

## CHAPTER X

### THE SOCIAL AND FINANCIAL COSTS OF OSTEOPOROSIS

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A brief discussion into the nature of the condition, its prevalence, incidence and its target population was required before the social and financial costs could be stated. Indeed it was crucial to establish the condition as an important financial stress to health services worldwide. Estimations were then made concerning the costs, both economically and socially, with subsequent research to determine the most viable method for reduction of such costs. The possibility of reducing hospitalization periods via the introduction of community care projects, the concept of screening for the condition and an increased awareness of the preventive mechanisms were all considered. It became apparent that, due to limited knowledge concerning the disease and its treatment, it was best to focus attention on preventing the condition.

#### **1. Nature of osteoporosis**

Osteoporosis, as defined by WHO in is a systemic skeletal disease characterized by low bone mass and microarchitectural deterioration of bone tissue with a consequent increase in bone fragility and susceptibility to fracture.<sup>1</sup> Osteoporosis may affect the entire skeleton with the most common fracture sites being the hip, wrist and vertebrae. These fractures are a considerable health problem causing substantial morbidity and mortality in the elderly and imposing enormous financial strains on the health service. As indicated by the WHO, Osteoporosis is defined using the measurement of Bone Mineral Density (BMD), where a value of

BMD 2.5 SD or more below the young adult reference mean denotes the condition.<sup>2</sup> How common is this condition and whom does it affect? Osteoporosis is a complaint primarily affecting postmenopausal women (Type I osteoporosis), and secondly targeting the elderly (Type II osteoporosis). Its pronounced prevalence in these groups can be attributed to the fact that peak bone mass is usually achieved in the age range from 20 – 30 years, after which a decrease is inevitable. This decrease is much more common in females than in males, due to the onset of the menopause. This is related to the fact that the sex hormones i.e. estrogens are crucial in maintaining and controlling bone turnover. Osteoporosis is also associated with conditions such as Cushing's disease, rheumatoid arthritis, alcohol abuse, scurvy and endocrine disorders. In addition to being more common in the female sex, osteoporosis is more prevalent in Caucasians and Asians; those with a slim body build sedentary lifestyle, low calcium intake and nulliparity. Osteoporosis is a common condition; with the remaining lifetime risk of osteoporotic fracture in a 50 yr old British white female has been estimated at 14% for hip, 14% for spine and 13% for the radius. The comparative values for their North American counterparts are somewhat higher, estimated at 17.5%, 15.6% and 16% respectively.<sup>3</sup> The remaining risk of any fragility fracture approaches 40% in women and 13% in men.<sup>4</sup>

## **2. Financial costs of osteoporosis**

When discussing the cost of osteoporosis, in both human and economic terms, it is most practical to study data concerning hip fractures. Unlike fractures of the vertebrae and wrist, hip fractures almost invariably require hospital admission making data collection most feasible. It is estimated that 2/3 of vertebral fractures are not diagnosed clinically.<sup>4</sup> Osteoporosis, being a condition, which mainly affects the elderly, is more prevalent in developed countries due to the increased life expectancy. Therefore, to formulate accurate assumptions concerning costs, it is necessary to study the statistics from such countries. In the UK there are 6000 estimated hip fractures, 50000 fractures of the distal radius, and 40000 clinically diagnosed vertebral fractures annually.<sup>3</sup> The

total cost of osteoporotic fractures in England and Wales (1995) amounts to £742 million with £614 million being attributed to fractures of the hip.<sup>3</sup> In the USA health care expenditures attributable to osteoporotic fractures in 1995 were “estimated at \$13.8 billions, of which \$10.3 billions were for the treatment of white men, \$0.7 billion for non white women, and \$0.2 billion for non white men. Of the \$13.8 billion, \$8.6 billion was spent on inpatient care, \$3.9 billion on nursing homes, and \$1.3 billion on outpatient care.<sup>5</sup> As illustrated by the figures above, it is not simply hospitalization, which costs health services, indeed much aftercare, and attention is required. This is further reinforced by the following data: in New Zealand (population 3 million) the combined total cost of caring for women in the two years after a hip fracture in 1994 was £22 millions<sup>6</sup> and France (excluding vertebral fracture) \$740 millions for a population of 57 million people. In Australia it has been suggested that each individual pays \$40 annually towards the cost of osteoporotic fractures.<sup>7</sup> As life expectancy has improved and continues to do so in many parts of the world the burden of osteoporotic fractures continues to rise. In 1995 there were about 325 millions individuals in the world 65 years old or more and it is predicted to rise to more than 1500 million by the year 2050. Based on the ageing U.S. population One study has predicted that an annual hip fracture rate greater than 500,000 by the year 2040 and at 5% inflation rate the total cost of the fractures would be \$240 billion by the year 2040.<sup>8</sup>

### **3. Social costs of osteoporosis**

It would be very easy only to consider the financial cost of osteoporosis and to forget about the individual. Loss of independence is the major and most dreaded consequence of fracture in the elderly. Until recently most studies of morbidity were limited to studies of fracture malunion, aseptic necrosis and segmental collapse. More recent studies of human costs of fracture have considered the functional limitations, reduced activities of daily living, limitations in mobility and pain. Other quality of life issues have received less attention. When some fracture survivors return home they have an excellent medical result but they will be so

scared at the possibility of falling that their lifestyle will be severely restricted.

Osteoporosis and its associated fractures have, in many ways, as great a human cost as financial. It has been estimated by Doube et al<sup>9</sup>, that 1/3 of patients with osteoporotic hip fracture die as a result of the fracture, with a further 1/3 of patients requiring continued institutionalized care and with many of the remaining 1/3 suffering from loss in their independence and ability to perform their daily tasks. These serious social implications can directly lead to a reduced quality of life and an increased incidence of depression. This inevitably leads to further costs for the health service, in terms of psychiatry and social work. Parker et al argues that the mortality of 33% quoted relates to mortality at one year, and that all deaths over this period should not be attributed to the hip fracture. As the population is normally elderly approximately a 10% death rate should be expected annually, a further 10% might be accounted for by associated medical conditions. Parker therefore leaves, in his opinion, a more realistic figure of 10% as appropriate.<sup>6</sup> A main contributor to the costs of osteoporosis is the long hospitalization period associated with hip fractures, it is therefore reasonable to discuss methods that attempt to reduce this time without placing the patient at any potential risks, such as early discharge scheme for fracture patients.

#### **4. Screening program: BMD Vs Bone turnover markers**

Diseases of epic cost to the NHS, such as breast cancer are routinely screened for amongst the target population. This attempts to catch susceptible individuals before the condition progresses and treatment costs accumulate. In this respect it is reasonable to question why osteoporosis is not incorporated into a widespread screening program. The WHO acknowledges osteoporosis as a generally asymptomatic condition until fracture occurs, it is crucial to examine the criteria necessary for a successful and cost effective screening program. It is essential that the measurement renders a screening test which is highly sensitive i.e. has a definite ability to detect the disease when present, and also highly specific - having the ability to identify healthy individuals as

non - diseased giving few false positives. At present, one of the golden diagnostic criteria for osteoporosis is the measurement of bone mineral density (BMD) by DEXA, as indicated by the WHO.

BMD measurement was reported to have a sensitivity of 9% and specificity of 99% at a critical threshold of -2SD below the normal adult mean.<sup>10</sup> Hence, BMD may be an efficient measurement and provides a good assessment of fracture risk as stated that the predicative value of bone mass is similar to blood pressure for stroke, and better than that of serum cholesterol for cardiovascular diseases.<sup>10</sup> Although BMD can be an efficient measure and provides a good assessment of fracture risk it cannot, identify individuals who will have a fracture,<sup>10</sup> since the risk of fracture depends on many other skeletal related and fall related factors, many of which are independent of BMD. Skeletal related factors include femoral geometry, bone mass, microarchitecture, bone mineral structure and bone turnover. Fall related factors include variables such as neuromuscular function, cognitive impairment and visual acuity. In turn the chance of fracture once a fall has occurred is mediated by factors such as age, height, weight, mobility, and a genetic susceptibility to fracture. For these reasons, a universal screening program for osteoporosis, without maximum discretion is neither economically viable nor acceptable by general medics. A selective screening for susceptible individuals such as women with early menopause, who in addition are heavy smokers or alcohol consumers and have an important genetic disposition to the disease, may be a more feasible alternative. However, even such a limited screening initiative meets much opposition such as low compliance rates to the program, and treatment regimes, but more importantly to the effectiveness of reduction in fracture incidence.

It has recently been challenged that bone density alone cannot indicate the risk of fracture. Hui found that for the same BMD the risk of fracture rose from 8 fold to 10 fold from age less than 45years to greater than 80 years. In a sample of 5800 man and women over 55 years of age the risk of hip fracture rose 13 fold with age.<sup>11</sup> These observations suggest that something very important in the ageing process influences fracture risk independently of bone density. As indicated by Black et al a study on the

association of BMD and fracture risk showed a reduction in the risk of fracture at the hip and spine of more than 50% with a corresponding increase in BMD at these sites of only 5–8%,<sup>12</sup> and it difficult to attribute such a spectacular clinical result to such small increases in bone mass.

Bone turnover markers as indicators of osteoporosis are useful alternatives or should be used in combination with BMD screening. Bone turnover is maintained by two groups of cells – osteoblasts and osteoclasts. Osteoclastic activity is carefully mediated by the action of sex steroids and a co-coordinated physiological balance with the osteoblasts is maintained to ensure no net change of bone during adult life. After the menopause, circulating estrogen concentrations decrease, osteoclastic activity is no longer maintained accelerates far exceeding that of the osteoblasts. This directly implies that the concentration of bone turnover markers in postmenopausal women may be a new diagnostic method for osteoporosis and a better indicator of fracture risk. This concept also has direct implications for treatment i.e. the administration of anti-reabsorptive drugs such as bisphosphonates. Again, the sensitivity and specificity of the serum and urine bone turnover makers to fracture predication is still debatable.

The Royal College of Physicians (England) has recently published clinical guidelines for the prevention and treatment of osteoporosis. These conclude that there is no universally accepted policy for screening and that, although screening strategies may be developed in the future, in their absence a case finding strategy where patients are identified on the basis of fragility fracture or the presence of strong risk factors. It is clearly apparent that even if desired a widespread screening serve is simply not feasible.

### **5. Public awareness and prevention of osteoporosis**

As illustrated, widespread screening for osteoporosis is an undesirable concept, how then can the financial costs of the disease are significantly reduced? Through research it has become apparent that in order to decrease this “silent epidemic” prevention is the key. To reduce the

incidence of a condition via preventative mechanisms, the general public, via public health programs must be very aware of the condition and its implications. How well is the general public informed about this condition? A study performed by Keene et al concerned 84 patients who had recently suffered osteoporotic fractures. The results were most disappointing; with only 34 of the patients being aware of the condition and with this knowledge coming from doctors in only 29%.<sup>13</sup> These statistics represent a huge flaw in health education and promotion policies and also serious breakdown in communication between doctors and patients.

Since osteoporosis is thought to be inextricably linked to bone mass, it is reasonable to state that any mechanism increasing bone mass will present a defense to the condition. Peak bone mass occurs between the ages between 20–30 years, after which an inevitable decline is to be expected. Therefore, it is necessary to try and increase the peak bone mass achieved, which is possible only through childhood. The general public also needs further education on the importance of calcium rich and balanced diet on skeletal development. Exercise affects the skeleton in many ways. The direct effect of stress loading can be to increase bone mineral density, and should be regarded as important in the prevention of osteoporosis. Children from primary school age should be systematically taught of the importance of exercise in bone development. Vigorous exercise during growing age increases BMD by 2–20%, and is more beneficial than during adulthood.<sup>14</sup> Studying the BMD of professional athletes reinforces this concept, that a tennis players playing arm can be up to 30% more dense than the non – playing arm.<sup>14</sup> Although excessive weight bearing exercise cannot be recommended for the elderly and infirm, light exercise is thought to decrease the risk of an osteoporotic fracture even in people who are aged over 80. Moderate exercise may further decrease the risk of osteoporosis by improving muscle tone and balance – hence decreasing the likelihood of fall.

## **6. Conclusion**

It is clear that osteoporosis is a huge financial burden to the health services worldwide. With these costs set to rise in the future it is imperative that dramatic interventions occur in an attempt to reduce and limit these costs. As discussed, the possibility of a widespread screening program is not desired, and the advantages of early discharge from hospital have been vague. Attention must therefore be focused on prevention of both the condition and its endpoint i.e. fractures of the wrist, vertebrae and most importantly the hip. Through raising public awareness of the condition it can be hoped that, in general, individuals and families may alter their lifestyles. Children should be encouraged all levels to exercise regularly and consume a healthy diet in an attempt to increase their peak bone mass. Postmenopausal women should be educated on the importance of HRT, and the increased risk denoted by heavy smoking and alcohol consumption. In addition patients on long-term steroid use should be routinely informed of the risk of osteoporosis and prescribed treatment where necessary. For the elderly, attention should be focused, not on maintaining an already decreased BMD, but on preventing falls.<sup>15</sup> Simple advice such as keeping all areas well lit, fitting down loose edges of carpets, using non – slip mats in the bathroom, and having regular eyesight tests could all reduce the likelihood of fall and hence the cost of the condition. However, it has become most evident, that before it is possible to reduce the costs of this condition; more research into the condition is needed.

## References

1. Consensus development conference: diagnosis, prophylaxis, and treatment of osteoporosis, *Am. J. Med.*, 94 (1993).
2. WHO study group on assessment of fracture risk and its application to screening for postmenopausal osteoporosis, *WHO technical series*, 843 (1994).
3. L. J. Donaldson, A. Cook and R. G. Thompson, *J. Epidemiol. Com. Health*, 44 (1990).
4. L. J. Melton, E. A. Chinscilles, C. Cooper and A. W. Lane, *B. M. J.*, 92 (1992).
5. N. F. Ray, J. K. Chan, M. Thamer and L. J. Melton, *J. Bone Miner. Res*, 12 (1997).
6. M. J. Parker and J. K. Anand, *Public Health* 105 (1991).



7. E. Barrett-Connor, *Am. J. Med.*, 98 (1995).
8. R. Lindsay, *Am. J. Med.*, 98 (1995).
9. A. Doube, *B. M. J.*, 318 (1999).
10. D. Marshall, O. Johnell and H. Wedel, *B. M. J.*, 312 (1996).
11. S. L. Hui, C. W. Slemenda and J. R. Johnston, *J. Clin. Invest.*, 81 (1988).
12. D. M. Black, S. R. Cummings, D. B. Karpf and J. A. Cauley, *N. Engl. J. Med.*, 348 (1996).
13. G. S. Keene, M. J. Parker and G. A. Pryor, *B. M. J.*, 307 (1993).
14. S. Bass, G. Pearce, E. Hendrich and P. Delmas, *J. Bone Miner. Res.*, 13 (1998).
15. P. Kannus, *B. M. J.*, 818 (1999).

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