textsuperscript{3,7} Knowing that one of her most vital human processes, reproduction, is finished can be a large shock to some women. Even though the cessation of monthly periods may be gladly welcomed, the finality of menopause can be traumatic. This aspect of menopause must not be forgotten.

The primary cause of death in postmenopausal women is coronary heart disease (CHD).\textsuperscript{2-7} Estrogen is beneficial in keeping Low-Density Lipoprotein (LDL) levels down and High-Density Lipoprotein (HDL) levels high.\textsuperscript{2,6} During menopause, the levels change because there is insufficient estrogen to maintain the LDL and HDL levels at safe and healthy limits. As a result, risk for CHD or other cardiovascular diseases rise.\textsuperscript{2,6}

Another major risk for postmenopausal women is osteoporosis.\textsuperscript{2-7} Due to this fact, there is an increase in the number of physicians prescribing estrogen to delay the effects of osteoporosis. Hormone Replacement Therapy/Estrogen Replacement Therapy has been found to reduce the rate of bone resorption and to help protect against future bone loss.\textsuperscript{2-3,7}
CHAPTER III
OSTEOPOROSIS

Osteoporosis is one of the major issues the aging population must be concerned about, and one we must be aware of, as members of the medical field. This epidemic affects both men and women, or roughly 25 million Americans yearly.\(^8-10\) Osteoporosis is defined as a "skeletal condition characterized by decreased density of normally mineralized bone" and by micro-architectural deterioration of bone tissue with a consequent increase in bone fragility and susceptibility to fractures.\(^11-12\) While that definition is a generalized statement about osteoporosis, the WHO has provided the medical field with a diagnostic criteria based on bone density measures. A Bone Mineral Density (BMD) of 2.5 or more standard deviations below the mean of a young adult reference population would fit the osteoporosis criteria.\(^8,11-12\) The WHO definition is more concrete, however, it should not be strictly adhered to for diagnosis and treatment.\(^11\)

In order for the physician to use the WHO criteria to determine the presence of osteoporosis, the BMD must be measured and assessed. There are a few noninvasive techniques utilized to measure BMD either through radiation or X-ray. The one most frequently used is dual-energy X-ray absorptiometry (DEXA).\(^10,13-15\) The DEXA scanner assesses the bone mineral content by taking X-rays over the entire body or in specific sites such as the lumbar spine, proximal femur, or forearm.\(^13,15\) The radiograph or X-ray is sent to a laboratory where the density is calibrated to an aluminum reference wedge.\(^14\)
The results of the bone densiometry (measurement of bone density) are changed into statistical T and Z scores or standard deviation for interpretation.\textsuperscript{13,15} These numbers are compared to the young adult population reference mean value to use the diagnostic criteria as outlined by the WHO. Bone has a greater absorption of X-rays than soft tissue.\textsuperscript{10} Thus, if bone is osteoporotic, it will absorb fewer X-rays than normal bone. The measurement of bone mass can confirm the existence of osteoporosis as well as the extent of the bone changes due to osteoporosis.\textsuperscript{10}

Osteoporosis is two times more common in women than men, mainly due to women having lower bone mass than men throughout their lives.\textsuperscript{11,16} There are two designated categories of osteoporosis: primary and secondary. Primary osteoporosis is divided into three different types. Type I encompasses postmenopausal osteoporosis in women with estrogen deficiency due to menopause. Type II entails age-related osteoporosis including both men and women with decreases in bone mineral density due to normal aging. The last type of primary osteoporosis is idiopathic, having an unknown cause, affecting pre-menopausal women and middle-aged or young men. Secondary osteoporosis is caused by an identified source or disease and can affect anyone.\textsuperscript{10-11}

Before delving into osteoporosis more fully, normal bone remodeling must be addressed. Bone is an active tissue that is constantly remodeling itself via two phases: bone resorption and bone formation. Those coupled events occur throughout the adult skeleton as units of osteoclasts and osteoblasts. Osteoclasts are responsible for bone resorption and osteoblasts are responsible for bone formation. Teams of osteoclasts target areas of bone and form a cavity in the bone called a resorption pit. Osteoblasts follow in an exact process to fill in and reshape the missing region.\textsuperscript{12,17-18} In normal bone,
the pits are completely refilled with new bone and the bone mineral density remains unchanged. This cycle lasts for three to four months and roughly 10 to 30 per cent of bone is replaced yearly.16

In osteoporosis, the resorption pit is not completely refilled, and the coupling of the bone remodeling unit (osteoblasts and osteoclasts) is impaired resulting in a net deficit of bone or low bone mass (LBM).12 To state this another way, the rate of osteoclast resorption outweighs the rate of osteoblast formation.16-18 This is what is occurring in the aging adult human skeleton, especially in women at or near menopause where higher bone turnover results in a more rapid net loss of bone mass.17,19 With these circumstances, researchers have recommended anti-resorptive agents, such as estrogen replacement therapy, to slow the rate of bone loss.19

Of noted importance, peak bone mass is usually reached between the ages of 30 to 35 years; then bone mass levels are maintained for another 10 to 15 years.12 The lowered estrogen levels of menopause are associated with accelerated declining bone mass, with a maximum rate of loss within the first 5 to 6 years of menopause.12,18,20-21 If estrogen replacement therapy is not initiated within the first 10 years of menopause, up to 30 per cent of women’s bone mass can be lost.12 A gradual loss of bone continues from menopause until death.12,18 Bone cells have receptors for estrogen, and estrogen acts directly on the bone cells.6,18 The exact protective effect of estrogen on bones is not known; it is believed estrogen enhances calcium absorption and limits calcium removal from bones.22 One study found one-third to one-half of all bone loss in women is due to menopause.18
Osteoporosis by its definition is asymptomatic. Unfortunately true evidence of LBM exists only when a clinical manifestation of a fracture occurs.\textsuperscript{9,11,23} The most frequent manifestations are compression fractures of vertebral bodies and fractures of proximal femurs, humerii, and distal radii.\textsuperscript{11} Reports show that a woman’s risk of sustaining a fracture nears 75 per cent from age 50 until death.\textsuperscript{12,24} Generally, the risk of a fracture doubles for every standard deviation decrease in bone mass.\textsuperscript{9} By age 70, nearly 50 per cent of postmenopausal women have sustained a minimum of one osteoporotic fracture.\textsuperscript{21} Roughly 1.3 to 1.5 million documented osteoporotic fractures occur annually.\textsuperscript{10,12,22} These numbers show just how debilitating osteoporosis can be and how prevalent it is in society.

Osteoporosis affects both cortical and trabecular bone tissue. Normally, the outer cortical bone tissue appears solid and dense and surrounds the inner trabecular bone tissue that is porous and honeycomb-like. All bones are composed of both kinds of bone tissue in various amounts and in different areas. The axial skeleton, or vertebrae, is composed mainly of the porous trabecular tissue and is covered with a thin layer of cortical tissue. The fine, criss-cross lattice structure of trabecular tissue is extremely strong. The criss-cross pattern leaves a large amount of surface area exposed revealing prime sites for bone formation and resorption. As mentioned earlier, bone resorption occurs at a normal rate, but bone formation is impaired resulting in LBM.\textsuperscript{12} When enough sites are broken down, the bone becomes structurally unsound, and the cellular connections cannot reconnect.\textsuperscript{16,25} Failing of the vertebral spine in the elderly population occurs because of the spine’s inability to support the internal stresses from the loads applied to it.\textsuperscript{19} As a result, vertebral compression fractures may be experienced by elderly
or postmenopausal women. These compression fractures are further complicated by back pain that is only relieved with bed rest, a loss of height, decreased size of abdominal and thoracic cavities, an accentuated thoracic kyphosis as well as other postural problems.11

Bones from the appendicular skeleton are also affected by osteoporosis. These long bones are constituted of mostly cortical tissue with areas of trabecular tissue primarily found on the ends of the bone.16,25 The greatest percentage of bone loss does occur in trabecular tissue which is found in the metaphyses of long bones.10 Decreases in trabecular density and a thinning or a loss of trabecular bone has an associated reduction in the strength of the bone.10,24 These strength decreases can predispose bones toward appendicular fractures, especially of the distal radius and the proximal neck of the femur. Those specific sites are particularly susceptible for fractures with the phenomenon of falling.11,24 Because osteoporosis can affect both elderly and postmenopausal populations, prevention of falls is of utmost concern.

Prevention of osteoporosis, and, accordingly, prevention of falls associated with osteoporosis, is the ultimate goal for postmenopausal women. However, there are identifiable physical and behavioral risk factors of osteoporosis that cannot be prevented. With the decreased levels of estrogen, menopause is a definite risk factor for osteoporosis in women. Caucasian women and other non-black races have been found to have higher rates of being diagnosed with osteoporosis.2-3,8,10,12,22 A family history, either maternal or paternal, of osteoporosis increases the risk of osteoporosis development.2-3,8,10,12,22,23 Also, a thin body or a low body mass index along with a sedentary lifestyle can predispose women for osteoporosis.2-3,8,12 As mentioned earlier, decreased levels of estrogen through a shortened menstrual life by either late menarche or early menopause
can promote lower bone mass.\textsuperscript{2-3,8,10,12,22} In addition, behavioral risk factors like smoking, excessive alcohol or caffeine use and poor dietary intake can be detrimental to women’s bones.\textsuperscript{2-3,8,10-12,22,23} Also worth mentioning as risk factors are certain illnesses: cancer, liver or renal disease, hyperparathyroidism, thyroid disease, Cushing’s syndrome, genetic conditions, anorexia, and endometriosis.\textsuperscript{3,8,12} Certain medications are likewise associated with an increased risk of osteoporosis; for example, immunosuppressives, antineoplastics, anticonvulsants, steroids, and heparin.\textsuperscript{3,12}

It should be pointed out that one study found 80 to 85 per cent of women have normal bone mass at menopause.\textsuperscript{9} However, as reported earlier, the decreased levels of estrogen associated with menopause have detrimental effects on bone mass and increase the risk of developing osteoporosis. Above all, the goals of preventing osteoporosis involve optimizing the present amount of bone mass and preserving the skeletal integrity of the bones.\textsuperscript{12} The most effective treatment of postmenopausal women for prevention of bone loss and possible increase in bone mass, as many studies have shown, is the prescription of hormone replacement therapy.\textsuperscript{2-3}
CHAPTER IV
HORMONE/ESTROGEN REPLACEMENT THERAPY

Since the 1930s, hormones have been prescribed to menopausal females for the therapeutic treatment of menopausal symptoms.\textsuperscript{26-27} The number of women taking and the number of physicians prescribing estrogen continued to rise through the next few decades. The use of estrogen reached a peak in 1975 totaling 28 million prescriptions.\textsuperscript{3} However, those numbers dropped significantly in the later 1970s when a link was discovered between estrogen replacement therapy (ERT) and endometrial cancer.\textsuperscript{3,26-28} More research was performed in the 1980s which found ERT use increased again.

There are three different classes of estrogen used in ERT. One class of available estrogen is the natural estrogens, which include estradiol, estrone, and estriol.\textsuperscript{3} All three of these estrogens exist naturally in the female body. Estradiol is mainly present in menstruating females and is the most potent. Estrone is predominant after menopause and Estriol is a weak estrogen created by the metabolism of estrone.\textsuperscript{19} Another class of estrogens used in ERT is conjugated equine estrogen which is primarily used in post-menopausal prescriptions. The final class of estrogen is synthetic estrogen, used for contraceptives.\textsuperscript{3} All of the classes have varying levels of potency. The estrogens used for post-menopausal symptoms are markedly less potent than the estrogens used in oral contraceptives.\textsuperscript{3}
All classes of estrogen can be found in various forms: oral pills, percutaneous gels, subcutaneous implants, or vaginal creams. Oral estrogen pills are the predominant form of prescribed estrogen and an overwhelming majority of women tolerate it well. However, since the pills are ingested, the estrogen must enter the bloodstream and pass through the liver creating the potential of hepatic problems. Transdermal estrogen retains the beneficial effects of oral estrogen without having to pass through the gastro-intestinal tract. As a result, transdermal gels and creams "have no adverse effects on the GI tract, no effect on hypertension, and less nausea" than oral pills. There is, however, a potential for mild skin irritation, erythema, or itching. Above all, it is ultimately up to the woman what form of estrogen she would prefer to use.

Estrogen was initially the primary prescription of replacement therapy for treatment of menopausal symptoms. As mentioned previously, the use of unopposed ERT was linked to the increase in cases of endometrial cancer. As a result of these findings, more research was performed by combining estrogen with other hormones to reduce the risk of cancer. It was discovered that adding progestin to ERT (known as Hormone Replacement Therapy (HRT)) provided protection against this adverse effect of endometrial cancer. The combination of progestin and estrogen continued to be effective for the treatment of menopausal symptoms, as well as aiding in the prevention of heart disease and osteoporosis. This combined hormonal prescription is the leading type of HRT. It is also the "only prescription medicine that is FDA approved" to prevent osteoporosis.
One of the most significant benefits discovered in the 1980s was by the National Institute of Health. The Institute held a conference on osteoporosis that "strongly recommended estrogen as a preventive measure against this disabling and even fatal condition." Even with this vital information, two sets of researchers, Schmitt, et al and Roberts, et al, found that relief of menopausal symptoms was the most prominent decision-making reason by post-menopausal women to take HRT. More emphasis must be placed on the long-term benefits of HRT, namely the reduced incidence of osteoporosis and heart and circulatory diseases. While a discussion of HRT and circulatory diseases would be worthwhile, this chapter will mainly focus on HRT and its positive interaction with osteoporotic bone.

HRT serves as an antiresorptive drug, thereby preventing bone loss and fragility, narrowing the imbalance between bone resorption and bone formation, and decreasing the overall rate of bone turnover. Osteoblasts have specific estrogen receptors that are directly affected by the estrogen aiding in the prevention of bone loss. Estrogen is found to be the single most effective preventive agent against osteoporosis and bone loss. However, it must be stated that estrogen "cannot replace lost bone, nor straighten spinal curvatures or restore lost height." It must be emphasized that HRT is preventive and not curative.

The effects of estrogen in HRT are numerous, but some of the more significant ones will be highlighted. Estrogen improves the calcium balance protecting bones from becoming osteoporotic. Estrogen allows more efficient calcium absorption from the kidneys, as calcium helps maintain bone mineral density (BMD) and bone mass. The thyroid is stimulated by estrogen to produce calcitonin which serves as a protective
measure from the dissolving effects on bone of parathyroid hormone. Finally, proteins in
the liver, secreted when estrogen is present, bind to blood-borne adrenal hormones to
prevent their bone-destructive effects.\textsuperscript{16,29} Estrogen works all over the body to help
maintain bone density.

The beneficial effects of HRT on bones are at the maximum peak if initiated
within three to five years of menopause.\textsuperscript{16,20,30,34} It has been found that "the larger the gap
between menopausal onset and ERT [initiation], the greater the bone loss" and more
damage by osteoporosis.\textsuperscript{35} The use of oral estrogen decreases the incidence of hip and
vertebral fractures by 50 per cent, when started within the aforementioned window of
time.\textsuperscript{12,18,20,24,30} One source reports even higher values of "a 60 percent decrease in hip
fractures, and a 90 per cent decrease in vertebral fractures" in post-menopausal women
using HRT.\textsuperscript{16} Another study found the mean BMD and bone mineral index (BMI) were
both higher in women on HRT than women who had never received HRT.\textsuperscript{20} It is
important to note that even delayed HRT will continue to slow bone loss, though some
bone has already been lost.\textsuperscript{16,35} At any point of menopause, HRT use is significant
because it will still benefit osteoporotic bones.

Some controversy remains about the duration of HRT required to remain effective
for protection against osteoporosis. The potential of developing osteoporosis naturally
levels off at age 65, or ten to fifteen years after menopause.\textsuperscript{16,35} Traditionally, post-
menopausal lifetime use of HRT was the standard protocol.\textsuperscript{35} Physicians have followed
this concept because research stated that the termination of oral estrogen caused a rapid
loss of bone as if the estrogen had never been initiated.\textsuperscript{12,24} Estrogen's protective and
beneficial effects on the skeleton and bones are lost within a few years of terminating
usage. One study suggests prescribing HRT for fifteen to twenty years after menopause with a gradual weaning off period. However, further research and investigation is necessary to set some boundaries for physicians to follow.

While all of the previous discussion has focused on the positive and beneficial effects of HRT, the negative effects must be discussed as well. Not every postmenopausal female is eligible to receive the bone preserving HRT. As with other pharmacologic agents, HRT has both absolute and relative contraindications. The absolute contraindications are as follows:

- undiagnosed vaginal bleeding
- known or suspected pregnancy
- active thrombosis/thrombophlebitis
- endometrial adenocarcinoma
- breast cancer
- estrogen-dependent tumors
- acute or chronic liver disease
- family history of breast cancer
- significant fibrocystic disease
- fibroid uterine tumors
- uterine cancer

Women with the above conditions should not use HRT as a defense against osteoporosis.

The relative contraindications are as follows:

- history of breast cancer
- uterine leiomyoma
- endometriosis\textsuperscript{26,30}
- hypertriglyceridemia\textsuperscript{26}
- gallbladder disease\textsuperscript{16,26-27,30}
- migraines\textsuperscript{26,28,30}
- history of thrombosis\textsuperscript{26}
- impaired liver function\textsuperscript{19}
- systemic lupus erythematosi\textsuperscript{28}
- history of reproductive cancer or cardiovascular disease\textsuperscript{27,30}
- pancreatic disease\textsuperscript{27,30}

Depending on the severity and at the physician's discretion, women with these conditions may or may not use HRT.

In addition to the contraindications, side effects are also associated with the use of HRT. Some of the more commonly reported ones are nausea and GI upset, breast tenderness and fluid retention, headache and weight gain, migraines, changes in mood, increased blood pressure, gallbladder and liver disease, thrombophlebitis, and increased clotting.\textsuperscript{8,19,30-31} Another important major side effect is irregular vaginal bleeding.\textsuperscript{8,30-31} This usually occurs within the first nine months to one year of beginning HRT and gradually ceases in frequency.\textsuperscript{8} Fortunately, most of these unwanted side effects can be reduced or eliminated quite easily through changing the dosage or changing the form of administration.\textsuperscript{19}

Unless the listed contraindications restrict use, all at-risk postmenopausal females should be prescribed HRT to prevent osteoporosis. Although previous generations had managed without HRT, women are currently living much longer and need to be able to
function normally for as long as possible. So often, health care of the post-menopausal population focuses on the relief of menopausal symptoms and not the prevention of osteoporosis. Also, social, socioeconomic, environmental, and physical barriers exist which can limit the amount of appropriate services and resources available to the elderly. All patients need to be well informed about his/her diagnosis, prognosis, and treatment. Postmenopausal females especially must be aware of the options available to them to avoid or lessen the debilitating effects of osteoporosis.
CHAPTER V

PHYSICAL THERAPY INTERVENTION

The field of physical therapy in the past few years has gradually shifted its focus from one of reactive treatment to a more proactive approach of injury prevention. Common ailments and problems are being analyzed in an attempt to discover different techniques to help prevent injury. Some examples of these preventative techniques are ergonomic training or the incorporation of a wellness program. With the background and education received from an accredited Physical Therapy school, physical therapists have the necessary tools to aid clients in need. Such is the case of postmenopausal females for whom a physical therapist’s expertise can develop an appropriate exercise program to lessen the detrimental effects of osteoporosis.

Research has proven that regular exercise does aid in slowing the rate of aging of the skeleton. Exercise is also believed to be the only preventive measure that not only halts bone loss, but actually stimulates the formation of new bone. While this is extremely beneficial for postmenopausal women, females of all ages can benefit from a lifestyle with activity. Exercise, especially of a weight-bearing nature, can “increase peak bone mass in youth or decrease the rate of bone loss in later life.” Women maintaining an active lifestyle, regardless of age, have significantly greater bone mass as compared to women leading sedentary lifestyles. This significant difference in bone mass is maintained well into the seventh and eighth decades of life.
Exercise is a documented initiator of the bone remodeling process through stimulation of muscle activity, gravity, and mechanical loading effects. There are four main ways that exercise strengthens bones. First, it places actual physical stress on the bone, which thereby respond by getting larger and stronger. This concept is exactly the same as for muscles; activity causes hypertrophy and increase strength while disuse causes atrophy and weakness in both bone and muscle. Second, exercise stimulates increased blood flow to all bones providing more bone-building nutrients to keep the bones strong. Third, small electrical potentials are created in bone tissue during exercise that stimulates production of new bone. Finally, exercise shifts the body’s hormonal control of bone remodeling towards more new bone formation.

The hormonal control of bone remodeling is of particular importance to postmenopausal females whose estrogen levels have decreased, causing loss of the beneficial effects of estrogen on their bones. Studies have found that exercise programs initiated by postmenopausal females with other factors unchanged (diet, medications, etc.), showed no signs of bone loss, reduced their risk of sustaining a fall, and even increased their bone density. These gains and benefits can be greatly improved upon through cessation of smoking, limiting alcohol and caffeine intake, as well as taking a calcium supplement. However, the highest levels of bone mineral content and bone mass may be obtained through the aforementioned items with the addition of prescribed HRT.

Exercise is a general term, and the type of exercise that is effective against osteoporosis must be defined. To obtain the optimal effect on bone mass, the exercise must be of a weight-bearing nature. Some excellent examples of weight-
bearing exercises are: walking, jogging, hiking, dancing, skipping rope, resistance training or tennis.\textsuperscript{12,16,21} The impact loading of weight-bearing exercise combines motion, pulling, and stress, which have an osteotrophic effect on long bones.\textsuperscript{16,24} Non-weight-bearing exercise such as swimming, while excellent for cardiovascular and over-all body fitness, does not provide any benefit for decreasing osteoporosis.\textsuperscript{12,24} After clearance from the woman’s physician to begin an exercise program, each woman must be instructed in proper warm-up and cool-down techniques in addition to knowing how to take her own pulse and to keep it within her target heart rate (THR).\textsuperscript{16} Above all, any good exercise program combines and includes muscular strengthening, weight-bearing tendencies, cardiovascular fitness, joint mobility, agility, and balance.\textsuperscript{12,23-25,28}

Individually developed exercise programs that are appropriate have a higher rate of compliance when designed and supervised by a licensed physical therapist.\textsuperscript{6} Physical therapists are taught the types of exercises that should be performed to achieve the most benefit to the woman. The exercise program established for promoting bone health and strength in postmenopausal females is recommended to follow five principles. First, the exercise must be specific in that it promotes a local osteogenic effect. Secondly, the exercise must overload the body; the intensity must progressively increase to continue to receive the same improvement. Third, knowing initial values of bone mineral density (BMD) before the exercise is begun indicates the amount of potential to improve. For example, a woman with a small BMD has a greater potential to increase her BMD than a woman with a larger BMD. The fourth principle is that of diminishing returns which corresponds to the second principle of overload. Bone density increases with exercise, but approaches a biological limit. Therefore, greater effort is necessary to achieve gains
in bone strength. Lastly, the principle of reversibility states that the positive osteogenic effects of an exercise program on bone are lost if the exercise program is terminated.\textsuperscript{21}

In addition to an all-inclusive, aerobic, weight-bearing training program, other specific exercises are also recommended for their therapeutic effects. It is suggested that instruction in pectoral stretching and deep breathing be a part of the prescribed home exercise program.\textsuperscript{16,31} This will aid in keeping the shoulders down and back in an appropriate posture and will provide for sufficient diaphragmatic movement. Avoiding heavy lifting and strenuous forward bending should be strongly recommended, as these movements place increased load on the spine in the direction of flexion.\textsuperscript{31} Strong abdominal muscles are vital to supporting the spine. However since flexion and flexed postures should be avoided, isometric abdominal strengthening exercises are more appropriate.\textsuperscript{16,31,37} Using isometrics limits the number of flexed forces placed on the spine; therefore there is no increased incidence of vertebral fractures in postmenopausal females.\textsuperscript{37}

Of utmost importance as part of a physical therapy instruction are correct body mechanics and posture. Correct body mechanics are essential to all people, but especially for postmenopausal females since the focus is keeping the spine in a neutral position. Postmenopausal women must be instructed in the following proper lifting techniques: keep the head up, bend at the hips and knees to get down to the level of the object, do not bend at the waist, keep the back straight, grip the object firmly, and hold it close to the body. When sitting, the low back should be supported with a small pillow or a prescribed lumbar roll and feet must be on the floor. Soft chairs must be avoided as they force
flexion of the spine. In addition, firm beds are advised to keep the spine in a neutral position.\textsuperscript{38}

Along the same lines of body mechanics, proper posture must also be addressed. The head and shoulders should be in alignment over the hips. Tucking the chin in and under avoids a forward head position. Never should a slouched or slumped position be maintained. Regular posture checks in windows or mirrors must be incorporated into one's daily routine to ensure correct posture. For example, to assure correct neck extension while riding in the car, the back of the head should be touching the headrest. If these suggestions are not followed, these women increase their risk for sustaining a vertebral fracture, may develop a fixed flexed posture, and may limit the ability to perform activities of daily living (ADLs). Above all, postmenopausal females must remember to stand tall and maintain an erect spinal position.\textsuperscript{38}

Studies have shown that an emphasis on extension and extension exercises are of benefit for postmenopausal females. One particular study compared four different treatments on their effects on osteoporotic bone. The four groups were divided into an extension group, a flexion group, both flexion and extension, and neither flexion nor extension. The extension group performed prone back extension exercises and sitting scapular retraction exercises to strengthen the erector spinae muscles. The flexion group did half sit-ups and a sitting erector spinae stretch by flexing the trunk. Both flexion and extension exercises were taught to the third group. Finally, the last group did neither of the previous treatments, but was instructed in maintenance of proper posture during ADLs. All subjects were told to avoid lifting objects weighing greater than ten pounds and to flex the knees, not the spine, when bending. Eighty-four per cent of the subjects in
the extension group showed no further damage to their osteoporotic bones. The group incorporating both flexion and extension exercises presented with 47% of the subjects without further bone loss. Next, of the subjects instructed only in posture, one-third experienced bone loss. The flexion group had only 11% of the subjects maintain their bone mass. This study exemplifies the importance of extension exercises for reducing the amount of bone loss. Consequently, postural training and extension exercises must be incorporated into a postmenopausal female’s osteoporosis prevention program. This study gave only a couple of beneficial extension exercises to prescribe. A more comprehensive exercise list is provided in the Appendix.

The role of exercise has a definite place in the treatment and prevention of osteoporosis in postmenopausal females. Exercise does increase bone mass and does enhance the positive effects of estrogen on bones. As a result, women exercising and taking prescribed HRT have the highest BMD levels than women just exercising or only taking HRT. While a lifetime of activity and weight-bearing exercise is of the most benefit, exercise begun at any time will aid in slowing the aging of bone and the formation of osteoporosis. Physical therapists should be consulted to set up an appropriate exercise and postural training program for postmenopausal women.
CHAPTER VI
SUMMARY

Women compose roughly half of the world’s population, and, therefore, must face menopause and its effects. Because so many women are affected, it is imperative that menopause be freely discussed privately, publicly, and by physicians. Women must be made aware of the possible consequences of menopause, both positive and negative. They also must be informed on ways to reduce the negative aspects of menopause.

Due to the reduced amount of estrogen, osteoporosis and bone loss are two negative aspects of menopause. The lowered estrogen levels directly influence bone cells resulting in weakened bone tissue. Consequently, postmenopausal females are at an increased risk for fractures and disability. Fortunately, studies have shown that hormone replacement therapy can relieve the symptoms of menopause, preserve the amount of bone present, and prevent further bone loss. Hormone replacement therapy has the greatest benefit if it is started at or shortly after menopause begins.

An active lifestyle is most beneficial if initiated early, but can still be effective at any stage of life. It is especially important to advise postmenopausal women to perform weight-bearing exercise for bone stimulation. Extension exercises are also recommended to counteract flexion forces placed on the spine. Lastly, proper body mechanics and posture instruction are of extreme importance to keep the spine in alignment. For postmenopausal women with an increased risk of developing osteoporosis, an appropriate
exercise program in addition to physician prescribed hormone replacement therapy are of utmost benefit
APPENDIX
OSTEOPOROSIS - 2 Shoulder Pinches

Pinch shoulder blades together.
Hold 10 seconds while counting out loud.

REPEAT: ___ Times
___ Times a Day.

OSTEOPOROSIS - 4 Elbow Backs

Place hands behind your head and pull elbows back as far as possible.
Hold 10 seconds while counting out loud.

REPEAT: ___ Times
___ Times a Day
POSTURE - 7 Shoulder Blade Squeeze

Rotate shoulders back, then squeeze shoulder blades together.

REPEAT _____ times.
Do _____ times per day.

OSTEOPOROSIS - 3 Axial Extension (Chin Tuck)

Gently pull chin in while lengthening back of neck.
Hold 10 seconds while counting out loud.

REPEAT: _____ Times
_____ Times a Day.
POSTURE - 13 Isolated Spine Extenders

Inhale slowly.
Exhale while sitting or standing as tall as possible.
HOLD position for 5 seconds, breathing normally.
Relax.

REPEAT _____ times.
Do _____ times per day.

STRENGTH BUILDING - 10 Torso Stabilizer

Lying on floor or hard mattress, bend knees. Breathing normally, tighten stomach muscles. Hold for count of 8.
REPEAT _____ times. Do _____ times per day.
Lie on back with knees bent and fingertips touching ears. While breathing OUT, slowly try to lift shoulders about 4" off the floor. Keep small of back against floor. Breathe IN while returning to floor. REPEAT _____ times. Do _____ times per day.

OSTEOPOROSIS - 1 The Body Extender

Extend arms over head or as far as possible. Push entire body into the bed. Count out loud for 10 seconds while pushing. Relax for 10 seconds. REPEAT: _____ Times _____ Times a Day. Copyright VHI 1993
REFERENCES


