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Osteoporosis: a Social Problem in the Elderly Population

ABSTRACT

RESEARCH OBJECTIVE: The aim of this review is to present a broader scope on osteoporosis – both as a medical problem and as a major social burden.

THE RESEARCH PROBLEM AND METHODS: Osteoporosis is a systemic skeletal disease, characterized by low bone mass, leading to increased bone fragility and fractures. It does not only lead to major medical expenses, lower health-related quality-of-life but also strains the population with significant social burden. As modern science is intensively exploring the problem of osteoporosis, new research articles expanding our knowledge on this disease come out weekly. This growing body of research calls for an up-to-date review of the existing state of knowledge on osteoporosis.

THE PROCESS OF ARGUMENTATION: This manuscript presents and overview on osteoporosis and associated problems such as fractures in the following order (1) Etiology and pathogenesis of osteoporosis, (2) Osteoporosis risk factors, (3) Epidemiology of osteoporosis, (4) Aging of the Polish population, (5) Clinical consequences of osteoporosis, (6) Criteria of the World Health Organization (WHO) for Caucasian women after menopause, (7) Morbidity and mortality associated with osteoporotic fractures, (8) Risk factors related to the collapse of the condition of osteoporotic patients, (9) Bone fragility and falls, (10) Recognizing osteoporosis, (11) Prevention and treatment of osteoporosis, (12) Cost of treating fractures, (13) Fracture liaison service, (14) Senior care, (15) Purpose of modern geriatrics, (16) Social inequalities and osteoporosis.

RESEARCH RESULTS: The two major determinants of risk in the development of osteoporosis are peak bone mass and rate of bone loss. These two determinants are influenced by a number of genetic (non-modifiable) and environmental (partly modifiable, and modifiable) factors. Osteoporosis is becoming increasingly prevalent with the aging of the world population. Worldwide, more than 200 million people are suffering from osteoporosis, and 1 in 2 women and 1 in 4 men over 50 will have an osteoporosis-related fracture in their lifetime. About 5% of falls result in fractures, half of which are proximal femur fractures. Out of all falls leading to fractures, 10-25% result in injury or requirement of specialized medical

care. Falls are one of the main causes of disability and the fifth most common cause of death in people over 75 years of age.

CONCLUSIONS, INNOVATIONS AND RECOMMENDATIONS: This review provides a concise overview om osteoporosis as a linked medical and social problem. It also identified a number of knowledge gaps necessary to fill in order to progress our knowledge on osteoporosis diagnosis, prevention and treatment. Understanding patients' preferences and needs will allow to align them with appropriate service models which are likely to optimize patient outcomes.

→ **KEYWORDS:** OSTEOPOROSIS, ELDERLY, FRACTURES, SOCIAL INEQUALITIES

Osteoporosis comes from the latin words "osteon" and "porus" meaning porous bone. According to the National Osteoporosis Foundation (2001): "Osteoporosis is a disease of the skeleton, characterized by impaired bone strength, resulting in an increased risk of fracture." The World Health Organization (WHO) (1993) defines it as: "Osteoporosis is a systemic skeletal disease, characterized by low bone mass, leading to increased bone fragility and fractures." It can be a systemic disease, as emphasized by the definition from the WHO, or it can be confined to a localized area, with little systemic involvement.

Etiology and Pathogenesis

Bone strength reflects the integration of two main features: bone density and bone (NIH Consensus, 2001). There are many factors contributing to the risk of osteoporotic fractures, all of which should be taken into account in the assessment of fracture risk in patients. Risk factors such as aging, menopause and other risk factors as described below, leads to increased bone loss. Together with low peak bone mass, this leads to low bone density, which in turn leads to an increased risk of fractures due to poor bone quality and a propensity to fall.

Osteoporosis can be described by two models, the primary model, or a secondary model. According to the primary model, osteoporosis can be either idiopathic, or divided into two types, Involution Type I (postmenopausal) or Involution Type II (senile).

Type I, or postmenopausal osteoporosis, occurs in 5% to 20% of women, affecting this population within 15 to 20 years of menopause,

with a peak incidence in the 60s and early 70s (Daniel, 1996). The incidence in women is eight times higher than in men, with the frequency of postmenopausal osteoporosis accounting for the overall female-male ratio of 2:1 to 3:1 (Charles, 1997). Because of the drop in estrogen production following menopause, women lose nearly 50% of their trabecular bone and 35% of their cortical bone throughout their lifetime, whereas men lose only 25% of both types of bone (Iqbal, 2017). Therefore, at least 65% of the bone loss that occurs in women during the first two decades after menopause can be attributed to lack of estrogen, rather than to aging.

Senile (Type II) osteoporosis occurs in women or men over 70 years of age and is usually associated with decreased bone formation along with a decreased ability of the kidney to produce 1,25-dihydroxyvitamin D3. The vitamin D deficiency results in decreased calcium absorption, which increases the parathyroid hormone level and therefore bone resorption. Type 2 osteoporosis primarily leads to an increased risk of hip, long bone, and vertebral fractures.

Secondary (sometimes referred to as Type III) osteoporosis results from the presence of diseases, conditions, or medicines that predispose to bone loss, and is associated with individual genetics. It occurs equally in men and women and at any age. In men, most cases are due to disease or to drug therapy, but in 30% to 45% of affected individuals, no clear cause can be identified (Anderson, 2017). This type of osteoporosis is associated with a variety of conditions, including hormonal imbalances, cancer, gastrointestinal disorders, drug use, chronic renal failure, hyperthyroidism, hypogonadism in men, immobilization, osteogenesis imperfecta, inflammatory arthritis and poor nutrition (Praet et al., 1992; Alderman & Hill, 1994; Feber, Cochat, & Braillon, 2017). Secondary osteoporosis accounts for about 40% of the total number of osteoporotic fractures seen by a physician (Gallagher, 1999).

Risk Factors

The two major determinants of risk in the development of osteoporosis are peak bone mass and rate of bone loss. These two determinants are influenced by a number of genetic (non-modifiable) and environmental (partly modifiable, and modifiable) factors. It is estimated that roughly 70% of cases of osteoporosis are probably a result of genetic predisposition, with the remaining 30% of cases triggered by environmental influences (Iqbal, 2000).

Ethnicity, age, and gender are all important non-modifiable risk factors for decreased bone mass. Caucasians and Asians are at greatest risk, whereas blacks and Hispanics are relatively protected due to greater peak bone mass (Iqbal, 2000). Women are more likely to have osteoporosis than men because of a lower peak bone mass and greater rate of bone loss, especially after menopause. Moreover, increasing age is an important risk factor in both men and women, since bones become less dense and weaken with age.

There are several partly-modifiable risk factors for osteoporosis. Any factor that results in estrogen deficiency in women, especially before natural menopause, such as early menopause, late menarche, premenopausal oophorectomy, or amenorrhea, increases the risk of bone loss. In men, low testosterone due to hypogonadism has been associated with the development of osteoporosis due to deficient stimulation of androgen receptors on (Vanderschueren & Vandenput, 2000). Furthermore, malnutrition due to eating disorders such as anorexia nervosa is considered one of the risk factors for osteoporosis, which is present in more than half of all patients with anorexia (Grinspoon, Herzog, & Klibanski, 1997). Bone loss in anorexia nervosa often occurs at a young age and may persist even after recovery, predisposing patients to debilitating spinal compression fractures. The pathogenesis of bone loss in anorexia nervosa is poorly understood, but may result from a number of mechanisms, including estrogen deficiency, inadequate vitamin and calcium intake, and nutritional effects on bone formation (Grinspoon, Herzog, & Klibanski, 1997). Other less well established partly modifiable risk factors include slim silhouette, low body weight, and comorbidities (Kreiger et al., 1982).

Lastly, modifiable risk factors for osteoporosis include glucocorticoids, low level of physical activity, smoking, caffeine, increased calcium excretion, diet poor in calcium and vitamin D, and alcohol. Iatrogenic glucocorticoid excess can cause osteoporosis in steroid therapy doses >5 mg of prednisone or 25 mg of hydrocortisone daily for prolonged periods (more than 6 months), contributing to bone loss by increasing bone resorption and decreasing bone (Daniel, 1996). Prolonged bed rest and a sedentary lifestyle are also important risk factors for osteoporosis, however, evidence suggests that obesity may be a protective factor against osteoporosis because of the conversion of adrenal androgens to estrogens in peripheral adipose tissue (Iqbal, 2000). A study published in New England Journal of Medicine showed that women who are smokers have low levels of estrogen and thus have menopause significantly earlier than non-smokers (Hooper & Seeman, 1994). Female smokers should therefore be considered to be at increased risk for osteoporosis.

The role of caffeine in osteoporosis is extremely controversial. Caffeine is a diuretic and causes hypercalciuria, and evidence indicates that aging individuals are less able to compensate for the diuretic effect of caffeine by increasing serum concentration of 1,25-dihydroxyvitamin D (Cooper et al., 1993). Elderly consumers of coffee may therefore have a negative calcium balance, which in turn aggravates age-related bone loss.

The habitual consumption of even moderate quantities of alcohol (1 to 2 drinks per day) on a chronic basis has been clearly identified as a risk factor for the development of osteoporosis even in young women and men. Those who drink heavily are more prone to bone loss and fracture, both because of poor nutrition and the increased risk of falling. Although the exact mechanism by which alcohol influences bone metabolism is not clear, it is likely a combination of both direct effects of alcohol on bone cells and indirect or modulating effect through mineral regulating hormones such as vitamin D metabolites, parathyroid hormone, and calcitonin (Kimble, 1997; Sampson, 1997; Klein, 1997). Alcoholics have also been found to have higher levels of glucocorticoids in their blood, inducing bone loss.

All of these factors should be taken into account when assessing the risk of fracture and determining whether further treatment is required. Because the osteoporotic fracture risk is higher in older women than in older men, all postmenopausal women should be evaluated for signs of osteoporosis during routine physical examinations (Lane, 2006). The clinical consequences and economic burden of this disease call for measures to assess individuals who are at high risk to allow for appropriate intervention.

Epidemiology

Osteoporosis is becoming increasingly prevalent with the aging of the world population. Worldwide, more than 200 million people are suffering from osteoporosis, and 1 in 2 women and 1 in 4 men over 50 will have an osteoporosis-related fracture in their lifetime (Johnell & Kanis, 2005). Osteoporosis causes more than 9 million fractures annually, of which 1.6 million are hip fractures, 1.7 million are forearm fractures, and 1.4 million are vertebral fractures (Melton, 2000). The lifetime risk for any fragility fractures in Caucasian women at age 50 years approaches 40% and 13% in men (Hernlund et al., 2013). Europe and North America accounts for 51% of worldwide osteoporotic fractures, while most of the remainder occur in the Western Pacific region and Southeast Asia (Johnell & Kanis, 2005).

In Europe, the number of new fractures in 2010 was estimated to be 3.5 million, comprising approximately 620,000 hip fractures, 520,000 vertebral fractures, 560,000 forearm fractures, and 1,800,000 other fractures (Hernlund et al., 2013). The annual number of fractures are estimated to rise to 4.5 million in 2025, corresponding to an increase of 28%. In women, approximately 50% of fracture related deaths were due to hip fractures, 28% due to vertebral fractures, and 22% due to other fractures. In men, corresponding proportions were 47%, 39%, and 14%, respectively (Hernlund et al., 2013).

In the United States, almost 44 million men and women aged 50 and older suffer from osteoporosis, representing 55% of this population in the United (NOF, 2017). By year 2020, it is estimated that more than 61 million men and women in the same age category will be affected. In Canada, osteoporosis affects approximately 1.4 million people, mainly postmenopausal women and the elderly (Tarride et al., 2012). It affects 1 in 4 women and more than 1 in 8 men over the age of 50 years. Almost 30,000 hip fractures occur each year in Canada, and it is expected to quadruple by the year 2030 (Tarride et al., 2012).

Although the likelihood of developing osteoporosis is currently greatest in North America and Europe, developing countries are likely to see an increase in osteoporosis in the future, as population longevity in these countries continue to increase (Genant, 1999). *Capture the Fracture* is a global campaign initiated by the International Osteoporosis Foundation implemented to reduce the incidence of osteoporosis by facilitating the implementation of coordinated, multi-disciplinary models of care for secondary fracture prevention (Åkesson et al., 2013).

Aging Population in Poland

With 38 million residents, Poland has the eighth-largest population in Europe. A successful transition from communism to democracy, which began in 1989, has brought several significant changes to the country's economic development, demographic structure, quality of life, and public policies. As in the other European countries, Poland has been facing a rapid increase in the number of older adults, with the population age 65 and above growing more rapidly than the total population (Leszko, Zając-Lamparska, & Trempala, 2015). As a result, Poland is facing an uncertain future, putting pressure on workers, the economy, and the healthcare system.

According to Central Statistical Office in 2008 (GUS), there are 7,262,000 women > 50 years of age, and 5,595,000 men > 50 years

of age in Poland. As shown in Table 1, the share of people aged 60 for women and 65 for men increases from 2010 to 2035. When analyzing the Province of Lesser Poland, and Poland as a whole, it is estimated that in Poland in 2035, the percentage of people aged 65+ in the total population will amount to up to 23.2%, with the percentage of seniors expected to reach 22.1% in Lesser Poland (Table 2).

According to the demographic professor Piotr Szukalski, there are currently 1.6 million "very" old people living Poland, which is eight times more than in 1950, when there were 180,000 people ages 80+ (one in ten Poles). He further states that migrations of younger Poles, slump birth rates, and predicted lower mortality rates would see the population age further in the future, especially with baby boomers set to enter into their 80s in 10-15 years. As a result, there will be a need to offer services both to enable increasingly dependent elderly to stay home and to offer round-the-clock, institutional care, as in the future, the current model of family-based care will change.

Table 1
The Aging Population in Poland According to GUS

Year	Population (thousand)	The percentage of people aged 60 for women, 65 for men
2010	38,200	17
2020	37,829	22
2030	36,796	25
2035	35,993	27

Source: Central Statistical Office (GUS), Poland.

Table 2
The Demographic Structure of the Polish Population

Year	1991	1995	2000	2005	2010	2035
Lesser Poland Province	10.4*	11.0*	12.2*	13.2*	13.6*	22.1*
Poland	10.2*	10.9*	12.1*	13.1*	13.5*	23.2*

*The percentage of people aged 65+; Source: Central Statistical Office (GUS), Poland.

Clinical Consequences

Osteoporosis is a silent disease until the patient experiences a fracture, with fractures and their complications being the relevant clinical sequelae of osteoporosis. Osteoporosis can have profound impacts on physical function and activity. These impacts accumulate over time through a cycle of impairment, as fracture leads to longer term detriments in physical function, including loss of muscle, activity avoidance and reduced physical capacity, which in turn leads to greater risk of fracture and potential for further physical restrictions (Kerr et al., 2017). This cycle of impairment is complex, as other physical, psychosocial and treatment--related factors, such as comorbidities, fears, and beliefs about physical activity and fracture risk influence physical function and everyday activity. The pain, physical limitations, and lifestyle and cosmetic changes caused by osteoporotic fractures can also have serious psychologic effects, including depression, loss of self-esteem, anxiety, fear, anger, and strained interpersonal relationships (Lips et al., 1999; Adachi et al., 2002; Johnell & Kanis, 2005).

Criteria of the World Health Organization (WHO) for Caucasian Women After Menopause

The World Health Organization convened a group of experts in 1994 to establish criteria to assess the fracture risk and its application to screening for postmenopausal osteoporosis. These criteria applied only to Caucasian postmenopausal women since the research data was primarily limited to this group at that time. In addition, diagnosis was based on three skeletal sites of measurement: lumbar spine, hip, or forearm.

Osteoporosis is defined based on bone mineral density (BMD), with a standardized score, called T-score, comparing BMD to average values for young healthy women used to define the categories. The categories for diagnosis are (Johnell & Kanis, 2005):

- standard (BMD above 1 SD below the peak bone mass, with a T-score equal to or higher than -1.0);
- low bone mass, referred to as osteopenia (BMD of less than 1 SD below the peak bone mass, but more than 2.5 SD below normal, with a T-score between -1.0 and -2.5);
- osteoporosis (BMD smaller or equal to -2.5 SD below the peak bone mass but without the occurrence of fractures, with a T-score of -2.5 or below);

- severe osteoporosis (BMD smaller or equal to -2.5 SD below peak bone mass with the occurrence of fractures, T-score of -2.5 or below with a history of fractures).

Advances in research has demonstrated limitations in the original definition. Defining fracture risk by BMD alone has not appeared to capture the majority of people at risk for breaking a bone (WHO, 2017). Therefore, a revised description of osteopenia and assessment of osteoporosis was released in 2008. The revised assessment includes BMD with selected risk factors for fracture along with height and weight. A fractured risk score, called FRAX, is calculated to determine the 10-year probability of a fracture. Two scores are given, the first one being the probability of a hip fracture, and the other being the probability of a major osteoporotic fracture, defined as a wrist, shoulder, hip, or painful spine fracture. Hopefully, the revised assessment will more accurately assess the true fracture risk for postmenopausal osteoporosis.

Morbidity and Mortality Associated with Osteoporotic Fractures

Patients living with osteoporosis experience a variety of fractures associated with different morbidity and mortality. Each low trauma fracture in the elderly is associated with an increased risk of a subsequent fracture, with a higher risk in men than in women. All major fractures, proximal fractures, minor fractures in the very elderly, and minor fractures followed by a re-fracture, are associated with premature mortality, greatest in the first 5 years post-fracture (Center, 2017). Having a subsequent fracture further increases the mortality risk, but if an individual survives the high risk period, their risk returns to that of the background population.

Hip fractures have an overall mortality of 15-30%, with the majority of deaths occurring within the first six months after the fracture (Keene, Parker, & Pryor, 1993). The number of hip fractures per 100,000 women with osteoporosis is presented in Figure 1. Notably, 1 in 5 people die during the first year after a hip fracture, whereas nearly one third require nursing home placement after hospital discharge, and fewer than one third regain their prefracture level of physical (NIH Consensus, 2001). Mortality is higher in men than in women with significant variation between blacks and caucasians. Figure 2 shows the mortality rate of women in the first year after fracture of the femur.

Vertebral fractures are associated with an increased risk of morbidity, including back pain, height loss, deformity (kyphosis), disability,

and restrictive lung disease (Johnell et al., 2004; Miyakoshi et al., 2003). Fractures of the vertebral bodies cause acute or chronic back pain in the area between the middle part of the thoracic spine and middle part of the lumbar spine, sometimes exclusively in the lumbar spine. Fractures of the thoracic vertebrae lead to lower growth and progressive kyphosis of the thoracic spine (Figure 3). Additional characteristics include touching of the lower ribs on the iliac crests, and pressure from the upper body on the bowels causing constipation, distention, reduced appetite, and premature satiety (Johnell & Kanis, 2005).
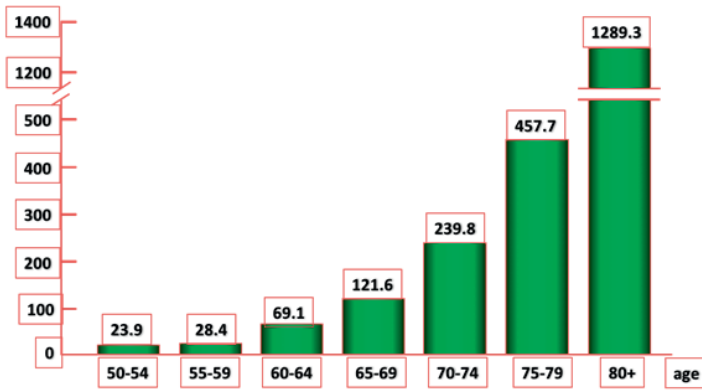

Figure 1.The Number of Hip Fractures Per 100,000 Women With Osteoporosis. Source: Gullberg, Johnell, & Kanis, 1997, 407-413.
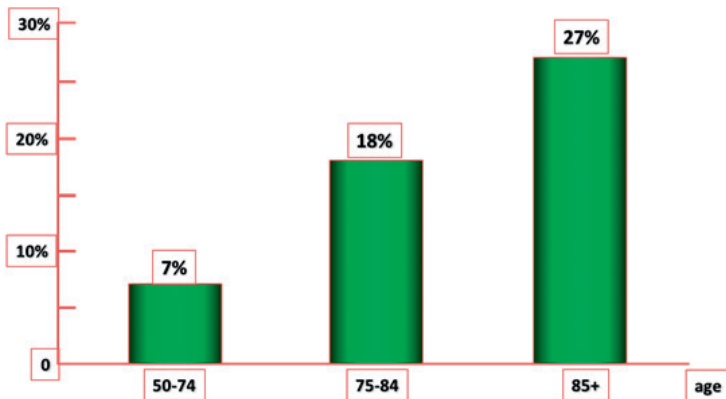

Figure 2. Mortality Rate of Women in the First Year After Fracture of the Femur. Source: Forsén, Sogaard, Meyer, Edna, & Kopjar, 1990, 73-78.
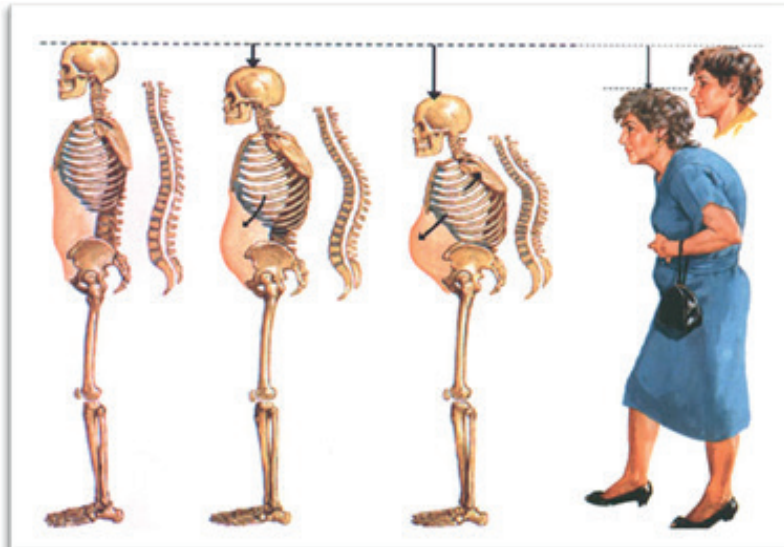
Figure 3. Progressive Kyphosis of the Thoracic Spine.

The lowered upper back is referred to as "Dowager's hump" with decreased thoracic growth and forward ejection of the abdomen.

Colles fracture is a very common extra-articular fracture of the distal radius that occur as a result of falling onto an outstretched hand. There is no increased mortality in this fracture type, and its incidence is difficult to estimate. The most common complications are related to broken arms and immobilization (dystrophy) (Lips et al., 1999).

Despite an improvement in overall health and population mortality over the years, excess mortality post-fracture has not changed in the past two decades. All trauma and fractures in the elderly heralds a high risk of poor outcomes, particularly in the first few years after fracture. Early intervention should be initiated to minimize casualties.

Risk Factors Related to the Collapse of the Condition of Osteoporotic Patients

There is a variety of risk factors related to the worsening of the condition of osteoporotic patients. Firstly, when patients with osteoporosis are interviewed about their condition, the fear of falling greatly increases their risk of falling and a decline in their condition. Secondly, signs and

symptoms such as muscle weakness, pain and inflammation of joints, and cognitive impairment (depression and memory problems) greatly impacts the quality of life and the condition of osteoporotic patients. Additional risk factors related to the collapse of the condition of patients with osteoporosis include abnormal gait and balance requiring the use of assistive devices, the presence of chronic diseases impairing the function of organ movement, visual disability, urinary incontinence, age over 65 years, low body weight, and the use of more than four drugs, psychotropic drugs, and antihypertensive drugs. It is vital for people suffering from osteoporosis to reduce exposure to modifiable risk factors, and for health professionals to treat comorbidities associated with the worsening of the condition of osteoporotic patients to avoid potentially fatal fractures.

Bone Fragility and Falls

Fragility fractures are the hallmark of osteoporosis and are particularly common in the spine, hip and forearm but may also affect other sites. Falls are the leading cause of fractures in the elderly, with hospitalized patients being three times more likely to fall than those living alone. Women fall three times more often than men with 60% of all falls occurring in a house, and 40% outside. About 5% of falls result in fractures, half of which are proximal femur fractures. Out of all falls leading to fractures, 10-25% result in injury or requirement of specialized medical care. Falls are one of the main causes of disability and the fifth most common cause of death in people over 75 years of age.

There are several factors related to an increased risk of falling in the external environment. Risk factors include bad lighting (eg. housing), obstacles inhibiting movement (eg. movable objects and wires), slippery, uneven surfaces (eg. sidewalks covered with ice or snow), lack of facilities designed to facilitate change of position (eg. barriers facilitating the change of position in the toilet, bathroom, and non-slip mats in the bathtub or shower), and public transport and traffic (eg. inadequate means of communication, lack of ability to get on and off the cars, the absence of ramps, elevators or escalators).

All people over the age of 65 should take precautions when walking to prevent falls. Precautions include wearing low-heeled shoes with rubber soles, using handrails as one goes up and down steps and escalators, avoiding highly polished marble or tile, using a walker or cane as needed, and considering wearing hip protectors or hip pads for added protection. Community services can provide help, such as 24-hour pharmacies

and grocery stores that take orders by phone and internet, especially in poor weather. It is important that individuals with osteoporosis are aware of any physical changes that may affect their balance and gait, and that they discuss these changes with their healthcare providers.

Recognizing Osteoporosis

There are several measures that are used to assess the presence of osteoporosis. First of all, an interview is conducted with the aim of detecting the probability of the presence of osteoporosis by identifying risk factors. Secondly, a physical examination is performed assessing the functional status of the patient. Additionally, X-ray examination of the thoracic spine and the detection of lateral lumbar projections, and bone densitometry, are used to recognize osteoporosis. At present, laboratory tests cannot be used to diagnose osteoporosis. However, laboratory testing should be used as an integral part of studies of patients with low bone mass to identify secondary causes of low bone mass. Radiologic laboratory assessments of bone mineral density generally should be reserved for patients at highest risk, including women over the age of 65, younger postmenopausal women with risk factors, and all postmenopausal women with a history of fractures.

Together, clinical assessment of osteoporotic risk factors and objective measures of bone mineral density can help to identify patients who will benefit from intervention, which in turn can potentially reduce the morbidity and mortality associated with osteoporosis-associated fractures.

Prevention and Treatment

Treatment of osteoporosis has had limited success, as no therapy fully restores lost bone mass (Iqbal, 2000). Prevention is a more useful approach, and ideally, people at high risk should be identified when preventive measures can be instituted. Preventive measures include regular exercise to make bone stronger, such as walking, hiking, jogging, stair-climbing, dancing, tennis, exercise classes, or other weight-bearing exercise that protects bone mass when accompanied by an adequate daily intake of calcium and vitamin D. Exercise not only improves bone health, but also increases muscle strength, coordination, balance, and better overall health. In addition, modification of diet and lifestyle can reduce the risk of osteoporosis in many patients. Appropriate dietary changes

include a reduction of alcohol and caffeine intake, smoking cessation, and an increase in calcium intake through diet or supplementation. Prevention should begin early in life, and teenagers should be taught the importance of exercise and of diets rich in calcium, which is contained in yoghurt, cheese, milk, nuts, and green leafy vegetables.

Various medications are available for prevention and treatment of osteoporosis. Pharmacologic interventions for the prevention of fractures in patients with osteoporosis aim at maintaining a bone mass level that effectively prevents fractures throughout life. Patients that are eligible for treatment must be identified as patients with a high risk of fracture, and the therapeutic threshold limit must be set prior to pharmacological treatment. A number of agents are currently available, but only a few have been evaluated under controlled conditions in clinical trials in which the primary efficacy end-point was the prevention of fractures.

The Cost of Treating Fractures

Osteoporotic fractures are one of the most common causes of disability and a major contributor to medical care costs in many regions of the world (Masi, 2008). In Europe, the disability due to osteoporosis is greater than that caused by cancers (with the exception of lung cancer) and is comparable or greater than that lost to a variety of chronic non-communicable diseases, such as rheumatoid arthritis, asthma and high blood pressure related heart disease (Johnell & Kanis, 2005). Moreover, the combined lifetime risk for hip, forearm, and vertebral fractures is around 40%, equivalent to the risk for cardiovascular disease (Kanis, 2002). In women over 45 years of age, osteoporosis accounts for more days spent in hospital than many other diseases, including diabetes, myocardial infarction, and breast cancer (Kanis et al., 1997).

Osteoporotic fractures cost the United States health care system approximately $17 billion annually, with an annual cost projected to approach $50 billion by year 2040 (Miller, 1999). These medical costs represent a greater burden than the projected annual costs of stroke, breast cancer, diabetes, or chronic lung disease (Lane, 2006).

In Europe, the cost of osteoporosis in 2010 was estimated to be €37 billion, out of which treating incident fractures represented 66%, long-term fracture care represented 29%, and pharmacological prevention represented 5% (Hernlund et al., 2013). The total health burden of osteoporosis in the EU was estimated to be 1,180,000 lost QALYs (Quality Adjusted Life Years), the majority of which were consequences of prior fractures

(Hernlund et al., 2013). Furthermore, it was estimated that approximately 26,300 life-years were lost in the EU in 2010 due to incident fractures.

Clearly, the clinical and economic consequences of osteoporosis call for a concerted effort to assess patients at risk to allow for prevention and early intervention when appropriate.

Fracture Liaison Service

Health authorities worldwide are coping with rising costs and disability resulting from fragility fractures in the older population. Yet, evidence shows that the burden of fragility fractures could be reduced through early identification and treatment of patients who have previously suffered a fracture. Currently, 80% of individuals who experience a fragility fracture are never offered screening and/or treatment for osteoporosis even though they are twice as likely to suffer a fracture in the future. Left undiagnosed and unprotected, these patients often go on to experience new fractures.

The dismal rate at which treatment of osteoporosis is initiated following any fragility fracture can be dramatically improved with the help of a fracture liaison service. A fracture liaison service is a coordinator-based, secondary fracture prevention service implemented by health care systems for the treatment of osteoporotic patients. It consists of a coordinator, often a nurse, which aids in several aspects of secondary osteoporosis treatment including preoperative preparation, post-operative care, organization diagnostics, care at home through contact with a GP, medicines, and rehabilitation. The coordinator act as the link between the patient and the orthopedic team, the osteoporosis and falls prevention services, and the primary care physician, and enhances the communication between the various health-care providers involved and ensures that the patient follows a clearly defined care pathway. Implementation of fracture liaison services will contribute to reduce the burden of fragility fractures through early identification and appropriate treatment.

Senior Care

Senior care is the fulfillment of the special needs and requirements that are unique to senior citizens. It emphasizes the social and personal requirements of senior citizens who need some assistance with daily activities and health care, but who desire to age with dignity. The form of

senior care provided varies greatly among countries and is rapidly changing. Traditionally, senior care has been the responsibility of family members and was provided within the family home. Increasingly in modern societies, senior care is now being provided by state or charitable institutions. The reasons for this change include decreasing family size, the greater life expectancy of elderly people, the geographical dispersion of families, and the tendency for women to be educated and work outside the home (Tin et al., 2009). Although these changes have affected European and North American countries first, they are now increasingly affecting Asian countries as well.

In modern senior care facilities, inadequate social support is a strong risk factor for mortality. Social issues such as loneliness, reduced functional activity, financial difficulties, housing problems, little involvement of the family, difficulties in meeting spiritual needs, and the inability to implement own social needs are areas that are difficult for health care providers to assist with. To ensure optimal conditions for elderly in senior care, there is an increased demand for social care, increased investment (eg. medical-social care), and adaptation of utilities (eg. public support for the elderly and people with disabilities).

Purpose of Modern Geriatrics

Modern geriatrics integrates outpatient care with the elderly being the primary subjects. The aims of geriatric care include adapting logistics, architectural facilitating, medical care, and protection. In the search for new solutions, combining rational medical care with spending quality, and taking into consideration the current rates of the aging society, standardization and revision of funding rules for geriatric care is urgently needed. Successful aging is multidimensional, with the determining factors primarily being prevention of disease and disability, maintenance of high physical and cognitive function, and sustained commitment to social action and productivity.

Social inequalities and osteoporosis

Social inequalities in health have been present and recognized for centuries (Marmot, 2001). Even in overall wealthy countries, poverty is not rare (Groffen et al., 2008). Regardless of standardized levels of living, health inequalities are present across all relative levels of deprivation

(Wilkinson, 1997). However, little is known regarding social inequalities in reference to osteoporosis and fractures. Brennan et al. have recently conducted systematic reviews on the associations between socioeconomic status, BMD (Brennan et al., 2011) and osteoporotic fractures (Brennan et al., 2009) among community-dwelling adults. The authors concluded that partially limited, good quality evidence exists, supporting social inequalities in bone mineral density and fracture. However, the authors also issue a "call to action" regarding further research, preferably from cohort studies rather than simple ecological or case-control studies, to further elucidate the relationships between individual level markers of socioeconomic status, BMD and fracture. Clarification of whether osteoporosis and fracture are socially patterned could, in the future inform planning for health care and social care services, as well as enable public health strategies for prevention, intervention and treatment of osteoporosis and fractures (Kanis et al., 2009).

However, results from UK studies regarding BMD and social inequalities are inconsistent – some authors like Quah et al. (2011) and Court-Brown et al. (2011) conclude that higher levels of social deprivation are associated with higher rates of hip fracture or lower levels of BMD. On the other hand, some authors (West et al., 2004; Jones et al., 2004;) found no evidence for association between socio-economic status and hip fracture, hospital admissions for fracture or accident and emergency presentations for fracture. The COSHIBA (Cohort for Skeletal Health in Bristol and Avon) study, collecting cross-sectional data on history of fracture in individuals after 50 years of age and socio-economic status [30] showed no associations between the two in the examined women.

The results from other international studies are also inconsistent. For example, Zingmond, Soohoo & Silverman (2006) (ecological study) and Farahmand et al. (2000) (case-control study) concluded that lower income is associated with higher rates of hip fracture among American men and women and among Swedish women. On the other hand, Johnell et al. (2007) identified an association between lower levels of economic prosperity and lower rates of hip fracture. In further contrast, Hokby, Reimers & Laflamme (2003) conducted a cross-sectional study of Swedish men and women and found no association between home ownership and hip fracture rates. Also Vestergaard, Rejnmark & Mosekilde (2006) found no association between income or education and any fracture in his case-control study of Danish men and women.

The lack of strong, convincing evidence for social inequalities in fracture and osteoporosis is not fully surprising, when one assesses this in the context of the limited and inconsistent literature. It is possible that

inequalities across social groups may have been masked if the detrimental effects of lower socio-economic position on bone health were offset by a history of more manual work (Syddall et al., 2012). The retirement age and status of the analyzed cohort may also be an important factor to consider. The study by Benzeval, Judge & Smaje (1995) has questioned the appropriateness of social class for studies of health inequalities among older people. Clark, Ness & Tobias (2005) have studied the association between social position of the mother in pregnancy and bone mass of the child at age 10 years among 6,702 children and concluded that social position exerted opposing height- and weight-dependent effects on bone mineral content and area in childhood such that overall inequalities in bone health were masked.

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