Osteoporosis: An examination on the pathology clinical prevention methods health education programs behavioral strategies and a program guide for developing and implementing a rural-based osteoporosis education program

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Osteoporosis is a devastating disease due to its physical, financial, and emotional toll on individuals and society. However, effective prevention methods do exist. Several clinical prevention methods are examined in this paper. Estrogen replacement therapy was found to be an effective prevention mode, however, side effects need to be considered before engaging in its use. Supplementation of the diet with calcium, either through calcium-rich foods or supplements, was discovered to be beneficial for pre-menopausal women for enhancing bone density, but was not an effective prevention mode for slowing or halting bone loss after menopause. Calcitonin was found to be a very promising prevention method, although more work needs to be done to determine what, if any, side effects are caused by this therapy. Exercise was determined to be beneficial for enhancing bone density, but did not compensate for estrogen deficiency after menopause.

Effective health education programs designed to prevent and manage osteoporosis share similar components. Components include a) structuring the program as an opportunity for participants to socialize, b) designing the program to be as self-guided as possible, c) using a variety of individuals to facilitate the program to keep participants’ interest levels high, d) including an exercise component if feasible. Finally, including a pre-post questionnaire is essential for the facilitator to assess knowledge gained from the program.

Behavioral strategies to consider when developing a program include: a) making the threat of the disease seem as personal as possible, b) increasing women's awareness of their own susceptibility to the disease, c) using case histories versus generalized information for effective education of the effects of the disease, and d) showing women how their daily life can be enhanced by using hormone replacement therapy if they are experiencing hot flashes and disruptions of daily life.

The program designed in this project was aimed at a rural-based population. Components found to be successful in other programs were incorporated into this project.
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INTRODUCTION

Osteoporosis is a disease that is physically, financially and emotionally devastating to individuals and society. The Royal College of Physicians found that patients with hip fractures occupied 20% of all orthopaedic beds, and that the incidence of hip fractures rose 254% between 1954 and 1983 (Dixon, 1992). Every year in the United States 1.2 million bone fractures are credited to this disease, resulting in five to six billion dollars in health care costs (Baran, Sorenson, Grimes, Lew, Karellas, Johnson, Roche, 1990). "Given present levels of exercise and past dietary habits, by the age of 90, one-third of all Caucasian women will have sustained a hip fracture" (Resnick and Greenspan, 1989, p.251). "These projections of incidence have limitations, however, because they are based on women who are presently osteoporotic. It may be accurately inferred that these women have lived different lives from the 40-year old women of today. Thus projections of the incidence of osteoporosis would be more valid if they controlled for such factors as smoking, exercise and diet" (Cobb, personal communication, cited from: U.S. Congress, Office of Technology Assessment, The Menopause, Hormone Therapy, and Women's Health, 1992, p. 25). In terms of individual costs, about 20% of all hospital patients with hip fractures are dead in six months, and of the remaining individuals, about 50% lose their independence (Dixon,
Along with physical difficulties, people suffer emotionally as well, due to the precipitation of confusion and states of dementia (Law, Wald, Meade, 1991).

Osteoporosis is a disease that takes an enormous toll on society and individuals, however, effective preventive and treatment methods do exist. The goals of this paper are to: 1) examine the pathology of osteoporosis, 2) evaluate the effectiveness of clinical prevention methods through a review of related literature, 3) examine preventive and rehabilitative programs for the purpose of providing a framework for a rural-based osteoporosis prevention program, 4) review behavioral strategies that facilitate compliance to a prevention program, and 5) develop an educational preventive program aimed at a middle-aged female population to implement in a rural Montana community.

THE PATHOLOGY OF OSTEOPOROSIS

Thorneycroft (1989) states osteoporosis is defined as "reduced bone mass per unit volume with a normal ratio of mineral to matrix" and asserts that an individual has osteoporosis if bone mineral density is less than 80% of the young normal value for that race and sex (p. 1306). The mineral density of bone is basically the mass of calcium salts per unit volume (Law, et al., 1991). There are two types of bone: cortical, or compact, and trabecular, or spongy. Overall, the skeleton is about 75-80% cortical, and
20-25% trabecular (Thorneycroft, 1989, Kanis, 1991). Bone remodelling is surface-based, which means bone remodelling occurs on the outermost layers of the bone versus the inner layers. The metabolic activity of trabecular bone is much higher than that of cortical bone since its surface to volume ratio is ten times greater, even though trabecular bone accounts for a minimal amount of bone mass (Kanis, 1991). Therefore, conditions that lead to bone loss affect trabecular bone quicker than cortical bone (Cummings, Kelsey, Nevitt, O'Dowd, 1985). The following table shows approximate proportions of cortical and trabecular bone at various sites in the skeleton. The figures show that commonly fractured body parts consist primarily of trabecular bone, since fractures often occur in this type of bone.
Table 1

Proportions of Cortical and Trabecular Bone in Common Fracture Sites

<table>
<thead>
<tr>
<th>Site</th>
<th>Cortical (%)</th>
<th>Trabecular (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hip</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Trochanteric region</td>
<td>50</td>
<td>50</td>
</tr>
<tr>
<td>Neck</td>
<td>75</td>
<td>25</td>
</tr>
<tr>
<td>Vertebrae</td>
<td>33</td>
<td>66</td>
</tr>
<tr>
<td>Forearm</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Distal</td>
<td>30-50</td>
<td>50-70</td>
</tr>
<tr>
<td>Middle</td>
<td>95</td>
<td>5</td>
</tr>
</tbody>
</table>

Note: From "Epidemiology of osteoporosis and osteoporotic fractures" by Steven R. Cummings, 1985, Epidemiologic Reviews, p. 180.

Bone metabolism is a complex process. Via a specific series of events, old bone is removed, new bone tissue is laid down, and mineralization occurs. In the erosion phase, specialized cells called osteoclasts detect an area of inactive bone surface and enzymatically dissolve the tissue, resulting in the formation of a cavity (DeGraff, Fox, 1986). Mononuclear cells found deep within these resorption holes are believed to be signals for attracting osteoblasts, cells that form new bone tissue, to those sites. The process of attracting osteoblasts to the erosion site is called coupling (Kanis, 1991). This process ensures that
osteoblasts are attracted to these sites exclusively. These cells secrete osteoid matrix, the organic component of bone, and begin the process of mineralization several days later by the deposition of calcium phosphate and calcium carbonate (Kanis, 1991).

In order to maintain healthy bones, the rate of new matrix formation and mineralization must equal the rate of bone resorption. Approximately five millimols (mmol) of calcium is resorbed from bone daily, which must be matched by deposition of an equal amount during bone formation (Kanis, 1991). At any given time nearly 10-15% of bone surface is undergoing remodelling, with the remaining surface being relatively latent. However, if an increase in the remodelling of bone occurs, several consequences arise.

Bone remodelling results in a net deficit of bone, at least until the resorption cavities are completely filled. This occurs because accumulation of calcium into bones occurs after matrix production, not before. The skeletal volume missing at any one time will increase in proportion to the number of functional bone remodelling units. This skeletal deficit, termed the resorption space, normally amounts to approximately 0.76% of total body calcium (Kanis, 1991). Parfitt (1983) calculated that a fivefold increase in bone turnover would produce a negative balance of 30 grams, or a decrease in total bone volume of 3% under steady state conditions.
Another consequence of increased skeletal remodelling relates to the turnover time of the skeleton. If bone turnover is accelerated, a proportionately greater amount of bone volume is occupied by young rather than old bone. It is important to recognize that mineralization continues for many months after the bone remodelling sequence. Therefore, a younger, less dense skeleton may be more susceptible to fracture than a more stable, mature skeleton.

A third consequence is that the osteoid in the incompletely formed bone remodelling units at any one time is not mineralized, leaving a softer, less dense material in the calcium space of the bone. Thus the calcium space exceeds the resorption space by a small but fixed proportion.

For these three reasons the mineral content of bone may be significantly influenced by changes in bone turnover. Bone remodelling is a delicate process, and two primary factors can affect this process.

One factor is the amount of calcium ingested and absorbed into the system. The calcium requirement for humans is generally defined as the intake at which calcium intake and output are equal (Nordin and Heaney, 1990). In other words, the amount of calcium consumed in the diet and absorbed by the intestine must equal the amount lost through the skin plus urinary and faecal excretion. Nordin and Heaney (1990) assert 550 mg of calcium must be absorbed to
obtain this balance, and that the allowance needed to meet this requirement in 95% of normal humans is about 800-1000 mg/day. The skeleton houses 99% of the body's calcium (Kanis, 1991), but calcium is also needed in the vascular system to ensure proper muscle and nerve function.

If serum calcium levels fall, parathyroid hormone is secreted from the parathyroid glands, located above the thyroid glands. This hormone may be responsible for the increased activation of bone remodelling by promoting a rise in blood calcium levels. Parathyroid hormone acts on the bones by stimulating calcium reabsorption in the kidneys, a process that returns the calcium to the blood. Parathyroid hormone also promotes the formation of 1,25-dihydroxy vitamin D3, and so it indirectly helps raise plasma calcium levels via the effects of this hormone. Vitamin D3 helps raise plasma calcium levels by stimulating (a) intestinal absorption of calcium and phosphate, (b) resorption of bone, and (c) the renal reabsorption of phosphate so that less is excreted in the urine.

If high blood calcium levels exist, the hormone calcitonin facilitates the removal of excess serum calcium. Calcitonin is secreted by the parafollicular cells in the thyroid glands. This hormone lowers blood calcium levels by (a) inhibiting osteoclast activity and (b) stimulating the urinary excretion of calcium and phosphate by inhibiting their reabsorption in the kidneys.
Therefore, when calcium intake is high, the rate of bone remodelling will decrease. Conversely, if calcium intake is low, the body will increase the bone remodelling process in order to maintain adequate serum calcium levels.

Another factor that affects bone remodelling is the hormone estrogen. It is secreted by the ovaries and lowers urinary calcium levels and also lowers plasma alkaline phosphatase, an enzyme that helps regulate bone metabolism. These effects suggest a direct effect of estrogen on bone, an explanation supported by the discovery of estrogen receptors in bone cells. This is compatible with the idea that estrogen regulates the sensitivity of bone to parathyroid hormone or the calcium setpoint in the parathyroid glands (Eriksen, Colvard, Leberg, Graham, Mann, Spelsberg, Riggs, 1988). When menopause occurs, ovarian function ceases, and therefore, so does the production of estrogen. The lack of estrogen in the system causes an excessive loss of calcium from the bones, which can ultimately lead to the development of osteoporosis. As demonstrated, several factors affect bone health. Other factors also affect a woman's risk for developing osteoporosis.

In Western societies, females have less bone mass than men do at all ages, thus increasing women's risk, since they have less bone mass to lose than do men (Cummings et al., 1985). Also, studies based on medical records show that
age-specific incidence rates for hip fractures are two to three times higher in women than in men. Caucasians and Asians have higher risk of bone fracture than Blacks, who have greater bone mass and density. Although not conclusive, evidence suggests a woman's age at first full-term pregnancy, menopausal symptoms and length or variation of her menstrual cycle do not appear to be related to fracture risk. Thin women have an increased risk of fracture more so than obese women, perhaps because obesity may protect against bone loss after menopause by increasing the amount of biologically available estrogen. Cummings et al. (1985) states "chronic use of several types of medications may speed bone loss, predispose to fracture, or have potentially adverse effects on calcium metabolism. Use of corticosteroids accelerates trabecular bone loss more than cortical bone loss and predisposes to fractures of the vertebrae, ribs, and perhaps hips" (p. 193).

Several nutritional factors relate to risk of osteoporosis as well. Increasing protein content in the diet has been shown to increase urinary calcium excretion and have at least short-term negative effects on calcium balance. However, this probably plays a rather small role in osteoporosis risk (Cummings et al., 1985). Matkovic et al. observed higher protein, phosphate, and calcium intake in the Yugoslavian region that had a lower rate of hip fractures, but Garn et al. found no correlation between
protein intake and the estimated area of metacarpal cortical bones in adults in the Ten State Nutrition Survey. Consumption of protein-rich foods, such as dairy products, may slightly improve or have no net impact on calcium balance because the effects of higher protein intake appear to be offset by the high levels of phosphorus and calcium found in these foods. Long-term deficiencies of Vitamin D result in osteomalacia, a disorder characterized by bone that is qualitatively abnormal due to an impaired state of mineralization. This is important to keep in mind since the ability of the skeleton to provide structural support depends on the amount of bone tissue as well as degree of mineralization (Frame and Parfitt, 1978). Heaney and Recker (1982) found an association between caffeine intake and negative calcium balance in premenopausal women. Hutchinson, Polansky, and Feinstein (1979) discovered that a history of alcoholism significantly increased risk of hip fractures. "The association between alcoholism and osteoporosis could result from a direct toxic effect of alcohol or could be a consequence of poor nutrition, reduced body weight, cigarette smoking, reduced physical activity, liver disease, chronic illness, or other factors" (Cummings et al., 1985, p. 192).

Most studies suggest that women who smoke cigarettes have a greater risk of hip, vertebral, and Colle's fracture than women who do not smoke. Women who smoke also appear to
have lower cortical bone mass (Cummings et al., 1985).

In summation, factors that can affect bone density and risk of osteoporosis include calcium input and output; estrogen levels; bone mass; being of Caucasian or Asian descent; being thin; long-term corticosteroid use; consuming excessive amounts of protein; caffeine and alcohol; and smoking. The ability to diagnose osteoporosis depends on an accurate measurement of bone density.

According to Thorneycroft (1989) the two most widely used techniques for accurate measurement of bone density are photon absorptiometry and computed tomography screening. Dual-beam photon absorptiometry assesses bone density by measuring bone absorption of two beams of radiation, therefore, any bone in the body can be measured with this technique. Since the beams have different energies, they are absorbed differently by fat and bone. Single photon absorptiometry can only be used for bones not surrounded by or containing fat, thus making it a useful technique for cortical bone measurements, such as the wrist and heel bone. A disadvantage to this technique is that unless correction for the fat in bone marrow is made, false levels may be obtained. Computed tomography scanning measures both cortical and trabecular bone density. Disadvantages, however, include costly equipment and the fact that this procedure exposes the patient to a high radiation dose.

Thorneycroft states that, in his opinion, dual-photon
absorptiometry is the more practical approach, since it offers the advantages of less cost, less radiation, and ease of measurement. He contends the "gold standard" for determining osteoporosis is an iliac bone biopsy, however, this is not used often since it is invasive and painful. Understanding bone metabolism and methods of bone density measurement leads to examining current clinical prevention methods for osteoporosis. It is important to examine these methods to see if they significantly affect bone density.

CLINICAL PREVENTION METHODS

Estrogen Therapy

One of the most cited studies concerning the use of estrogen as treatment for postmenopausal bone loss is the study conducted by Lindsay, Aitken, Anderson, Hart, MacDonald and Clarke (1976). The investigators attempted to verify that estrogen therapy produced gains in bone mineral content by studying data from a five-year follow up program involving a controlled trial of mestranol (estrogen) therapy in oophorectomized women (women who have had one or both ovaries removed).

Investigators followed one-hundred twenty patients who were part of an original trial of estrogen therapy for five years. Twenty-four were followed from oophorectomy (excision of one or both ovaries), sixty-four from three years after, and thirty-two from six years after. None had
previously received estrogen replacement therapy. Investigators were able to, in a double-blind fashion, estimate dosage of estrogen by giving identical active or placebo tablets which subjects obtained in boxes of 120 and acquired more by returning a coded postcard to the hospital pharmacy. By counting these postcards it was possible to obtain a rough estimate of the number of tables consumed by each patient. For the first three years of therapy the research team measured the patients every six months at the mid-point of the third metacarpal of the right hand for bone mineral density by photon absorptiometry.

Results showed initial bone mineral content in the three groups agreed with other studies which stated bone is lost most rapidly in the initial three year period after oophorectomy and relatively slower after that. Changes in bone mineral content (BMC) showed that placebo treated patients followed from two months after operation lost bone at a rate of 2.7% per year. Bone mineral density (BMD) in the mestranol treated group decreased 0.4% per year, a result which was significantly different from the loss of bone experienced by the control group (p<0.01). Lindsay et al. concluded by stating that since mestranol prevented bone loss in all three groups, and the metacarpal mineral content correlates well with that of the radius, femur, and spine, it is reasonable to assume changes described here are representative of changes in other parts of the skeleton.
Lindsay, Hart, Forrest, and Baird (1980) conducted a study to determine whether measurements of estrogen-treated cortical bone reliably reflected the density of spinal trabecular bone, since significant doubts existed as to whether this is an accurate measurement.

The researchers studied 100 oophorectomized women who had taken part in a study of bone loss following oophorectomy and the effect of long-term estrogen therapy. The only selection criteria were continuity of treatment and duration of attendance; these 100 had attended consistently for the longest period of time. Fifty-eight of these women had been prescribed mestranol, and 42 identical placebo tablets. The median duration of treatment for the group was nine years and there was no significant difference in duration of attendance between placebo-treated and estrogen-treated patients.

Each patient was reviewed every six months for the first three years of attendance and yearly thereafter. Investigators made photon absorptiometric measurements of subjects' midpoint of the third metacarpal of the right hand and the midpoint of the radius, as well as taking height and weight records.

Results showed that subjects who received estrogen had significant protection against bone loss when measured by photon absorptiometry. Significant height reduction occurred in 38% of the placebo-treated women whereas only 4% suffered
height loss in the estrogen-treated group. The authors concluded "...our study does show clearly, even with a crude technique of spinal measurement, that small doses of estrogen prevent progression of spinal osteoporosis" (p. 1153).

Christiansen, Christansen, and Transbol (1981) devised a study which investigated the effects of estrogen on bone mass in normal women soon after menopause and focused on the rate of bone loss after treatment was discontinued. One hundred-fourteen volunteers were selected by questionnaire and medical examination. All had experienced menopause three to six years before.

The researchers performed two studies. In the first, they assigned subjects into a treatment group, which took estrogen supplements, and a control group, which took a placebo. After two years of treatment, the volunteers were asked to continue in a second study. The researchers randomized the women into four groups: a) continued hormone treatment, b) discontinued hormone treatment with placebo, c) former placebo treatment with continued placebo, and d) former placebo treatment with hormone treatment. Of the original 114 volunteers 77 completed both studies.

Christiansen et al. used photon absorptiometry at the distal forearm to measure bone density. They analyzed significance of changes within groups by using paired Student's t test. Results showed that hormone replacement
therapy created significant increases ($P<0.001$) in mean bone mineral content after one year (1.9%), two years (2.5%), and three years (3.7%) of treatment. In the placebo group there was a virtually linear fall in BMC of 1.9% a year ($p<0.001$). Withdrawal of hormone replacement in the first group created an annual decrease of bone mineral content of 2.3%.

Christiansen et al. concluded by stating that even temporary hormone replacement after menopause will have a lasting beneficial effect on bone mass.

Kiel, Felson, Anderson, Wilson, and Moskowitz (1987) performed a retrospective cohort study of 2,873 women in the Framingham Heart Study to assess the effect of postmenopausal use of estrogens on the risk of hip fracture. Researchers obtained information regarding estrogen use, body weight, age at menopause, smoking and alcohol consumption at biennial examinations to evaluate the risk of hip fracture. Fractures occurred in 179 postmenopausal women. The relative risk of hip fracture in subjects who had taken estrogens at any time was 0.65 after adjusting for age and weight ($P<0.05$). The adjusted relative risk in women who had taken estrogens within the previous two years was decreased to 0.34 ($P<0.05$). Researchers also found that taking estrogen within four years of menopause also protected against fracture. Kiel et al. stated that although they were able to demonstrate a protective effect of estrogen for hip fractures, they were not able to...
determine ideal duration and dosage. They support the administration of estrogen to older women, at least up to the age of 74.

Estrogen replacement therapy appears to be an effective agent in retarding post-menopausal bone loss. However, many facets of this therapy exist and all must be considered before beginning this program. Contraindications to estrogen replacement therapy exist for the following situations: a) known or suspected pregnancy; b) known or suspected breast cancer; c) known or suspected estrogen-dependent neoplasia; d) undiagnosed abnormal genital bleeding; e) active thrombophlebitis or thromboembolic disorders (Physician's Desk Reference, 1994).

There are also risks involved when using estrogen therapy. Some studies have suggested a possible increased incidence of breast cancer in those women on estrogen therapy taking higher doses for prolonged periods of time. The majority of studies, however, have not shown an association with the usual doses used for replacement therapy (Physician's Desk Reference, 1994). This is essentially in agreement with Coope and Roberts (1990), who state "The consensus is that the use of hormone replacement therapy for less than 10 years does not increase the risk, although the figure of six years may be better as the limit of safe use as regards to breast cancer" (p. 295).

Additionally, The Menopause, Hormone Therapy, and Women's
Health, produced by the Office of Technology Assessment from the U.S. Congress, cites personal communication with D.B. Thomas from the Fred Hutchinson Cancer Research Center in Seattle, Washington, who said "The increased risk may also be restricted to those women who used doses larger than the current dose of 0.625 mg per day of conjugated estrogen—many studies fail to separate the effects of duration of use from those of higher dose" (1992, p. 43).

The Physician's Desk Reference (1994) reports the risk for endometrial cancer among estrogen users is about four-fold or greater than in nonusers and appears dependent on duration of treatment and on dosage. Barrett-Conner (1987) found similar conclusions, noting that unopposed estrogen use at the current lower doses carries at least a five-fold increased risk for endometrial cancer. However, there is no significant increased risk for endometrial cancer associated with the use of estrogens for less than one year, although greatest risk appears linked with usage of five years or more (Physician's Desk Reference, 1994). Further, Ernster, Bush, and Huggins (1988) state that this kind of cancer is relatively rare and is not fatal in the vast majority of cases associated with estrogen use.

Using estrogen therapy during pregnancy is considered risky due to an association with an increased risk of fetal congenital reproductive-tract disorders. Other risks include gallbladder disease, elevated blood pressure,
hypercalcemia. (Physician's Desk Reference, 1994).

The Physician's Desk Reference (1994) lists the following as noted common side effects to estrogen replacement therapy: a) nausea and vomiting; b) breast tenderness or enlargement; c) enlargement of benign tumors of the uterus; d) retention of excess fluid; e) a spotty darkening of the skin, especially on the face. Further, Coope and Roberts (1990) note the possibility of women experiencing light cyclical vaginal bleeding as a side effect when using estrogen replacement therapy. The U.S. Congress Office of Technology Assessment's background paper titled The Menopause, Hormone Therapy, and Women's Health includes the possibility of headaches as side effects (1992, p. 35).

There are potential benefits to using estrogen replacement therapy not specifically related to bone density. In hysterectomized women, estrogen therapy increases levels of high density lipoproteins (the "good" type of cholesterol), lowers total cholesterol levels and reduces the risk of dying from coronary heart disease (Coope and Roberts, 1990). Rothert (1990) included reduction or alleviation of hot flashes and vaginal dryness as other potential benefits to hormone therapy.

It seems prudent that each woman should consult with her physician before deciding to undertake this therapy. There are distinct advantages and disadvantages to this
therapy, and the decision to use estrogen is unique and individual for every woman.

Calcium Supplementation

Supplementation of the diet with calcium is presented as a clinical prevention mode for established osteoporosis. Riis, Thomsen, and Christiansen (1987) conducted a two-year study on 43 postmenopausal women to examine the effect of calcium supplements compared to estrogen supplements and placebo. In this double blind study, the authors randomly assigned women to one of three groups: a) 3 mg daily of percutaneous estradiol (estrogen cream) combined with progesterone the second year plus placebo calcium during the entire period, b) placebo estrogen cream and 2000 mg of calcium carbonate ingested daily, c) placebo estrogen cream and placebo calcium. Single photon absorptiometry was used to measure bone mineral content in the forearm and dual photon absorptiometry was used to measure bone density in the entire body and spine.

Of the 43 women who entered the trial, 36 completed all nine examinations, creating an attrition rate of 16%. Researchers used one-way analysis of variance for differences between initial values. All P values testing the significance of differences (Type I errors) were two-tailed. All P values testing the risk of Type II errors were one-tailed. In the groups treated with calcium or placebo, the bone mineral content in the four bone
compartments fell significantly (P<0.001), representing a bone-loss rate of 4 to 8 percent over two years. In the estrogen group, however, the bone mass was unchanged throughout the study. After 15 months, the bone mineral content in the proximal forearm had decreased significantly more in the placebo group than in the calcium group (P<0.005), and this difference between the two groups remained significant throughout the trial (P<0.005 to 0.010). The same trend was seen in the bone mineral content of the entire skeleton, although it did not reach significance. There were no differences between the calcium and placebo groups in the bone mineral content in the distal forearm and the bone mineral density of the spine. In their discussion Riis et al. concluded that dietary calcium supplements in the dosages used was not an effective alternative to estrogen or progestogen hormone replacement in the prevention of postmenopausal bone loss.

Ettinger, Genant, and Cann (1987) designed and conducted a study to examine the rate of bone loss in untreated (not taking hormone therapy or calcium supplements) females experiencing spontaneous menopause and to test for possible protective effects of estrogen or calcium. Women between the ages of 49 and 59 who were members of the Kaiser Permanente Health Plan in San Francisco were asked to enroll in this prospective study. Eighty-four women entered the study, all of whom had had
spontaneous menopause 6 to 36 months before entering the study. Investigators assessed the subjects for menopausal status by testing for elevated levels of follicle-stimulating hormone. After being informed of risks and benefits of each therapy offered, the authors allowed the subjects to select their own treatment method.

Twenty-five women elected no special treatment and maintained their usual dietary calcium intake of 622 mg/day. Forty-four women chose to supplement their dietary intake up to 1500 mg/day by taking 1000 mg/day of oyster shell calcium in two doses. Fifteen subjects who had mean calcium intakes of 1733 mg/day chose .3 mg/day of conjugated estrogens combined with the same calcium supplementation. The authors had administered .3 mg/day of conjugated estrogens in other previous studies and discovered that this amount without additional calcium supplementation was ineffective in retarding bone loss. Of the 84 who entered the study, 11 dropped out and were not included in the analysis.

Variables recorded included parity, time since menopause, smoking history, and activity level. Single-photon absorptiometry was used to measure bone mineral content at the radial diaphyseal site. Authors used analysis of variance to test for intergroup differences of demographic variables. The authors assessed differences between each woman's baseline and subsequent bone mineral measurements by the paired t-test and group differences by
analysis of variance. The change in spinal trabecular mineral content after two years served as the continuous dependent variable in a stepwise multiple regression analysis of all clinical variables.

Results showed baseline bone mineral values were close to those expected and were similar in all treatment groups. After two years of followup, comparisons between the mean two-year values and the mean baseline values showed a significant reduction of 9% in spinal trabecular mineral content (P=.002) and a reduction of 1.1% in combined cortical thickness (P=.02) in women receiving no treatment and a decrease of 10.5% in spinal trabecular mineral content (P=.0001) and a .8% decrease in cortical thickness (P=.001) in women taking calcium supplements. Women taking both estrogen and calcium showed no significant changes in spinal trabecular mineral content (+2.3%), and combined cortical thickness (-0.2%).

Ettinger et al. concluded that calcium supplements alone do not protect against the accelerated bone loss that occurs at menopause and which preferentially affects trabecular bone. The authors add that by adding calcium to the diet, estrogen therapy may be made more safe and acceptable without loss of its protective effects on the skeleton, since a smaller dosage of estrogen is needed if calcium supplementation is added to the therapy.

Dawson-Hughes, Dallal, Krall, Sadowski, Sahyoun, and
Tannenbaum (1990) conducted a two year, double-blind, placebo-controlled, randomized trial to determine the effect of calcium on bone loss from the spine, femoral neck, and radius in 301 healthy postmenopausal women.

Subjects were recruited by advertising on local television stations and by direct mailings. The criteria for admittance included being white, in good general health, normal ambulation, age 40-70 years, at least six months since menses and normal results on physical exams and lab tests. By design, half the subjects had a usual calcium intake of less than 400 mg/day, and one half had an intake between 400 and 650 mg/day. Dietary calcium and vitamin D intakes were measured every six months by using a food frequency questionnaire. Dual photon absorptiometry was used to measure bone mineral density of the spine and femoral neck. Single photon absorptiometry was used to measure bone mineral density at the distal radius.

Researchers randomly assigned half of the women with calcium intakes less than 400 mg/day to treatment with placebo, 500 mg of calcium carbonate, or 500 mg of calcium citrate. Using a separate randomization scheme, the researchers assigned the half of the women whose daily intake was 400 to 650 mg to the same three treatment groups. The women in each of these six groups were instructed to take two tablets daily at bedtime and to maintain their usual diets. Every six months, each subject was evaluated on
a physical exam, urine and blood measurements, bone-density measurements, and compliance with the study regimen. Forty-six dropped out, creating an attrition rate of 13%.

To determine which treatment groups lost or gained bone-mineral density, the authors compared annualized least-squares means of rates of change with zero. When adjustments were not necessary, comparisons among the treatment groups were made with analysis of variance and Tukey's honestly significant differences. They used unpaired t-tests to assess differences between the two calcium-intake groups and between laboratory values at baseline and at two years. All P values were two-tailed.

Their results agree with other studies that found bone loss from the spine in early-postmenopausal women is unresponsive to calcium supplementation. Results indicated that early post-menopausal women (women who had undergone menopause five or few years earlier) had lost bone from the spine after two years and that calcium supplementation had no effect on the density of the radius. The decline in bone density was statistically significant in all three treatment groups and was not affected by calcium supplementation. Among the late-postmenopausal women (women who had undergone menopause six or more years earlier) those who received calcium citrate had no statistically significant loss of bone density at any site. The bone density of the spine decreased significantly in the calcium carbonate and placebo
groups, and the bone density of the femoral neck decreased significantly in the placebo group. Dawson-Hughes et al. concluded that healthy older postmenopausal women with a daily calcium intake of less than 400 mg/day can significantly reduce bone loss by increasing their calcium intake to 800 mg/day.

Baran et al. (1990) conducted a study to evaluate prospectively the effect of dietary calcium in the form of dairy products on the vertebral bone mass of 30- to 42- year old premenopausal women. Fifty-nine premenopausal women were recruited for participation. They were divided into two groups balanced for the factors of age, weight, vertebral BMD, and dietary calcium intake. None of the subjects regularly exercised, smoked, or took medication thought to affect calcium metabolism. One group was randomly assigned to dairy product supplementation of calcium by 500-600 mg/day. The control group was asked to maintain their baseline diets. All women completed 3-day diet histories, and these were repeated five times during the study. Of the 59 women who began the study, 37 completed the 3-year followup, and 22 withdrew after varying amounts of time.

The authors analyzed bone density of the lumbar spine using dual photon absorptiometry at the start of the study and at 6, 12, 18, 30 and 36 months. They completed two sets of comparisons. First, they analyzed differences between the supplementation and control group using Student's t test.
Second, they analyzed differences among the 59 women who began the study using covariance of analysis to see whether and how much the withdrawals may have biased the results. In order to determine if bias affected the results, the same set of analyses was carried out using all women in the study at each follow-up time. The same results were found. Results showed that during the course of the study, vertebral bone density of the supplementation group did not change significantly, whereas the control group lost bone at a significant rate ($P<0.02$). This significant difference persisted at the conclusion of the 3-year study ($P=0.05$). Baran et al. concluded that the results of this study indicate that calcium supplementation in the form of dairy products decreased the rate of vertebral bone loss in premenopausal women.

These four studies basically agree with Cummings et al. whose review article stated, "Lifelong high intakes of calcium may increase the maximum bone mass achieved at skeletal maturity, and postmenopausal calcium supplementation may slow the rate of bone loss, although less effectively than estrogen therapy" (1985, p. 189). This idea is congruent with the suggestion from the literature that premenopausal bone reacts more favorably to calcium than does postmenopausal bone. Also, Christiansen's review paper states, "Our data indicated that calcium therapy is not an effective substitute because calcium alone cannot
prevent bone loss" (1992, s36). In summarizing the role of calcium supplementation, the literature advises that while a calcium-rich diet is beneficial for positively affecting premenopausal bone density, and therefore children and premenopausal women should be encouraged to maintain a high-calcium diets, even after menopause, calcium by itself is not an effective clinical prevention mode for osteoporosis.

Calcitonin

Calcitonin, a peptide hormone produced in the parafollicular cells of the thyroid, is connected with calcium balance by inhibiting bone resorption via a direct action on osteoclasts. MacIntyre, Stevenson, Whitehead, Wimalawansa, Banks, and Healy (1988) conducted a study to compare the effects of estrogen and calcitonin in a randomized two-year study in 70 normal postmenopausal women. Subjects were postmenopausal, as confirmed by the measurement of circulating gonadotropins and gonadal steroid hormones. Subjects also had been untreated for one year. Most were within five years of the onset of the menopause. Researchers randomly assigned patients to one of four treatment groups: a) a placebo gel and three placebo tablets a day for 12 days each month, b) a calcitonin group in which women applied daily inactive percutaneous gel and took inactive tables and thrice weekly self-administered injections of synthetic human calcitonin, c) an estradiol (estrogen)/progesterone group, in which women
applied estrogen gel daily along with taking oral progesterone, and d) a group which applied an estrogen gel daily and self-administered calcitonin injections three times per week.

The investigators followed the patients at three-month intervals to assess vertebral bone density with computed tomography. Results showed that patients in the fourth group had a loss of 4.6% of vertebral bone. Bone changes for the groups not receiving calcitonin were decreases of 10.2% for the placebo group and a decrease of 3.8% for the third group, whereas the second group showed a mean decrease of 2.5%.

MacIntyre et al. concluded that calcitonin can be as effective as estrogen in slowing postmenopausal bone loss. They suggest that calcitonin may come to have an important role in preventing postmenopausal bone loss and perhaps in stopping the progress of established osteoporosis.

Overgaard, Riis, Christiansen and Hansen (1989) conducted a trial to study the effect of salmon calcitonin (salcatonin) given intranasally on calcium and bone metabolism in early postmenopausal women. A nasal spray was developed since the spray is more acceptable to subjects than administering injections. The subjects included 52 women aged 47-56 who had experienced a natural menopause two and a half to five years previously and who had participated in the Riis et al. study on calcium in 1987. After this
first study the researchers used random sampling to assign the women to receive either the active drug, 100 IU of salmon calcitonin given intranasally two times a day, or a placebo of saline solution. Of the 52 women, 75% completed the two years of the study.

The authors examined the subjects' bone mineral content of the forearms every three months by single photon absorptiometry. They measured bone mineral content of the lumbar spine by dual photon absorptiometry, and measured bone mineral content of the entire skeleton by using dual photon absorptiometry.

Authors tested the differences between initial values by Student's t test for unpaired data. They tested the significance of changes within groups by Student's t test for paired data. Results showed that in the women receiving salcatonin, bone mineral content increased by 2.5%, whereas in women receiving placebo it declined by 5.7%. Spinal bone mineral content was higher in those receiving salcatonin than in those receiving placebo after one and two years. The mean bone mineral content in the forearms and total skeleton of both groups decreased by about 2% a year. After two years there were no significant differences in bone mineral content between the two groups at these sites. The authors concluded that the salcatonin given intranasally had a selective effect by preventing bone loss from the spine but not from the forearms or the total skeleton, but felt
that higher doses may have an effect in other parts of the skeleton.

Gennari, Agnusdei, Montagnani, Gonnelli, and Civitelli (1992) studied the effects of an intranasal salmon calcitonin spray on vertebral mineral content. Twenty-one early postmenopausal women were selected to participate in this study. Subjects had to have vertebral mineral content one standard deviation below the age-match average of normal women. The researchers measured vertebral mineral content using dual photon absorptiometry.

Patients were randomized for treatments of one year with either 200 IU of calcitonin every other day or were give a placebo. Mean values within each group were compared using a Student's t test for dependent or independent variables. One-way analysis of variance was used for comparisons between groups. Results showed that at one year, the treatment group significantly increased vertebral mineral content by 3.3%, and that the placebo group experienced a decrease of 3.5%. Gennari et al. concluded by acknowledging their dosage of salmon calcitonin stopped axial bone loss in early menopause and that they also experienced good compliance rates.

Christiansen's review paper (1992) on current modalities for osteoporosis stated that salmon calcitonin is a very promising treatment, citing his own and Overgaard's work, and may also be an excellent prevention mode as well.
This belief was also reiterated by Dixon's review paper (1992), which stated that calcitonin, although expensive, is also valuable for its pain relieving action. However, more work needs to be done in order to determine what, if any, side effects are caused by this therapy.

In reviewing the previous studies, it appears calcitonin may be an agent as effective as estrogen in retarding post-menopausal bone loss, however, more research needs to be performed in order to determine its effects on various skeletal parts.

Exercise

Grove and Londeree (1992) conducted a study to compare the effects of three levels of activity: sedentary, low impact, and high impact on the lumbar bone density of early postmenopausal women. Through newspaper, television, and radio ads, healthy, early postmenopausal sedentary Caucasian females were recruited to participate in this study. Lab tests determined the health and menopausal status of each subject. The researchers used dual photon absorptiometry to assess lumbar bone density.

Grove and Londeree designed this study as a pretest-posttest, randomized control group design. The subjects chosen were matched in groups of three on bone mineral density and weight and then assigned randomly to control, low impact and high impact groups. Treatment consisted of: one group performing high impact exercise, defined as forces
greater than or equal to two times the body weight, such as jumping jacks, running in place, and knee-to-elbow with jumps; one group performing low impact activities, defined as forces equal to or less than one and one-half times the body weight (slow walking, fast walking, and heel jack without jump); and one nonexercising control group. Each of the experimental groups took part in a supervised exercise program three times a week for approximately one hour. Each session consisted of a 15 to 20 minute warmup period, a 20 minute supervised exercise session, followed by a 15 minute cool-down period. The intensity of the exercise routine did not increase during the length of the study.

Statistical analysis included using a mixed three-way trend analysis of variance (p=0.05 level) with repeated measures on one factor over a one-year period. Results indicated that the control group experienced a significant decrease in BMD during the study (F=12.631, P<0.002). The low and high impact exercise groups did not show significant changes in BMD over time (F=0.035, P=0.853 and F=1.084, P=0.308, respectively). Post-hoc planned comparisons were performed to determine whether the changes in BMD were significant among groups. Results showed that low impact and high impact exercise both prevented the decline in BMD that occurred in the control group (control vs. low, F=7.001, P=0.0142; control vs. high, F=10.558, P=0.0034; high vs. low, F=0.364, P=0.5520). This suggests that the impact
threshold for BMD maintenance may be less than one and one-half times body weight when the exercises are performed three times per week for 20 minutes per session. Grove and Londeree concluded by stating "From the present study it appears that 20 minutes of low impact exercise three days per week for one year is effective at maintaining BMD. Increasing intensity to high impact exercise has minimal additional effect on BMD" (p. 1193).

Marcus, Drinkwater, Dalsky, Dufek, Raab, Slemenda, and Snow-Harter (1992) produced a review paper on exercise and osteoporosis. They stated that the type of exercise that best promotes bone density has yet to be determined. Most often, weight-bearing exercise, such as walking, jogging, and dancing are prescribed to halt bone loss associated with menopause. "However, recent evidence suggests that exercise with higher loads at specific sites provides a more effective osteogenic stimulus than do lower loads that are generally distributed"(p. s303). These authors said that forces produces at the lumbar vertebrae during fast walking and jogging are one times the body weight and 1.75 times the body weight, respectively. However, during weight-lifting activity (defined as nonweightbearing), loads on the lumbar vertebrae are as much as five to six times the body weight. They reported this specificity issue is supported by some of the literature, suggesting that the effects of exercise are not homogenous but reflect the demands imposed at individual
Brewer, Meyer, Keele, Upton and Hagan (1983) conducted a trial to compare the skeletal status of two groups of premenopausal middle aged women of diverse physical activity levels. The treatment group consisted of forty-two middle aged (30-49) women who had participated in a running program for at least two years and were currently training for a marathon. Number of years training ranged from two to thirteen with the average being five. Training distance per week averaged 40 miles with a range of 20-80 miles. The control group consisted of 38 women of similar age who had not participated in a regular exercise program, defined as three days a week and 30 minutes in duration.

Bone mineral status was determined by single-photon absorptiometry of the middle phalanx of the fifth finger, the os calcis (heel bone), and the bone mineral content and width of the radius. Anthropometric measurements included height, weight, skinfold thickness, girth, and body dimensions.

Statistical analysis of the data consisted of Pearson product-moment correlation coefficients, and regression parameters. The authors tested the hypothesis by using t-tests, covariance analysis, and Fisher's Z test for the correlation coefficient.

Comparisons of bone mineral status revealed mean values in the exercise group to be statistically greater than
compared to the control group at the midshaft of the radius (P<0.05), the phalanx (P<0.001), and the os calcis (P<0.001). These findings suggest that bone mineralization may be enhanced in premenopausal middle-aged women who engage in exercise of a moderate-to intense level and continue to do so in postmenopausal years.

Pocock, Eisman, Yeates, Sambrook, and Eberl (1986) investigated the relationship between physical fitness and bone mass in the femoral neck, lumbar spine, and forearm. Eighty-four Caucasian women with no previous history of bone disease were recruited for this study. Ages ranged from 20-75 years, with a mean age of 49 years, and 46 were postmenopausal.

Researchers tested bone mineral density (BMD) in the lumbar spine and right femoral neck using dual photon absorptiometry. Single photon absorptiometry was used to measure bone mineral content in the forearm. Researchers quantified physical fitness by predicting maximal oxygen uptake (VO2 max) according to the Astrand Rhyming bicycle ergometer test. When analyzing the data, the investigators used linear regression and stepwise multiple regression along with incorporating Student's t test to test the significance of the partial regression coefficients.

Results showed that femoral neck BMD was significantly positively correlated with VO2 max (r=0.60, P<0.001). Further analysis found age, VO2 max, and weight to be
independent significant predictors of femoral neck BMD ($r^2=0.5$, $P<0.001$). Results from lumbar spine assessment were similar to those of the femoral neck. Lumbar BMD was significantly positively correlated to VO2 max ($r=0.54$, $P<0.001$). Forearm bone mineral content was positively correlated with only VO2 max ($r=0.42$, $P<0.001$), whereas both height and weight positively correlated with BMD in the lumbar spine and femoral neck.

Pocock et al.'s discussion stated that these data clearly demonstrate that BMD of the femoral neck and lumbar spine in women are significantly related to variations in the level of physical fitness, as defined by a measurement of aerobic fitness. They contend that in particular, physical fitness was the only predictor of femoral neck BMD in postmenopausal women.

Prince, Smith, Dick, Price, Webb, Henderson, and Harris (1991) devised a study to investigate the effects of exercise alone, exercise with calcium supplementation, and exercise with hormone replacement therapy. One-hundred women with low bone density at the distal forearm agreed to participate. Forty-two women with normal values for forearm BMD were assigned as controls.

Members of the group that performed exercise alone were required to attend a weekly exercise class and complete two 30-minute brisk walks each week. Another group performed the same exercise regimen and ingested 1000 mg of calcium
lactate-gluconate nightly. The third group performed the same exercise routine and took 2.5 mg of hormone replacement nightly throughout the two-year study period.

Investigators measured forearm BMD at three sites every three months using single photon absorptiometry, and at every six months the women recorded their physical activity for four days in an activity diary. The research team used one-way analysis of variance to analyze base line results. If the F test was significant, Duncan's test was used to evaluate group differences.

Results showed that women in the exercise group experienced bone loss similar to those in the control group. Both exercise plus calcium supplementation and exercise plus hormone replacement were effective in slowing or stopping bone loss, (P<0.05), however, on average, the exercise program alone was ineffective in preventing bone loss.

Shangold (1990, p. 56s) expressed the same sentiments in her review paper on exercise and the postmenopausal woman. Shangold stated, "Although exercise is beneficial for bone density, it does not appear to compensate for estrogen deficiency."

In summation, exercise is beneficial for enhancing bone density. However, other modes are much more effective, especially if used in conjunction with exercise.

As shown above, many treatment options exist for preventing osteoporosis. Sadly, though, many women are
confused and/or misinformed or unaware of their options. Women need education and information regarding their available choices. The next section of this paper examines some current educational osteoporosis programs and clarifies components of successful programs.

HEALTH EDUCATION PROGRAMS DESIGNED TO PREVENT AND MANAGE OSTEOPOROSIS

The purpose of including this section is to review different types of osteoporosis prevention and management programs in order to discover the effective components of these programs. These components will later be utilized in developing an educational program.

Boeckner, Kohn and Rockwell (1990) developed, delivered, and evaluated a nutrition course titled "Eating Today for a Healthier Tomorrow" offered through the University of Nebraska and the Cooperative Extension Service. The course addressed nutrition habits linked with risk reduction for coronary heart disease, cancer, osteoporosis and obesity. The goals of this program were to enable participants to evaluate their own diets according to the recommended practices and appropriately modify their food selections.

Teaching teams consisted of an extension agent and a registered dietician for each of the seven participating counties. On some occasions, a nurse or a physician acted as an instructor. Before the program started, the teaching
teams were involved in a two-day training program. The purpose of this program was to introduce and distribute the course materials and lesson plans, offer teaching suggestions, and explain the evaluation that would accompany the project. In order to reach as many people as possible, extension agents used the following marketing modes: direct mailings; radio, television, and newspaper advertisements; fliers; posters; and presentations to local groups.

A wide variety of printed and audiovisual teaching aids helped participants learn through discussion, goal setting, games, and food tasting. An extension food and nutrition specialist and a registered dietitian developed instructor and participant manuals for three lessons.

One hundred ninety-five participants enrolled in the courses. Ninety percent were female, and 52% were between 40 and 59 years old. The majority (38%) were housemakers, while the rest were professional or clerical (34%), or retired (15%).

The research team offered this program in six sessions of two and one-half hours each. They added a reunion party, 2 months later as a seventh session for post-course evaluation data collecting purposes. They collected demographic data at the beginning of the course, and collected food frequency data from participants at the beginning of the program and at the reunion party.

The fifth session focused on reducing the risk of
osteoarthritis and cancer. Discussion topics included the influence of calcium and other dietary factors on the development of osteoporosis and figuring one's calcium needs.

Seventy-three percent of the participants complete pre- and post-course food frequency data. Pre-data were reflective of the month prior to the course and post-data were reflective of eating habits approximately two to four weeks after course completion. Results showed that in the dairy group, participants selected more low-fat dairy products, such as low-fat yogurt, fruit sherbets, and low-fat cottage cheese after the course than before (p<.05). In addition, the selection of high-fat cheese was significantly reduced in the post-test data (p<.05). These results suggest that by increasing their consumption of low-fat dairy products, subjects subsequently increased their calcium intake, which has been demonstrated to positively affect bone density.

The authors believed this program was successful. They stated that one factor which contributed to the success was that the program supported dietary self-analysis so that individuals could decide appropriate actions for themselves. Another factor was that the six-session format provided a social opportunity for participants as well as an informative setting. Also, the Cooperative Extension Service has the capability to remain in contact with participants and offer
Chow, Harrison, and Dornan (1989) initiated a hospital-based self-help and ambulatory care program for osteoporotic patients in Toronto, Canada. This program consisted of four components: education, social interaction, exercise and research. The goal of this program was to restore and maximize the functional capability of the individuals through education, social support and physical activities.

Physicians from the community referred patients with the diagnosis of osteoporosis based on laboratory and radiological investigations. This study reported data on 90 patients who were followed for two years. The age range in 47-82 years with a mean age of 66.5 years. All subjects took a one-gram calcium supplement daily.

Dual-photon absorptiometry and neutron activation analysis determined bone mass. The patients also underwent a symptom-limited exercise treadmill test to determine the cardiac response to exercise, patient's aerobic capacity and to determine an appropriate training heart rate for the patient.

Subjects had the opportunity to learn about osteoporosis from the educational seminars given monthly by specialists and health care workers in the field. Topics included in the lecture series were nutrition, exercise, home safety and medical treatment options for osteoporosis. Patients were encouraged to participate in the seminars and
questionnaires are filled out after each session. The survey showed that the feedback from the participants was positive. Through increased awareness of the disease, the patients became more compliant with proper nutrition, physical activity and other preventive measures.

Using Beck's Depression Inventory, (Beck, Ward, Mendelson, Mack, Erbaugh, 1961) the authors discovered that 60% of the osteoporotic patients were depressed and socially isolated, especially in the winter months for fear of falling on icy sidewalks. The authors believe social functions and interactions between the participants foster peer group support. Through mutual encouragement patients become motivated to participate in the exercise program.

The exercise classes were conducted by an exercise fitness leader in the hospital gymnasium. The researchers assigned patients to either the home or hospital exercise groups. The protocol consisted of a thrice weekly 30 minute submaximal muscle strengthening unit focusing on all major muscle groups of the trunk and limbs and a 30 minute aerobic routine. Overall compliance with the exercise for the home groups was 20% while the hospital group was 80%. The authors felt motivation and peer group support played important roles in the increased compliance seen in the hospital group. The authors concluded by stating results of this pilot program, which utilized components of education, social interaction, and exercise, are very encouraging and
that similar satellite programs have been started in other parts of Canada.

Coope and Roberts (1990) reported on their results from a program which consisted of health education and screening and prescription of hormone replacement therapy for as many women as possible of all social classes. The authors' practice included 1200 women aged 40 to 60 years. These women were contacted with a letter asking them to attend the clinic. All the clinics were identical in format and were held each week in the two hours of the lunch break. A woman would attend only once during a period of two years. If she was unable to attend on the day of the appointment, the researchers advised her to come at a later date.

When the patients attended the clinic a secretary obtained their medical history and determined that each client had a cervical smear during the past three years. A doctor gave a five minute informal talk to the group explaining the meaning of osteoporosis and how it can be prevented. The nurse then recorded data on each patient concerning exposure to ultraviolet light, smoking, exercise, height, weight, blood pressure, and tested urine for albumen and glucose and a cholesterol screening for high-risk patients. Each patient then had an individual consultation with the doctor who recorded her previous history and whether the ovaries had been removed, her daily calcium intake, alcohol intake and whether she was currently taking
hormone therapy. The investigators examined the data for possible contraindications to hormone therapy. The physician also looked for increased risk factors such as early menopause, thin, slight build, white ethnic origin, low mobility, low calcium diet, smoking habits and corticosteroid use. A menstrual history was taken, including date of last menstrual period, and individuals with heavy, irregular or postmenopausal bleeding were referred for diagnostic curettage. Breast and pelvic exams were also performed when time allowed and patients with lumps in breast or pelvis were referred and were not considered for hormone replacement therapy until tests had excluded any malignancy. Researchers urged women who were unable or unwilling to take hormone replacement therapy to increase their calcium intake to 1300 mg/day. For those on hormone replacement therapy, the doctor suggested a calcium intake of 800 mg/day. If patients could not properly digest milk products, the doctor recommended calcium supplements. Researchers encouraged patients to stop smoking, and limit their alcohol consumption to 2 drinks per day, and to exercise. Any problems detected such as high blood pressure, abnormal urine test, abnormal bleeding patterns or high or low weight were channelled to appropriate clinics or for surgery appointments.

A health education component also existed in the program. An attempt was made to teach women about the loss
of bone density which occurs at the menopause, its relationship to fractures in later life, and the use of hormones in prevention. Most patients were anxious about therapy and a full account of possible risks and benefits were given. Several of the attenders were ignorant of the meaning of osteoporosis and often confused it with osteoarthritis, and were concerned about increasing weight if they increased their intake of dairy products. Many were confused about whether low fat milk contained calcium and needed to be advised that calcium content in skim milk is actually higher than whole milk. Women reported reluctance to accept periods, which can occur due to hormone use, and had concerns about cancer and that the therapy was 'not natural'. After an explanation of the benefits of hormone replacement therapy for a limited period (six years' use reducing risk of fractures by 50%) many accepted the therapy.

The research team didn't attempt to pressure patients into taking hormone therapy. The doctor explained the advantages and disadvantages of treatment and the different types of therapy. Hormone users were followed up three months after the first prescription and thereafter at intervals of six months to a year.

Between January and December 1988 43% of the women offered an appointment attended the clinic. Demographic data showed attenders came from the higher social classes, that
16% of attenders smoked, had a mean daily calcium intake of 757 mg, and that 15% were already using hormone replacement therapy. Doctors prescribed hormone therapy to 45% of attenders, but at the one year follow up only 38% of those contacted were still taking therapy.

The authors attributed the low 43% attendance rate to the fact nearly all of the women were in full-time paid employment in addition to family responsibilities and care for aging parents. Some women came to the clinic at the second or third attempt and others arranged to attend at a later date. The authors stated they do not envision prescribing hormone therapy for all menopausal women and this would not be a practical proposition. The researchers felt key components of this program were the health education and screening programs. They stated this clinic is popular with patients and has demonstrated the project feasibility.

Gold, Lyles, Bales, and Drezner (1989) structured a program for the long-term management of osteoporosis—the Duke University Preventive and Therapeutic Program for Osteoporosis (DUPATO). The goals of DUPATO were not only to reduce the physical threats of osteoporosis, but to minimize the emotional threats, such as denial and avoidance, experienced by patients. The primary aims were "to manage the metabolic bone abnormalities of osteoporosis with appropriate drug therapy, exercise and diet while
concurrently attending to the less tangible emotional needs of the patients" (p. 800). This multidisciplinary approach enabled them to provide appropriate disease-related information, to review poor dietary and exercise behaviors, and give pharmacological help if necessary.

Three primary nonphysical needs are regularly addressed. First, the patient's home and social environment is assessed when making long-term health care management decisions. For example, the research team instructs a 70-year old woman to carry grocery bags no heavier than five pounds and make several trips rather than tell her not to carry her own groceries. The researchers believe patients are more likely to comply with recommendations if they feel their lifestyles are dealt with sensitivity and awareness. Second, they educate the patients about osteoporosis so the patients have an understanding and factual knowledge about their disease. This allows the patients to face their illness with greater awareness and resolution. Finally, the physician sets limits on the amount of physical activity a patient can engage in. This helps the patient's social network understand the disease and recognize the patient's limitations.

The researchers stated that patients who participate in DUPATO develop more effective ways of coping, comply with physician's recommendations, are more aware of osteoporosis, and experience significant reductions in feelings of
hopelessness and depression.

Several components from the previous programs could be implemented into an osteoporosis prevention programs. One component would certainly be to structure the program as an opportunity for participants to socialize, since rural living can often be isolated and lonely. Another factor would be to have the program be as self-guided as possible. The director of the program would be a facilitator, leaving the actual responsibility of changing lifestyle behaviors to the program participant, which would result in a greater sense of internal locus of control, a psychological construct that refers to people's belief about whether they are personally in control of what happens to them (Fox, 1990). Current, accurate information presented in a variety of forms would appear to keep participants' interest levels high. Also, using a variety of individuals to facilitate the program would help keep the program interesting and be invaluable in program design by creating a network of resources. If the facility would allow for it, an exercise component, such as a beginning exercise class, seems beneficial. This way, the participants could learn the proper technique and form for exercising and would help create group cohesion. Certainly, a pre-post questionnaire would enable the facilitator to assess knowledge gained from the program. Section four examines strategies for health professionals to consider when attempting to facilitate
behavior change in females with osteoporosis or who have a strong potential for developing the disease.

BEHAVIORAL STRATEGIES

Wurtele (1988) reported that understanding, predicting, and enhancing health-related behaviors are common goals for health psychologists, and two influential models are frequently used to study the relationships between individuals' beliefs and their health behaviors: the Health Belief Model (HBM), and the Protection Motivation Theory (PMT). Variables common to these two models include a) the individual's perception of the severity of the threat, b) perception of his or her vulnerability to the threat, and c) the perceived effectiveness of the recommended threat-reducing response. Also self-efficacy, which is an individual's belief that he or she is competent and can succeed at a particular task, is proposed to influence attitudes and behavioral intentions. Wurtele chose to test the utilization of a modified PMT, and examine two components of the theory, vulnerability and response efficacy, which are found to have consistent effects in the literature, with osteoporosis, a health issue not previously investigated with these components.

Subjects were women ages 17 to 26 years old (x=19.2). Researchers recruited them through a introductory level psychology class, and participants were instructed that the
The purpose of the study was to develop health education materials for college women. The researchers arranged groups of five to 10 members, and assigned a number to each subject to facilitate honest responses. Investigators distributed essays designed to manipulate the two independent variables. They gave each subject an essay containing information on her vulnerability to osteoporosis (high or low) and on the effectiveness of taking calcium supplements (high or low). The dependent measures were subjects' perceptions of the severity of the disease, their perceived vulnerability, the response efficacy, and self-efficacy.

This study showed intentions to change behavior as the best predictor of self-reported and actual behavior change, and only those intentions specific to the behaviors prove to be significant predictors. This was determined by measuring three questionnaire items concerned with calcium supplementation. The questions were: a) "Within the next week I plan to start taking calcium supplements and to take them on a regular basis"; b) "Over the next two weeks I plan on increasing the amount of calcium in my diet"; and c) "Since free samples of calcium supplements will be available to all study participants, I intend to pick up a sample within the next week" (p. 631). Self-report measures of behavior change were assessed at the second meeting and included a global rating of change in intake of calcium-rich
foods. Subjects were also asked if they had started taking supplements on a daily basis and if they had picked up a free calcium sample. This was verified by checking the records of who picked up the samples. Using analysis of variance, Wurtele found that the vulnerability variable significantly affected subjects' responses. Subjects exposed to the high vulnerability essay reported stronger beliefs in their susceptibility to developing the disease than did subjects in the low-vulnerability condition. Response efficacy showed that subjects in the high-response efficacy condition reported significantly stronger beliefs in the effectiveness of the recommendations for preventing osteoporosis than did subjects in the low-response efficacy conditions, and the relatively low score obtained by the high-response efficacy group suggested a limitation of the response efficacy variable. Wurtele concluded by stating "For this audience of young women, it was extremely important to convince them of their susceptibility to a health threat in order to motivate them to act" (p. 635).

Rook (1987) designed a study that informed subjects about a serious degenerative condition likely to affect them personally someday unless appropriate preventive measures are taken. She designed the study to see if information presented in the form of a case history had a greater impact on subjects' attitudes, behavioral intentions and affective responses than was information presented in abstract form.
Rook recruited twenty women ages 34-70 years \((x=48.4)\) from various community settings to participate in a "study of health information." The two experimental conditions were a case history condition and an abstract condition. The researcher randomly assigned the subjects to the groups.

Women read a sheet that contained information about osteoporosis, associated risk factors, and prevention methods. The abstract version contained information referred to women in general, whereas the case history version contained information in reference to a specific older woman who had experienced osteoporosis.

The dependent variables included items such as how worthwhile exercise was to the subject; how worthwhile the thought of increasing the calcium content of her diet was; how interested she would be in receiving more information about osteoporosis; how effective she thought the material would be in persuading others to pay more attention to diet and exercise.

Three items rated subjects' affective response to the information: a) how concerned the material made her feel about osteoporosis, b) how serious a problem osteoporosis is in this country, and c) how optimistic the material made her feel about the possibility of preventing or slowing the course of osteoporosis.

Rook used T-tests to determine subjects did not differ in age, health, current activity level, or current awareness.
level to her dietary calcium intake. Analyses revealed the health information presented in case history form to be more persuasive than the information presented in abstract form \((p<.02)\). She summarized by saying the case history presentation had a greater overall persuasive impact on subjects' attitudes and behavioral intentions but did not consistently arouse greater affect, meaning that case histories had a greater impact on the subjects intentions to changes behaviors, but did not necessarily create actual behavior change.

Rothert, Rovner, Holmes, Schmitt, Talarczyk, Kroll, and Gogate (1990) conducted a study to determine how women weigh and combine information to make the judgment regarding estrogen replacement therapy. They studied women between the ages of 45 and 55 years all of whom had an intact uterus and were not taking hormone replacements. The researchers recruited these subjects through a civic organizations, churches, newspapers, television, and other avenues. Mean age was 49.2 years, the majority worked full-time, were Protestant, Caucasian, and were predominantly well-educated. Fifty-two percent were still having regular menstrual periods, 25% had experienced a period within the previous year, and 21.4% had not period for at least one year. Fifty-eight percent experienced hot flashes due to menopause.

The instrument used to assess women's judgments
consisted of two systematically designed written cases. The factors identified were severity of hot flashes, risk of fractures due to osteoporosis, risk of endometrial cancer, and treatment protocol with and without addition of progestogen. Researchers gave subjects a three-page information sheet describing the relation of hot flashes, osteoporosis risk, and endometrial cancer risk to estrogen replacement theory. Then researchers asked women to consider cases in which these three factors were represented in one of two levels a) risk of osteoporosis (high or standard), b) risk of endometrial cancer (high or standard), c) and hot flashes (severe or minimal). All possible combinations were included making eight cases, which were each repeated for a total of 16 cases. Researchers asked women in the first 16 cases how likely it would be that they would take estrogen replacement therapy using a five-point scale from "very certain that you would not take hormone therapy" to "very certain that you would take hormone replacement therapy".

Researchers collected data from subjects from four groups, with data collection lasting about one hour. Multiple regression analyses of each woman's reported likelihood of taking estrogen replacement therapy on the values of the three factors in the cases were done for each of the subjects. Standardized regression weights were calculated for all main effects and two-way interactions.
The D index of similarity was then calculated between all possible pairs of decision makers. The clustering process identified 120 women in Group One, 83 in Group Two, 40 in Group Three, and 9 in Group Four.

Results indicated women in Group One clearly placed the most importance in relief of hot flashes, that is, if they experience severe hot flashes, they will take estrogen replacement therapy, if they do not experience these flashes, they will not take the therapy. Women in Group Two, who had the highest education and stress level, indicated hot flashes and risk of fracture due to osteoporosis influenced them on the decision to take therapy. Group Three reported being influenced by information regarding severity of hot flashes, and somewhat by the risk of osteoporotic fractures. Group Four was the smallest group and had the lowest stress level, used the most medication to relieve menopausal symptoms, and had the lowest response to the variables. Groups Three and Four had higher and thus more positive expectations toward menopause than did Groups One and Two, which represented not just the absence of negative feelings but relief at the prospect of menopause.

In their discussion Rothert et al. pointed out subjects in this study were self-selected highly educated women, and a limitation of this study is lack of knowledge of the degree to which the results generalize to all women. They
stated perhaps health care professionals place too little value on process factors, such as hot flashes and how those interrupt daily life when discussing treatment options with patients. Too often, health care professionals place emphasis on morbidity and mortality data when informing patients of possible treatment outcomes, and for many patients, hot flashes and other daily occurrences are larger considerations than the morbidity and mortality statistics. Perhaps this is a consideration for those who design prevention programs as well. Possibly too much focus is spent on events that may or may not happen in the future, rather than spend time focusing on what happens in women's lives today, and how preventive strategies can positively alter their lifestyles now, rather than years later.

Other factors can also influence behavioral strategies. Certainly, characteristics of adult learners would influence what strategies to incorporate into a program.

One characteristic of an adult learner is autonomy (Ross, 1987). Adults want to feel they are in charge of their lives and have control. If a prevention program fails to take this into account and provides an "authority figure" who directs the action of the participants rather than provide a "facilitator", the program may experience low success rates.

Another characteristic of an adult learner is self-doubt (Ross, 1987). Many adults feel they aren't capable of
making new changes. The facilitator could help prevent this by helping the client recall past events in which she was successful in changing a behavior or habit, and by helping the client look at changing her dietary habits as another day-to-day event, rather than as a drastic change.

Adult learners also like to have established routines (Ross, 1987). If a prevention program abruptly changes this routine, it may cause anxiety in the client. Therefore, the ability of the client to cope with the new changes must be taken into consideration. A facilitator can help by pointing out these issues to the client and offer options, rather than instruct the client on exactly what to do in each situation.

The facilitator of the program should look at the client's life experiences, and use them in helping make the program successful for the client. Often adults know what will work and what will not work for them when making changes in their daily lifestyle.

The ways in which adults learn need to addressed, in order to develop effective course objectives and lesson materials. Adults are self-learners, meaning that they "...identify a need to learn, make the decision to learn, choose the type of learning situation to engage in, assemble the resources which are most appropriate for meeting that learning need, and evaluate the outcome of the learning experience" (Ross, 1987, p.6). By focusing on self-
responsibility, the prevention program will meet this need of the adult learner.

Motivation to change a health behavior must also be addressed when attempting to change behavior. Lewin's force field theory asserts that people's behavior is determined by the sum of psychological forces that influence them at any given time. When applying this to a prevention program, it is important to realize there are forces urging behavior change and forces for maintaining the status quo. To aid in moving towards change, Lewin suggests trying to remove inhibitory forces rather than trying to increase forces causing change to occur.

In summary, behavioral strategies health care professionals should consider when educating women about osteoporosis prevention methods includes: a) making the threat of the disease seem as personal as possible, b) increasing women's awareness of their own susceptibility to the disease, c) using case histories versus generalized information for effective education on the effects of the disease, and d) showing women how their daily life can be enhanced by using hormone replacement therapy if they are experiencing hot flashes and disruption of daily life. In applying characteristics and the adult learning process to a prevention program, it is crucial that the adults feel they are in control of making recommended changes, have the program director act as a facilitator and resource for
clients, and have clients' attempts to be viewed as learning experiences regardless if the attempts result in success or failure.

Section five will apply information gained from Sections one through four and will be a description of a prevention program aimed at middle-aged women in a rural Montana community.
A RURAL-BASED EDUCATION PROGRAM
DESIGNED TO PREVENT OSTEOPOROSIS

This section provides a framework for an osteoporosis prevention program developed for a middle-aged female population based in a rural Montana community. This program is education based, geared for adult learners, and focuses on an internal locus of control. The purposes of this program are to increase women's awareness of osteoporosis and to educate them regarding development of disease and prevention options.

Target Population

The target population is the middle-aged, Caucasian, rural-living female. This population was chosen because white females are among the highest risk groups for developing this disease. Women of any race are certainly welcome to join this program, however, the vast majority of people in the community are Caucasian. Therefore, this group will be targeted the most. A rural community is used because many Montana rural women have a limited access to medical care, therefore, creating a particular need for health education.

Location of Program

Key factors to consider when selecting a facility for a health education program should include a central location, building accessibility, size of meeting room, and a comfortable environment. This health education program takes
place in Deer Lodge, Montana. The author of this paper is currently General Manager at the Mount Powell Fitness Center (MPFC), 1010 Carter Street, Deer Lodge. The aerobics room in the MPFC will be the site for the program to be held. It is a large room, allowing for many to participate, and since it is based in a health club, an exercise component to the program can easily be added. The building is accessible to anyone, since there are no stairs to climb to get into the building, nor are there any stairs to climb to get to the aerobics room. The parking lot is level, and is well-lit for an evening program.

Recruitment of Clients

In order to generate as much participation in a health education program as possible, the program director must take into consideration factors such as effective advertising mediums that will capture the target population's attention, advertising budgets, and adequate length of time for program promotion. These factors are interdependent upon one another in order to generate program interest.

One advertising medium in this program is in-house promotion via flyers. This can be accomplished by designing and printing flyers to post in the women's locker room, aerobics room, and weight room. Posting flyers in local restaurants, grocery stores, and the local library would be helpful, too. Information to include on the flyer would be
name of program, its' purpose, meeting time, location, duration and frequency of program, who should attend, program cost, and who they could talk to in order to obtain more information. These flyers should be posted approximately three weeks before program begins. In the author's past experience of promoting and developing programs, three weeks of advertising and promotion appears to be quite effective. Any amount of time longer than three weeks seemed too far in advance for people to actually commit to a program, and any amount of time shorter than three weeks seemed to not give enough notice to people.

Bulletin boards would contain same information as the flyers, however, the use of colored paper and pictures could make the program information more eye appealing and visible. The bulletin board located on the wall directly facing the aerobics room will be used. Bulletin boards in local churches and the local library, could also be utilized.

Staff promotion is a third way of utilizing in-house promotion. By informing staff members of this program, they could then present this information to the members when they are checking in, working out, or relaxing in the hot tub. Staff members will tell members about program content, time of day, length and frequency and program cost.

Another advertising medium would be to use the local radio stations. For this program, KOPR 94.1 FM in Butte, Montana would be an excellent station to use, since its'
listeners stay tuned to this station more than listeners of other stations, however, that is according to KOPR's own statistics. Its' coverage includes all of southwestern Montana—from Bozeman to Missoula, Helena to Dillon. The format is Adult Contemporary programmed for specific appeal to the 25-54 market. This would be an excellent advertising medium, however, cost is prohibitive. Therefore, this will not be a utilized advertising medium.

Another way to advertise the program would be to place classified advertisements in the "The Western Shopper", a weekly free newspaper that is circulated to the Deer Lodge, Garrison, Avon, Helmville, and Anaconda communities. Starting approximately three weeks before the program begins, MPFC would run a weekly advertisement with information regarding program content, who should attend, session time, length, and frequency, cost, and who to speak with in order to obtain more information. MPFC recently created a trade out with the Western Shopper. In exchange for fourteen memberships, the MPFC receives over $1000 in advertising in the "Western Shopper" to use between November 1, 1993 to May 1, 1994, therefore, this advertising will be "free".

Time of day

Factors to consider for program directors when scheduling health education programs include the lifestyle components of the target population, such as careers, child
rearing, the expected roles that must be filled by the target population, and available "free time" the target population has. The author conducted a survey in January, 1994, in an attempt to define member interest for wellness programming. Results indicated Monday and Wednesday evenings from 7:00-9:00 were most convenient for survey respondents to participate in a wellness program or event (Tyler, 1994). Many women in the Deer Lodge community work outside the home, and/or have small children, so it is believed a program would be best attended if it was held after 5:00 PM. Since this is a conservative, rural community, many households depend on and expect the woman to prepare the evening meal at a regularly scheduled time. Aerobics classes at MPFC are currently held 7:00-8:00 PM Monday through Thursday and 8:00-9:00 PM Tuesday and Thursday. Taking these factors into consideration, the program will be held Monday and Wednesday evenings from 8:00-9:00, as the club cannot afford to cut out the aerobics classes in order to implement a new program.

Number and length of sessions

Again, the target population's amount of available time to attend a health education program must be taken into consideration when planning number of program sessions, session length, and duration of the program. Boeckner et al. (1990) conducted a successful nutritional program that consisted of six sessions lasting two and one-half hours.
each. These authors believed the session format provided not only an informative setting, but a social opportunity for the clients as well. As stated before, many women work outside the home, and have limited amounts of spare time during the week. There could be two options: either shorter session length and more meeting times, or longer sessions with fewer meeting times. It is decided to opt for the former, with one-hour meeting times two times for two weeks. The program will consist of four one-hour sessions, meeting Monday and Wednesday from 8:00-9:00 P.M. This will not only give adequate time to discuss all facets of osteoporosis prevention, but also give clients an opportunity to socialize. Even though the women in this community lead busy lives, it seems people are very isolated and would welcome the chance to visit with other people.

Program Cost

One demographic factor that cannot be overlooked when developing a health education program is the amount of money the target population has available to spend on preventive health care. One of the manager's goals at MPFC is to limit program costs so that all interested participants could attend. In order to cover cost of materials and supplies, MPFC will charge $10 per person. MPFC also has photocopying privileges at the Western Shopper in exchange for the trade out, so it is believed $10 will be sufficient to cover any other materials needed and will also help generate revenue.
Program Facilitators

The main role of the facilitator is to "generate and encourage participation from everyone, make progress toward the desired objectives, handle emotional reactions from the class and guide the discussion but not push it beyond the participants' interests or acceptance" (Phillips, 1992, 4). Phillips added "The facilitator's role is not to monopolize the topic, interrupt participants, or judge participant's statements" (p. 4).

The people who will run this program include Darla Tyler, manager at Mount Powell Fitness Center, along with guest speakers Donna Woodward, PT, director of the Deer Lodge Valley Therapy Clinic, Chris Phipps, occupational therapist at Deer Lodge Valley Therapy, and Dr. Martin, a physician from Powell County Memorial Hospital, as the guest speaker for the hormone replacement therapy session. These other facilitators are included in the program because of the expertise in their respective areas. Instead of paying the guest speakers, MPFC will offer them a free one-month membership, a $35 value. If they are already members, we will credit their account $35.

Format

As discussed earlier, adult learners want to feel autonomous, and like to have established routines. These are factors for the program developer to bear in mind when
designing a health education program.

The class format for this program will be casual, with the folding chairs placed in a circle in the center of the room to encourage participation and to aid in group cohesion. The atmosphere will be open and friendly, inviting participants to voice their thoughts, concerns, and feelings towards the course content. By designing the format in this manner, hopefully the participants will feel comfortable knowing there will be a consistent pattern and will have the ability to take control regarding choices available for osteoporosis prevention.

Session One

The outline for Session One is found in Appendix A. The opening of this program will welcome all clients to the program. The main facilitator (Darla Tyler) will introduce herself and define her role as program facilitator. Her role will be to provide information and resources for clients, and to suggest to clients they have the power to positively alter their health and well-being. After the introduction, she will list and define goals of the program, which are to educate women about osteoporosis, provide them with information regarding preventive options, teach home safety, and provide additional resources. She will then have clients introduce themselves, in part to help her get acquainted with them and also to aid in developing group cohesion.
The facilitator will then administer a brief questionnaire (see Table 3, p. 68) to assess clients' current knowledge regarding osteoporosis, its pathology, treatment and preventive strategies, and home safety. After the questionnaire is completed and returned, the discussion on osteoporosis pathology will begin.

Using information obtained through Parts I through IV, the facilitator will define osteoporosis, briefly explain the pathology process, explain the different measurement techniques, present risk factors, and ask for questions over any of the material. The facilitator will also use case histories, since it is found that more personal, intimate knowledge of a health risk makes more of an impact than does generalized information. To increase the sense of personal vulnerability, the facilitator will hand out a worksheet which asks clients their own personal osteoporosis risk (see Table 4 page 69). Once the worksheet is completed, the facilitator will ask for questions and generate discussion, thereby nurture a feeling of self-control and self-confidence in the group by showing them they do have options for preventing this disease. As discussed in Part IV, characteristics of an adult learner are self-doubt and autonomy, and if the facilitator provides tools showing clients they can change health behaviors, the chances for clients to positively change their health habits will be greater. The facilitator will consistently reinforce the
concept that she is providing the clients with tools and information to prevent osteoporosis, but it is up to the individual to take control and make decisions regarding preventive and treatment strategies.

In the next fifteen minutes of the session, the facilitator will provide a brief overview of how exercise is beneficial in enhancing bone density. She will ask clients to bring two unopened soup cans or use our two-pound hand weights to all of the remaining sessions to practice resistance training movements. Presentation of differences between aerobic and anaerobic exercise will be held, focusing on the definitions of aerobic and anaerobic exercise and explain how an anaerobic activity, such as weight training, and an aerobic activity, such as walking are both beneficial to building bone mass. Input will be solicited as to what types of activity clients are already performing and encourage them to continue exercising, or encourage them to begin an activity program with their physician's approval.

The last five minutes of the session will be devoted to goal setting. The facilitator will remind clients they are the only ones who have the capability of making positive changes in their own lives, and one way to accomplish this is to set small, realistic, tangible goals that are aimed at making positive changes in their lifestyle. Although the program has not gone in-depth on nutrition or exercise, the
facilitator will encourage participants to immediately write down one goal they would like to accomplish in the next two days that will be beneficial to their physical and emotional health. Suggestions will include walking, not consuming more than two alcoholic drinks per day, snacking on healthful foods, etc.
Table 2

Osteoporosis Pre-Course Questionnaire

1. Your age ________ years

2. Smoking affects my risk for developing osteoporosis
   Agree | Disagree
   5     | 4     | 3 | 2 | 1

3. Alcohol consumption affects calcium levels in bone
   5     | 4     | 3 | 2 | 1

4. Lifting weights is beneficial for osteoporosis protection
   5     | 4     | 3 | 2 | 1

5. I believe I have the ability to prevent the development of osteoporosis
   5     | 4     | 3 | 2 | 1

6. A person's home or workplace environment affects the risk of breaking bones
   5     | 4     | 3 | 2 | 1

7. I believe estrogen therapy is beneficial in preventing bone fractures
   5     | 4     | 3 | 2 | 1

8. I am aware of my personal risk factors for developing this disease
   5     | 4     | 3 | 2 | 1

9. The recommended amount of calcium I should obtain everyday through either foods or a supplement is ______ mg.

10. A non-dairy source of calcium is _______________
Table 3

Are You at Risk for Developing Osteoporosis?

This worksheet will help you discover if you are predisposed to developing this disease. Check all that apply.

1. ___ Do you have a family history of osteoporosis?
2. ___ Are your ancestors from the British Isles, northern Europe, China or Japan?
3. ___ Are you very fair-skinned?
4. ___ Are you small-boned?
5. ___ Are you over 35?
6. ___ Are you allergic to milk or milk products?
7. ___ Have you had your ovaries removed?
8. ___ Do you smoke?
9. ___ Do you drink alcohol?
10. --- Do you avoid dairy products in your diet?
11. ___ Do you get very little exercise?
12. ___ Is your diet high in protein?

If you answered "yes" to any of these questions, you may be at risk and should begin a program to prevent or halt the progression of the disease.

Note: From "Osteoporosis—a disfiguring disease that can be prevented" 1988, The Aerobic News, 3, p.7.
Session Two

The outline for Session Two is Appendix B. Session Two begins by reviewing the exercise goal made and success rates from Session One. The facilitator will ask for questions and feedback from the group regarding what goal they set for themselves, if they made their goal, how they felt about this, and if they didn't make their goal, ask the group for help concerning why the individual didn't make it. The purpose for doing this exercise is to help stimulate the feeling of an internal locus of control in the clients, and to show them they can and do perform healthy things for their bodies. Moving on, the facilitator announces the focus of Session Two is on the connection between nutrition and osteoporosis.

Calcium's role in osteoporosis prevention will be discussed further in-depth than was done in Session One. The discussion will also focus on recommended daily calcium intakes for women of all ages, and also include discussion on calcium supplements. The facilitator will ask the group how they obtain they daily calcium intake. Darla will then distribute a worksheet listing different calcium sources (see Appendix C). After hearing people's answers, the facilitator and other group members can give praise and/or suggestions to individuals for increasing daily calcium intake.
The "Bone Up on Calcium Game" is played by having the group take an oral quiz regarding food choices. The facilitator asks the group what is the highest calcium food in a group of 3 foods. For example, a question could be, "Which has the most calcium—a banana, a cup of broccoli, or a potato?" The first person who answers each question correctly receives a Milk-Bone dog biscuit, which they can redeem as a free guest pass to the Front Desk. Approximately 10 questions will be asked.

Alcohol also negatively affects the calcium in the body, so the facilitator will generate discussion by asking clients if they believe alcohol consumption contributes to osteoporosis development. Although not a nutritional component, smoking certainly adversely affects bone density. Facilitator will address this topic by asking for opinions regarding correlation between smoking and osteoporosis.

The third part of the session focuses on performing resistance-training exercises (lifting weights). Clients will be instructed how to actually perform the movements safely: overhead deltoid press, bent-over supported row, lying dumbbell chest press, bicep curl, tricep press, upright row, wrist curl, leg extension, leg curl, and calf raise. Clients will utilize the mirrors in the aerobics room to insure proper form.

Wrap-up will include brief summary of Session Two and a brief introduction for Session Three. Participants are
instructed to set a different goal to be reached before the next session, perhaps perform the same resistance training exercises at home in front of a mirror, purposely including a calcium-rich food in their diet they normally don't eat, etc. Before participants leave, they are offered high-calcium foods as snacks, including broccoli, yogurt, low-fat cheese wedges, etc. This will be a good opportunity for socializing.

Session Three

Appendix D is an outline for this session. Session Three begins by reviewing contents from Session Two and soliciting questions clients may have over that material or any questions from Session One. This may be an excellent time for the facilitator to have all clients finish the phrase, "I helped my bones this past week by ______". Answers may include exercising, not consuming alcohol, decreasing alcohol consumption, etc. The facilitator can reinforce internal locus of control and give the clients an opportunity to share their successes and reinforce self-confidence in changing health behaviors. The focus of this session is on hormone replacement therapy, and this will be presented by guest speaker Dr. Martin, a physician from Powell County Memorial Hospital.

After the presentation, clients will have opportunity to ask questions, and the facilitator Darla Tyler will move onto the exercise session. Clients will have their soup
cans or hand weights with them and will proceed to go through resistance training exercises once again with the assistance and guidance of Darla.

After the resistance-training session, the facilitator will spend approximately 10 minutes informing clients of guidelines to follow, equipment needed, and stretches to perform for various aerobic activities. Clients will participate in stretches as well as discuss activities they enjoy and stretches they perform for those activities. This week's goal is directed specifically towards the role of exercise in osteoporosis prevention. After wrap-up of today's session, a brief overview of Session IV will be given.

Session Four

The outline for this session is included in Appendix E. Session Four begins by reviewing material from Session Three. Afterwards, the facilitator will ask the group how their past week was in terms of changing behaviors, any problems they encountered or successes they had experienced. This would be an excellent opportunity to congratulate members on taking time to attend these sessions and reinforce the idea they need to continue to make time for themselves in order to manage the stress they may be experiencing in their lives. Session Four deals with home safety. Many osteoporosis fractures occur in the home, and it would be prudent to educate clients on ways to make their
homes safer, as well as how move throughout the day in ways that will help them reduce fracture risk.

Chris Phipps, an occupational therapist, will spend approximately 15 minutes discussing ways to make a home safer. She will ask clients to mentally walk through their homes and observe the lighting in stairways, look at carpets or rugs that are not properly secured, check to see if their bathtubs have safety rails, or at least have other bathroom furniture available to use as rails, and ask them to think about the environment surrounding the outside of the homes, such as icy sidewalks, uneven terrain, etc. Chris will then show clients ways to make their homes safer by removing or alternating potential hazards. After this discussion, clients will have the opportunity to ask questions.

Donna Woodward, P.T., will spend approximately 15 minutes educating clients on ways to perform daily tasks in a manner that will help prevent fractures. She will demonstrate and have participants perform safe ways to lift grocery bags, move a piece of furniture, clean their houses, etc. She will accomplish this by bringing a couple pieces of light furniture, such as a kitchen chair, and a big cardboard box, and have clients actually lift them, and she will critique and give input regarding their technique and posture. She will then allow time for questions.

The facilitator, Darla Tyler, will then congratulate group for completing this session and reinforce the idea
they took the personal initiative to learn more about preventing osteoporosis. At this point, the group will be asked to spend a few moments in silence writing a congratulatory letter to themselves as a means of reinforcing self-efficacy. If they feel comfortable in doing so, members will be asked to share their letters with the group in order to have all members hear positive statements about this accomplishment and gain insight toward how other group members feel about completing the course. Darla will also commend group for educating themselves, asking questions, and taking steps to change daily behaviors. She will give participants a list of additional resources they can use to gather more information regarding osteoporosis prevention (see Appendix F). The facilitator will point out that even just taking the time to learn about changing health behaviors is a success in itself. Group members are asked to complete a post-course questionnaire (See Table 4, p.79) before they leave the final session. They will also be advised they will receive a follow-up phone call approximately six months from the last session and will be asked the same questions. Finally, the facilitator will thank group members for participating.
Table 4

Osteoporosis Post-Course Questionnaire

1. Your age _______ years

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<th>Agree</th>
<th>Disagree</th>
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<td>5</td>
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2. Smoking affects my risk for developing osteoporosis

3. Alcohol consumption affects calcium levels in bone

4. Lifting weights is beneficial for osteoporosis protection

5. I believe I have the ability to prevent the development of osteoporosis

<table>
<thead>
<tr>
<th>Agree</th>
<th>Disagree</th>
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<tr>
<td>5</td>
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<td>3</td>
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6. A person's home or workplace environment affects the risk of breaking bones

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<th>Agree</th>
<th>Disagree</th>
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<td>5</td>
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<td>3</td>
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7. I believe estrogen therapy is beneficial in preventing bone fractures

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<th>Agree</th>
<th>Disagree</th>
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8. I am aware of my personal risk factors for developing this disease

<table>
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<th>Agree</th>
<th>Disagree</th>
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9. The recommended amount of calcium I should obtain everyday is _____ mg.

10. A non-dairy source of calcium is ________________
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APPENDIX A

Session One
Introduction and Purpose of Program and
Osteoporosis Pathology
SESSION ONE
INTRODUCTION AND PURPOSE OF PROGRAM AND
OSTEOPOROSIS PATHOLOGY

I. Introduction- 10 minutes

A. Welcome

1. Facilitator introduction

2. State purpose of program
   a. Educate women about osteoporosis
   b. Inform women regarding preventive strategies
   c. Provide information regarding hormone replacement therapy
   d. Teach home safety strategies
   e. Provide resources for osteoporosis education

3. Have clients introduce themselves
   a. Will help facilitator get to know clients
   b. Instill sense of group cohesion

II. Administer and collect questionnaire-10 minutes

A. Purpose-assess client's knowledge about topics to be discussed

B. Collect questionnaire

III. Discuss pathology of osteoporosis- 20 minutes by Darla Tyler

A. Define osteoporosis

B. Discuss osteoporosis pathology
C. Explain how osteoporosis is diagnosed
D. List uncontrollable risk factors
E. List controllable risk factors
F. Distribute worksheet to complete
G. Ask for questions

IV. Exercise Session and Wrap-Up- 20 minutes
A. Overview of how exercise helps prevent osteoporosis
B. Instruct clients to bring two unopened soup cans (approximately one pound each) or they can use our two-pound hand weights for remaining sessions
C. Discuss differences between aerobic and anaerobic exercise and how both types can help prevent this disease
D. Solicit input from group as to what kinds of physical activity they enjoy—show them that they may already be doing something beneficial for their skeleton and may not even know it.

V. Goal Setting
A. Point out to participants they are the only ones capable of making positive changes in their lives, and one way to accomplish this is to make small, realistic, tangible goals.
B. Have clients set one physical activity goal to be accomplished in the next two days.
APPENDIX B

Session Two

Nutrition and Osteoporosis
SESSION TWO
NUTRITION AND OSTEOPOROSIS

I. Discussion of goal setting and success rate - 10 minutes

II. Nutritional factors that affect osteoporosis development - 30 minutes

A. Calcium intake and absorption
   1. Review from Session One how calcium plays role in osteoporosis development
   2. Discuss recommended calcium intake
   3. Show clients options for increasing calcium intake
      a. Dairy products
      b. Non-dairy foods
      c. Calcium supplements
   4. Ask clients where they currently obtain their calcium sources from - generate discussion and trade information - give out calcium source sheet
   5. "Bone Up on Calcium" Game

B. Alcohol consumption
   1. Educate clients as to how excessive alcohol consumption negatively affects calcium stores in the body
   2. Advise clients regarding alcohol consumption
   3. Cigarette Smoking
C. Although not a nutritional component itself, smoking is harmful for bone density and needs to be addressed

III. Exercise session- 20 minutes

A. Facilitator leads group through resistance training using the soup cans or weights to perform movements that work the major muscle groups in an effort to show clients exercises they can perform at home that will stimulate bone development

B. Facilitator travels around room showing clients proper form and technique, giving encouragement and praise

C. Wrap-up-high-calcium foods are offered as a treat
APPENDIX C

Sources of Calcium
Sources of Calcium

The most plentiful sources of calcium are dairy products, which, unfortunately, can also be high in fat. However, low-fat dairy products often contain slightly more calcium are also available. This chart compares the calcium content of selected foods with their percentage of calories from fat.

<table>
<thead>
<tr>
<th>DAIRY PRODUCTS</th>
<th>Serving Size</th>
<th>Calcium (Mg)</th>
<th>Fat Calories</th>
</tr>
</thead>
<tbody>
<tr>
<td>Milk, Skim</td>
<td>1 cup</td>
<td>316</td>
<td>5%</td>
</tr>
<tr>
<td>Milk, 1%</td>
<td>1 cup</td>
<td>313</td>
<td>26%</td>
</tr>
<tr>
<td>Milk, 2%</td>
<td>1 cup</td>
<td>313</td>
<td>36%</td>
</tr>
<tr>
<td>Milk, whole</td>
<td>1 cup</td>
<td>291</td>
<td>48%</td>
</tr>
<tr>
<td>Yogurt, plain low-fat</td>
<td>1 cup</td>
<td>415</td>
<td>25%</td>
</tr>
<tr>
<td>Yogurt, plain non-fat</td>
<td>1 cup</td>
<td>452</td>
<td>3%</td>
</tr>
<tr>
<td>Yogurt, fruit low-fat</td>
<td>1 cup</td>
<td>314-383</td>
<td>18%</td>
</tr>
<tr>
<td>Blue Cheese</td>
<td>1 oz.</td>
<td>150</td>
<td>72%</td>
</tr>
<tr>
<td>Brie Cheese</td>
<td>1 oz</td>
<td>52</td>
<td>70%</td>
</tr>
<tr>
<td>Cheddar</td>
<td>1 oz</td>
<td>204</td>
<td>74%</td>
</tr>
<tr>
<td>Feta</td>
<td>1 oz</td>
<td>140</td>
<td>72%</td>
</tr>
<tr>
<td>Mozzarella, part skim</td>
<td>1 oz</td>
<td>207</td>
<td>56%</td>
</tr>
<tr>
<td>Provolone</td>
<td>1 oz</td>
<td>214</td>
<td>72%</td>
</tr>
<tr>
<td>Ricotta, part skim</td>
<td>1/4 cup</td>
<td>167</td>
<td>53%</td>
</tr>
<tr>
<td>Swiss</td>
<td>1 oz</td>
<td>272</td>
<td>72%</td>
</tr>
<tr>
<td>American</td>
<td>1 oz</td>
<td>174</td>
<td>74%</td>
</tr>
</tbody>
</table>
### VEGETABLES

<table>
<thead>
<tr>
<th>Vegetable</th>
<th>Serving Size</th>
<th>Calories</th>
<th>% Calories</th>
</tr>
</thead>
<tbody>
<tr>
<td>Beet greens, cooked</td>
<td>1 cup</td>
<td>164</td>
<td>0%</td>
</tr>
<tr>
<td>Broccoli, cooked</td>
<td>1 cup</td>
<td>178</td>
<td>0%</td>
</tr>
<tr>
<td>Swiss chard, cooked</td>
<td>1 cup</td>
<td>102</td>
<td>0%</td>
</tr>
<tr>
<td>Collards, cooked</td>
<td>1 cup</td>
<td>148</td>
<td>0%</td>
</tr>
<tr>
<td>Dandelion greens, cooked</td>
<td>1 cup</td>
<td>147</td>
<td>26%</td>
</tr>
<tr>
<td>Kale, cooked</td>
<td>1 cup</td>
<td>94</td>
<td>22%</td>
</tr>
<tr>
<td>Mustard greens, cooked</td>
<td>1 cup</td>
<td>103</td>
<td>0%</td>
</tr>
<tr>
<td>Turnip greens, cooked</td>
<td>1 cup</td>
<td>249</td>
<td>0%</td>
</tr>
<tr>
<td>Spinach, cooked</td>
<td>1 cup</td>
<td>244</td>
<td>0%</td>
</tr>
</tbody>
</table>

### CANNED FISH

<table>
<thead>
<tr>
<th>Fish</th>
<th>Serving Size</th>
<th>Calories</th>
<th>% Calories</th>
</tr>
</thead>
<tbody>
<tr>
<td>Salmon, canned, sockeye, with bones</td>
<td>3 1/2 oz</td>
<td>237</td>
<td>38%</td>
</tr>
<tr>
<td>Sardines, canned in water, with bones</td>
<td>3 1/2 oz</td>
<td>240</td>
<td>72%</td>
</tr>
</tbody>
</table>

Source: The University of Montana Student Health Service, Missoula, Montana
APPENDIX D
Session Three
Hormone Replacement Therapy
SESSION THREE
HORMONE REPLACEMENT THERAPY

I. Review material from Session Two- 10 minutes
   A. Discuss goals made and success rates
   B. "I helped out my bones by ____"

II. Introduce the guest speaker, Dr. Martin, a physician from Powell County Memorial Hospital, who will spend 30 minutes discussing risks and benefits regarding hormone replacement and calcitonin therapy.
   Allow time for question and answer period

III. Exercise Session- 20 minutes
   A. Facilitator leads clients through resistance training exercises for 10 minutes in order to stimulate bone development, show clients proper technique and form, and provide opportunity for clients to engage in guided physical activity
   B. Facilitator spends 10 minutes informing clients of aerobic activities that will stimulate bone mass, as well as inform clients of equipment needed, stretches to perform, and guidelines to follow for the following activities (by writing on paper over

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mirrors):

1. Walking
2. Aerobic dance
3. Step aerobics
4. Bicycling
5. Swimming
6. Jogging/running
7. Gardening
8. Ballroom/country dancing

C. Wrap up
APPENDIX E

SESSION FOUR

HOME SAFETY, WRAP UP
SESSION FOUR

Home Safety and Wrap Up

I. Review from Session Three-10 minutes

A. Review-analyze goal

B. "How was everyone's week?"

II. Home Safety-40 minutes

A. Introduce Chris Phipps, Occupational Therapist at Deer Lodge Valley Therapy Clinic

B. Chris will advise clients on how to make their homes safer-20 minutes

C. Introduce Donna Woodward, Physical Therapist at Deer Lodge Valley Therapy Clinic

D. Donna will show clients how to perform proper technique in performing everyday tasks, such as lifting grocery bags, moving furniture, etc.- 20 minutes-will have participants mimic movements.

III. Allow for final questions over program content

IV. Wrap up
APPENDIX F

Resource List
RESOURCE LIST

National Dairy Council
Rosemont, IL 60018-4233

Cheryl Bell, R.D., M.S.
Corporate Nutritionist
Safeway Inc.
Oakland, CA 94660

The Osteoporosis Foundation
Suite 510
612 Michigan Avenue
Chicago, IL 60011

The American College of Obstetricians and Gynecologists
Suite 300 East
600 Maryland Ave., S.W.
Washington, D.C. 20024

American Association for Retired Persons (AARP)
1909 "K" St., S.W.
Washington, D.C. 20049

Gibbons, John H. (19 )."The Menopause, Hormone Therapy, and Women's Health" Background paper produced by the Office of Technology Assessment

*your local library

*your hospital or health clinic