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Identifying Risk Factors for Osteoporosis in Young Women

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ABSTRACT

Purpose: Osteoporosis is a major public health concern that affects millions of women around the world. Although the diagnosis of osteoporosis greatly impacts the life of the patient, the health care cost associated with the sequelae of the disease process is exponentially greater. Commonly recognized as a disease of the old, osteoporosis is generally discovered in older age, but it is the result of many factors—both modifiable and non-modifiable—that impact bone strength beginning in childhood. This article discusses how the choices that a woman makes in her younger years can greatly impact her risk of developing osteoporosis. **Methods:** To collect and analyze information regarding risk factors for osteoporosis in young women, an extensive literature review was conducted. MEDLINE and various educational sites including DynaMed, National Osteoporosis Foundation, and *American Journal of Obstetrics and Gynecology* were searched. Many articles were found from 1998 and newer. **Results:** It can be seen that the pathogenesis of osteoporosis culminates in the later years of a woman's life, but it is the actions throughout the lifetime that lead to the development of osteoporosis. Therefore, it is imperative that health care providers, especially physician assistants and nurse practitioners, understand the factors that put patients at risk, recognize when those factors are present, and provide ways in which one can decrease or completely prevent the disease in young patients. **Conclusion:** Although the focus of osteoporosis has always been treatment in older women, it is necessary now to shift the focus of osteoporosis to prevention in younger women. By educating patients about the risk factors that are present and gaining awareness that development begins during childhood, providers and patients can work together towards prevention. The mnemonic "Use L.O.G.I.C. against risk factors for a L.I.F.E. of prevention!" was created as an easy way for mid-level providers to educate patients today, to recognize potential risk in a younger woman, and to work to completely prevent the development of the disease. The goal is to eradicate osteoporosis and to make this preventable disease a disease of the past.

INTRODUCTION

Osteoporosis has been defined as "a skeletal disorder characterized by compromised bone strength predisposing to increased risk of fractures of the hip, spine, and other skeletal sites."¹ The mechanism of osteoporosis is such that the delicate balance of bone formation and bone reabsorption is disrupted, which results in long-term and uninterrupted bone loss.¹ Although osteoporosis is frequently regarded as a secondary health condition that is most commonly seen in postmenopausal women, it affects more than 200 million women worldwide, with the greatest proportion of people coming from North America and Europe. There are over 10 million people afflicted by osteoporosis in the United States alone, and that number will continue to rise as the population ages.¹

Why should patients care? Even more startling than the number of people affected by osteoporosis is the amount of money spent annually to treat not only the disease state of osteoporosis, but also the resultant sequelae. With costs to the United States health care system reporting over \$17 billion annually for the treatment of over 1.5 million osteoporotic fractures, the total costs of the treatment of osteoporosis is found to be a "greater burden than the projected costs of stroke, breast cancer, diabetes, or chronic lung disease."¹ With that, the Surgeon General reports that "due to the aging population, the estimated number of hip

fractures and their associated costs could double or triple by the year 2040.² Even though the costs of osteoporosis are staggering, the unfortunate truth is that osteoporosis is a preventable disease. But it is still considered a “silent epidemic” that is rarely diagnosed until a patient is beyond the age of prevention or has undergone testing after sustaining a bone fracture.³

This article will define peak bone mass and discuss both preventable and inherited risk factors for osteoporosis, especially those which most commonly affect young women. It will also offer insight to the physician assistant and to the nurse practitioner about some basic steps that they can take when educating patients on how to prevent the development of osteoporosis. Finally, this article will provide some easy tools that the physician assistant and nurse practitioner can use to educate patients about recognizing whether or not they are at risk.

DISCUSSION

A common fallacy about osteoporosis is that it is thought to be only a disease of the old. The reality of this disease process is such that all the internal and external forces of a patient's life from when they are an adolescent and a young adult will directly contribute to his/her potential to develop osteoporosis as an adult. The National Institute of Health has found that “from birth through young adulthood, children steadily accumulate bone mass, which peaks sometime before age 30. The greater their peak bone mass, the lower their risk of osteoporosis later in life.”⁴ Peak bone mass is “the amount of bone tissue in the skeleton, which has reached its maximum strength and density.”⁴ Peak bone mass is important to the process of osteoporosis because it is seen as a “landmark determinant of subsequent bone health, which is affected by genetic, nutritional, mechanical, and hormonal factors.”^{3,6}

To better understand peak bone mass, an analogy can be used: a bank. A woman's bones are her “bank,” and the more “deposits” (good preventative decisions) that she makes until age 30 accumulate to form her “life savings” (peak bone mass). If the patient makes deposits, she is building strength in her bones. After age 30, no more deposits are accepted, and only “withdrawals” (deleterious decisions) are allowed to be made from the bank. If the patient makes deposits, she is building strength in her bones. The ultimate result is that if the amount in the bank before age 30 is high, then the impact of withdrawals allows for the risk of development of osteoporosis to remain low. Conversely, if only a few deposits are made before age 30, the risk of osteoporosis is high. Unfortunately, if the bank goes “bankrupt,” the risk of an osteoporotic fracture is extremely high.

Therefore, paying close attention to peak bone mass in younger women could greatly impact the potential for risk. The National Institute of Health suggests that “genetic factors may account for up to 75 percent of bone mass, and environmental factors account for the remaining 25 percent.”⁴ With that being said, it is important to understand what is considered a risk factor and who is potentially at a higher risk.

Risk Factors

The National Osteoporosis Foundation defines risk factors as “factors that increase the likelihood of developing osteoporosis and broken bones.”⁵ The risk factors for developing osteoporosis can be divided into five main categories: genetics, medications, chronic conditions, lifestyle, and other.

As previously mentioned, genetic or constitutional factors can contribute up to 75 percent of peak bone mass by age 30. The most compelling factors are a family history of osteoporosis or fractures. Although risk of fracture is not directly inherited, a family history of fractures secondary to osteoporosis leads to belief that osteoporosis is present in the family and that a significant risk is present for the development of future generations—especially those with other risk factors present.⁷ Accordingly, it can be seen that “women with a maternal history of hip fractures are approximately twice as likely to experience hip fractures as women without such a family history.”¹ Other factors include gender—women have higher fracture rates than men, race—Caucasian and Asian populations are at higher risk than African American and Hispanic populations, body size—women with smaller builds or physical frailty, late menarche, or premature menopause occurring before age 45 are at higher risk. All these factors can predispose a patient to have decreased bone mass, and subsequently, to increase their risk for osteoporosis. If those levels are found to be low, peak bone mass is associated with increased risk of osteoporotic fractures.¹

Medications can commonly lead to an increased risk of the development of secondary osteoporosis. Such medications directly cause bone loss or prevent calcium absorption, which results in decreased bone mass and the subsequent pathology of osteoporosis to take effect. Although there is no direct evidence that correlates medication-use and the development of osteoporosis, there have been reports that numerous drugs do in fact contribute to decreased bone mass.²

What are the drugs that can induce osteoporosis? Some of the more common medications include glucocorticoids (corticosteroids), immunosuppressants (chemotherapy drugs), progesterone, Lithium, heparin, and anticonvulsants (specifically

phenobarbital and phenytoin).^{2,8} Of all the drugs that were studied, the most attention has been directed towards corticosteroids. An evidence-based review conducted by Juliette Allport found that “oral corticosteroids used in a number of different chronic diseases contribute to an increased prevalence of osteoporosis and an increased incidence of fracture.”⁹ The exact impact of all medications, especially corticosteroids, is not completely understood. Therefore, use of certain medications in a patient who is already genetically high risk for osteoporosis should create a heightened sense of awareness for patients to protect themselves from the environmental factors that they can control.⁹

Chronic conditions requiring the extended use of medications facilitate the development of secondary osteoporosis. Sometimes it is the use of medications for the treatment of these conditions that can lead to a further decrease in bone mass. A list of disorders can be found in Appendix A, but the most common disease states that have the greatest impact on young women include gastrointestinal diseases (Celiac disease, malabsorption, Irritable Bowel Disease, Premature Ovarian Failure), endocrine diseases (Diabetes Mellitus, Hyperparathyroidism, Thyrotoxicosis), genetic diseases (Cystic Fibrosis), and other diseases (Anorexia nervosa, depression, Multiple Sclerosis, Idiopathic Scoliosis). Although the presence of any of these diseases should alert a health care provider to investigate further the potential of osteoporosis, there is no direct correlation to decreases in bone density. Accordingly, if a patient has multiple risk factors and one of the chronic diseases previously stated, it can be assumed that an additive effect of risk is present.¹⁰

The three areas of risk factors discussed thus far—genetics, medications, and chronic conditions—fall into the inherited or uncontrollable risk factors that may affect young women. These factors generate the greatest amount of risk, and these patients should be conscientious of the need to prevent osteoporosis. The next two types of risk factors to be discussed comprise the environmental factors that make up 25 percent of risk factors that affect bone mass.⁴

Environmental risk factors are such that the patient controls them. They can be broken down into two categories: lifestyle and other. The risk factors attributed to lifestyle or behavior that are associated with increased risk of bone loss include smoking, which is associated with “accelerated bone loss and increased risk of hip fracture in the elderly,”¹¹ excessive alcohol intake (> 3 drinks per day), and high caffeine intake (>330mg per day). Decreased physical activity affects bone mass, too. The National Institute of Health has found that “girls and boys and young adults who exercise regularly generally achieve greater peak bone mass than those who do not.”¹¹ Accordingly, it has been found that “the lack of certain health behaviors (e.g., adequate calcium intake and appropriate physical activity) during adolescence and early adulthood can put one at greater risk for this disorder in later years.”¹² So, not only does regular exercise protect against osteoporosis, but without it, people at any age are subject to an increased risk of decreased bone mass.

The categories of other factors that increase the risk of osteoporosis include low body mass and nulliparity (having no children). Low body mass or thinness has been associated with osteoporosis due to the fact that decreased body weight, especial Body Mass Index of less than 19, suggests increased risk of having a decreased bone mass.²

Nutritional factors that are a part of a young woman’s lifestyle and have an influence on the development of osteoporosis include low calcium intake, vitamin D deficiency, and high salt intake. The National Institute of Health has found that “calcium is an essential nutrient for bone health. Deficiencies in young people can account for 5 to 10 percent difference in peak bone mass and can increase the risk for hip fracture later in life.”⁵ Calcium is important because it is “one of the main bone-forming minerals, and appropriate supply to bone is essential at all stages of life.” With that, multiple studies have been conducted and a direct correlation has been found between calcium intake and increased bone mineral density.¹³ In 2002, a cohort study was conducted in young Norwegian women that assessed the effects of environmental and lifestyle factors on forearm bone mineral density. The results of the study found that lack of milk consumption had a statistically significant association with decreased bone mineral density. Although other factors were assessed, none were found to be as statistically significant as calcium intake.¹⁴ Because calcium has such positive effects on bone health, it is unfortunate that “fewer than 10 percent of girls age 9 to 17 actually get the calcium they need each day.”⁵

Although calcium is essential to bone health, it must appear in conjunction with other nutrients, specifically vitamin D, to be beneficial. Vitamin D is obtained via a person’s diet or by conversion in sunlight. It is important to bone health because adequate levels are needed to work with calcium to maintain high bone density. It is important to also recognize that although a patient may be compliant with the daily intake amount of calcium, if a patient is deficient in vitamin D, they may not be getting any of the benefits. This is because vitamin D helps the body to absorb calcium, and without adequate amounts, a patient is at greater risk for bone loss and osteoporosis.⁵ Other elements, including phosphorus and magnesium, have been shown to be necessary for good bone health. Be this as it may, the fact remains that without calcium and vitamin D, the ability to maintain good bone health and strength is very hard to accomplish.¹³

In an attempt to fight against osteoporosis, educating the public—especially young girls and women—about potential risk factors that are either genetically-determined or modifiable allows adolescent and young women to take control of the fate of their bones, potentially preventing “the debilitating consequences associated with osteoporosis as one approaches elderly years.”¹²

Prevention

Prevention is the key to the eradication of osteoporosis. To fight low bone mineral densities which lead to osteoporosis, steps for prevention must start during childhood and continue throughout a person's lifetime. In the *Clinician's Guide to Prevention and Treatment of Osteoporosis*, the National Osteoporosis Foundation states what requirements are needed to prevent the onset of osteoporosis. These preventative requirements encompass daily lifestyle modifications including adequate intake of calcium and vitamin D, regular weight-bearing exercise, avoidance of tobacco and excess alcohol, and treatment of other inherited risk factors present.²

Adequate intake of calcium and vitamin D daily are essential because they not only are inexpensive ways to reduce fracture risk, but they are necessary to achieve high peak bone mass and maintain good bone health throughout life. It has been determined that “the skeleton contains 99 percent of the body's calcium stores; when the exogenous supply is inadequate, bone tissue is reabsorbed from the skeleton to maintain serum calcium at a constant level.”² Increasing amounts of calcium should first be achieved through dietary sources like dairy products and vegetables, but when these sources do not prove to be sufficient, calcium supplements should be utilized.² For best prevention of osteoporosis, the recommended daily intake of calcium is a minimum of 1000 milligrams daily.

Vitamin D has been shown to not only play major roles in decreasing fractures, maintaining bone health, and helping with the absorption of calcium in the body, but it is also necessary for muscle performance and balance. Adequate daily amounts of vitamin D for younger women (ages 19 to 50) have been found to be 200 International Units (IU). Sources of vitamin D include cereals, egg yolks, salt-water fish, liver, and vitamin D fortified milk.² As it has previously been discussed, inadequate amounts of vitamin D can lead to deficiencies, which can greatly impact bone health. Many chronic conditions can lead to vitamin D deficiencies, including malabsorptive gastrointestinal disorders, chronic renal insufficiency, housebound patients, and patients with limited exposure to light. Therefore, it is necessary to be extra vigilant when trying to obtain adequate amounts of all daily nutrients.

Weight-bearing exercises, which have been defined by the National Osteoporosis Foundation as “exercises in which bones and muscles work against gravity as the feet and legs bear the body's weight, include walking, jogging, Tai-Chi, stair climbing, dancing, and tennis.”² Clinical data has shown that exercise during adolescence may not only increase bone density in early years of life, but also prevent fractures during old age. A meta-analysis of random controlled trials conducted in 2010 found statistically significant evidence that regular weight-bearing exercises can result in increased bone strength by up to eight percent at loaded skeletal sites (femur, tibia, and humerus) in children and adolescents.¹⁵ Accordingly, similar results were found in premenopausal women with improvement in skeletal strength by up to two-and-a-half percent with regular weight-bearing exercise.¹⁵ It can be seen that regular exercise is not only associated with an increase in bone mass in premenopausal women, but it also improves agility, strength, posture, and balance.¹⁶

Avoidance of tobacco and excess alcohol intake are also essential for prevention of the development of osteoporosis. This is because tobacco not only is detrimental to bone health, but it affects overall health negatively. As previously stated in this article, smoking is seen as a risk factor for the development of osteoporosis; therefore, by avoiding the smoking of tobacco, patients can improve their overall state of health. Alcohol, although seen to have protective effects for bone health in moderate quantities, is detrimental to bone health when in excess (>3 drinks per day) because of increased risk of falls.²

Ways to Recognize Potential Risk

Many potential risk factors and preventative measures have been discussed in this article. An easy way to remember the major categories of risk and prevention is by the use of this phrase: “Use L.O.G.I.C. against risk factors for a L.I.F.E. of prevention!” L.O.G.I.C. stands for all the risk factors that can affect young women: **L**ifestyle, **O**ther (factors), **G**enetics, **I**ntake (of medications), and **C**hronic conditions. L.I.F.E. stands for all the ways in which young women can prevent the development of osteoporosis: **L**ifestyle, (avoid excess) **I**ntake of alcohol and tobacco, **F**oods (to eat), **E**xercise (regularly). A full description of both mnemonics can be found in Appendix B.

By understanding the mechanisms of osteoporosis and the variables that can impact its development, today's health care can progress away from just treating osteoporosis and work towards successfully preventing it. But prevention does not stop with the education of young patients. Health care providers must work with adolescent and young adults to implement good, healthy

practices into their daily lives. This is because although much information is available about osteoporotic risk factors, following through with good life decisions is where young patients are falling short. In a 2005 study, a questionnaire to assess beliefs and knowledge about osteoporosis risk factors was completed by 227 adolescent (ages 12-16) girls in a small Canadian town. The results of the study found that although the majority of the girls recognized the risk factors for osteoporosis, many of them still participated in negative lifestyle behaviors. This was attributed to the lack of both understanding and a deeper education and implementation on the part of the girls.¹⁷ It is therefore imperative that health professionals facilitate the choosing of these healthier life practices by working towards a better understanding of osteoporosis prevention and its subsequent eradication in the next generation of young women.

CONCLUSION

Osteoporosis is a common medical condition that results in major physical and economic burdens for millions of women around the world. A significant cause of concern is not the millions already diagnosed with osteoporosis, but the potential that an overwhelming influx of patients affected by the disease will grow exponentially within the next thirty years. As health care changes, the costs attributed to this preventable disease will steadily continue to rise and potentially overwhelm the profession as a whole.

This article reviewed the most pivotal factor in bone health—peak bone mass. It is important to understand the effect of environmental and genetic factors on bone mass and how decreases in it have been shown to result in a greater risk of the development of osteoporosis. With that, it has been determined that the majority of a woman's potential risk is obtained genetically and is, therefore, beyond her control. That is why it is even more imperative for physician assistants and nurse practitioners to educate women—especially those under age 30 who are still building their peak bone mass and adding to their bone “bank.” Presenting the facts to young women that would allow them to understand the impact that they can make in preventing a potentially debilitating disease should not only be recognized but promoted and celebrated regularly in today's health care profession.

Accordingly, this article focused on identifying the major risk factors that can affect women of any age, but especially those factors that can impact younger women while they are still building bone. As previously mentioned, genetics greatly influence the potential for osteoporosis, but the environmental factors like the lifestyles and behaviors that a young woman chooses is just as important to recognize when educating patients. Therefore, understanding the steps for prevention is just as important in decreasing the risk of osteoporosis development as in avoiding its potential risk factors.

A major change is needed in today's health care for women. Changing the focus of health care from osteoporosis treatment to a mentality of prevention is necessary to take strides to eradicate this preventable disease. Although much research has not focused on the presence of osteoporosis in younger women, there is an obvious need to understand the pathogenesis of osteoporosis and how recognizing the development of this disease does not begin when a woman is older, but during her younger years. The majority of the research found in this article advocated further long-term research to better assess bone strength throughout the lifetime. In the interim, health care providers can use the mnemonic “Use L.O.G.I.C. against risk factors for a L.I.F.E. of prevention!” as a starting point for educating younger patients about their potential risk for developing this life-altering disease. With a good foundation of education and counseling, the near future will bring hope that osteoporosis will not be seen by women of all ages as a disease to fear, but as a disease that can be prevented throughout a lifetime.

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APPENDIX A**Medical Disorders that can Increase Development of Osteoporosis**

Celiac disease Malabsorption Irritable Bowel Disease Premature Ovarian Failure Primary Hypogonadism Prolactinoma Rheumatoid Arthritis Lupus	Diabetes Mellitus Hyperparathyroidism Thyrotoxicosis Chronic Obstructive Pulmonary Disease (COPD) Neurologic disorders Hypercortisolism Osteogenesis imperfect	Anorexia nervosa Depression Multiple Sclerosis Idiopathic Scoliosis Post-transplantation Alcoholism Cystic Fibrosis Chronic Renal Failure
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Source: Kanis JA, McCloskey EV. Risk factors in osteoporosis. *Maturitas: The European Menopause Journal* [Internet]. 1998 Feb 16;30(3):229-33. [http://www.maturitas.org/article/S0378-5122\(98\)00090-5/abstract](http://www.maturitas.org/article/S0378-5122(98)00090-5/abstract). Accessed July 21, 2011.

APPENDIX B
“Use L.O.G.I.C. Against Risk Factors for a L.I.F.E. of Prevention”

L.O.G.I.C.	L.I.F.E.
<u>Lifestyle</u> : low calcium intake, Vitamin D deficiency, high caffeine intake, inadequate physical activity, high salt intake, smoking, alcohol (>3 drinks/day)	<u>Lifestyle</u> : Live a healthy life
<u>Other</u> : age, low BMI, thinness, late age of menarche	<u>Intake</u> : Avoid tobacco and excess alcohol
<u>Genetic conditions</u> : Parental history of osteoporosis or hip fracture, gender	<u>Foods to eat</u> : adequate amounts of calcium and Vitamin D daily
<u>Intake of Medications</u> : corticosteroids, anticonvulsants, progesterone, chemotherapy medications, anticoagulants, Lithium	<u>Exercise</u> : regularly engage in weight-bearing exercises
<u>Chronic Conditions</u> : Anorexia nervosa, Premature Ovarian Failure, Diabetes Mellitus, Hyperparathyroidism, Celiac Disease, IBS, malabsorption, Sickle Cell Disease, Alcoholism, Multiple Sclerosis, Scoliosis, Epilepsy, Cystic Fibrosis	