

Chapter 45

Risk Prediction Model for Osteoporosis Disease Based on a Reduced Set of Factors

Walid Moudani

Lebanese University, Lebanon

Fadi Chakik

Lebanese University, Lebanon

Ahmad Shahin

Lebanese University, Lebanon

Dima Rajab

Lebanese University, Lebanon

ABSTRACT

The health industry collects huge amounts of health data, which, unfortunately, are not mined to discover hidden information. Information technologies can provide alternative approaches to the diagnosis of the osteoporosis disease. In this chapter, the authors examine the potential use of classification techniques on a huge volume of healthcare data, particularly in anticipation of patients who may have osteoporosis disease through a set of potential risk factors. An innovative solution approach based on dynamic reduced sets of risk factors using the promising Rough Set theory is proposed. An experimentation of several classification techniques have been performed leading to rank the suitable techniques. The reduction of potential risk factors contributes to enumerate dynamically optimal subsets of the potential risk factors of high interest leading to reduce the complexity of the classification problems. The performance of the model is analyzed and evaluated based on a set of benchmark techniques.

INTRODUCTION

Osteoporosis is a real public health problem because of its increasing frequency over the countries. It is considered as one of the major problems among women and older people. However, it becomes an essential index of health and economics in every country. Osteoporosis disease is a chronic complex health problem for millions of women worldwide, 80% of whom are postmenopausal, unless prevented or treated, this silent disease will continue to limit both the quantity and the quality of many older women and significantly add to health care cost for this group (Taylor, Schreiner, Stone, 2004; Kanis, 2002). This disease infects 30% of women after 50 years and 70% after 80 years. Osteoporosis preven-

DOI: 10.4018/978-1-5225-1759-7.ch045

tion is complicated but it holds promise as the best way to decrease future fractures (Kanis, Johansson, Johnell, 2005). Looking around the world, we see that osteoporosis occurs in some areas much more than in others — just as the incidence of cancer, heart disease, and diabetes varies from one culture to another. This clarifies that the development of weak bones is not a natural artifact of aging. While the United States has one of the highest osteoporosis rates in the world, there are other areas where this disorder is relatively rare, even among the older segments of the population (Dawson-Hughes, Tosteson, Melton, et al., 2008). For example, the inhabitants of Singapore, Hong Kong, and certain sectors of former Yugoslavia, as well as the Bantu of South Africa have traditionally held extremely low rates of osteoporotic fracture. In Japan, vertebral compression fractures among women between ages 50 and 65 were so rare that many physicians doubt their existence, and the incidence of hip fractures among the elderly Japanese historically has been much less than half that of Western countries (Koh, Sendrine, Torralba, et al. 2001; Sen, Rives, Messina, et al., 2005). Africans and native peoples living traditional lifestyles have been classified as “almost immune” to osteoporosis (De Laet, Kanis, Oden, et al., 2005). Interestingly enough, as these less technologically advanced countries become more Westernized, their rates of osteoporotic fracture are steadily increasing (Taylor, Schreiner, Stone, 2004). We note that some Lebanese studies have showed that the mean BMD for the Lebanese female is lower than that of the European woman. Another Lebanese study showed that the hip fractures occur at a younger age in Lebanon (between 65 and 75) compared to western population (above 75) and that 60% of patients with hip fractures have osteopenia rather than osteoporosis (Taylor, Schreiner, Stone, 2004; Kanis, 2002). The social economic burden of osteoporosis is so large that its etiology, prevention and treatment have become an urgent issue that needs to be coped with worldwide. The disease may continue its progress until even a slight twisting or bending motion may cause bones to fracture and break. Risk factors for developing osteoporosis include controllable factors such as nutrition, physical activity level, smoking, and consumption of alcohol, and uncontrollable factors like sex, family history, and ethnicity. Many people in any ages appear to be unaware of the risk factors and preventive behaviors. Preventing osteoporosis, and subsequent fractures, had become a goal of many health care practitioners.

Osteoporosis is a bone disease that commonly occurs among postmenopausal women. Recognizing population with high risks of osteoporosis remains a difficult challenge. Early detection and diagnosis is the key for prevention but are very difficult, without using costly diagnosing devices, due to complex factors involved and its gradual bone lose process with no obvious warning symptoms. Building an osteoporosis prediction system using data mining techniques based on analyzing postmenopausal risk factors is the aim of this study. By discovering the osteoporosis disease warehouses for Osteoporosis, significant patterns can be extracted in order to build a robust disease prediction models that aim to guide medical decision making (Harold, 2008) and provide an easier way to detect if a person can have the risk of an osteoporosis. The aim of this study is to examine the potential use of classification on a massive volume of healthcare data, particularly in prediction of patients that may have Osteoporosis Disease (OD), which unfortunately continues to increase postmenopausal in the whole world, then it will possible to prevent OD through modification of its risk factors. It enables significant knowledge, e.g. patterns, relationships between medical factors related to Osteoporosis disease, to be established.

The methodology used in this study to build the mining predictive model consists of several phases that start with medical-technical environment understanding, data understanding, data preparation, modeling, implementation and evaluation. The environment understanding phase focuses on illustrating the medical and technical parts of this research by defining the osteoporosis disease, introducing its major risk factors which will constitute the input parameters for the mining operation; and in the technical part,

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