Risk Patterns for Lumbar Spine Osteoporosis through Multivariate Analysis

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Abstract

We propose a set of Ordered Logistic Regressions to establish different risk patterns for Lumbar Spine Osteoporosis. Patterns are created by the additive combination of different risk factors which influence Osteoporosis significantly.

Keywords: Osteoporosis, Lumbar Spine, Pattern, Ordered Logistic Regression.

1. Introduction

Osteoporosis (OP) is considered a chronic or long-term disease because it affects 8.34% of Spanish women, reaching to 23% when they are over 65 years old [1,2]. The analysis of risk factors (RFs) has high importance for the evaluation of patients with suspected OP.

Previous studies show that: a) RFs with a higher influence on Osteoporosis are age, BMI<25, previous fracture (both osteoporotic and non-osteoporotic) and some diseases that cause bon loss; and b) lumbar-spine is the most prevalent type of OP [3]. Lumbar spine OP is also influenced by premature menopause.

This study goes a step further analysing the combination of Osteoporosis RFs. These combinations result in different risk patterns for OP, which allow a greater detail on the risk of patients to develop this disease. Thus, the objective of this study is to know risk patterns for lumbar spine OP through the combination of those factors which increment more noteworthy its risk in postmenopausal women.

2. An Osteoporosis measure: T-score

OP is a disease of bones that is caused by lack of calcium deposited in them. The disease is detected through a Bone Densitometry (DXA), an enhanced form of x-ray technology that is used to measure bone loss. The test results from the DXA will be in the form of score, namely T-score. T-score is the number of standard deviations above or below the mean for a healthy 30 year old adult of the same sex and ethnicity as the patient [4]. A score above -1 standard deviation is considered normal. A score between -1 and -2.5 standard deviation is classified as osteopenia (low bone mass). A score below -2.5 standard deviations is defined as osteoporosis.

3. Population

We conducted a cross-sectional study with 3,049 postmenopausal women. They were sending for DXA at the lumbar spine to Bone Densitometry of Rheumatology Unit at Marina Baixa Hospitals (Alicante, Spain) between 2010 and 2012. Personal information of the patients includes epidemiological characteristics (age, gender), RFs for OP, location of fracture for adults, diseases and drugs that cause bone loss.

4. Multivariate Analysis

First, we define patters as additive combinations of significant RFs in previous studies [3]:

$$\text{Pattern[i]}=\sum_{j=1}^{6} RF_j \quad \text{where RF}_j = \begin{cases} 1 & \text{patient present } \textit{factor} \text{ j} \\ 0 & \text{otherwise} \end{cases}$$

and *j*= age, BMI, premature menopause, previous fracture and bond loss disease

Second, we use Ordered Logistic Regression, using generalized linear models, to calculate the ORs for the risk patterns:

$$\text{link}(\gamma_j) = \frac{\theta_j - \left[\beta_1 x_1 + \beta_2 x_2 + \ldots + \beta_k x_k\right]}{\exp\left(\tau_1 z_1 + \tau_1 z_1 + \ldots + \tau_m z_m\right)}$$

Using the logit function, since the log of the odds results equal to the linear combination of the parameters. That is,

$$\ln\left(\frac{\Pr\left(FR_j\right)}{1-\Pr\left(FR_j\right)}\right).$$

5. Results

42.9% of patients suffer osteopenia and 25.6% osteoporosis. Age average is 63.08±0.34 years old (median 62, Rank 32-93). Descriptive statistics about RFs show: 30.3% has BMI<25; 25% premature menopause; and 31% previous fracture among which osteoporotic one is the most common (19.8%). Between diseases that cause bon loss, 6.1% had any kind of chronic arthritis (rheumatoid arthritis, spondyloarthropathies or SLE) or collagenopathies (polymyalgia rheumatica, temporal arteritis, dermatomyositis), and 22.4% some other non-rheumatic disease.

In women with 55 or less years old (23.3%) only the combination between underweight (BMI<25) and osteoporotic previous fracture is a risk pattern (1).

When women are 56-65 years old (35.1%) underweight, premature menopause or osteoporotic previous fracture implies a risk increment between 51% and 96% (2,3,4). The combination of two of these RF raises the OP risk from two to three times (7,8,9). If a disease that cause bone lost is added, the baseline risk increase between 53% and 64% (5,6).

In women over 65 (35.8%), the combination between premature menopause and previous fracture implies a greater increment in OP risk: 1.63 if it is an osteoporotic fracture and 2.10 if it is not (10,11,13). To be underweight and to have a non-rheumatic disease increases the risk in 91% (12).

Independently from the age, premature menopause implies a risk from 1.52 when it combines with a non-osteoporotic previous fracture to 1.86 when it is combined with a BMI<25 (14,16,17,19). However, previous fracture plus a disease that cause bone loss raise the OP risk around 70% (15,18,22). To be underweight joined other RFs leads to the highest risks (20,21,23,24,25).

Table 1: Risk Patterns for Lumbar Spine OP

Pattern	Age at DXA	Underweight	Premature menopause	Osteoporotic previous fracture	Non-Osteoporotic previous fracture	Bone loss disease	OR[a]	CI	n
1	< 55	X		X			2.17	(1.01 - 4.67)	26
2	56-65		X				1.51	(1.14-2.01)	225
3		X					1.75	(1.35-2.28)	326
4				X			1.96	(1.40-2.75)	163
5				X		Non-rheumatic	2.49	(1.31-4.76)	41
6			X			Non-rheumatic	2.15	(1.21-3.84)	49
7		X		X			2.30	(1.32-4.02)	54
8			X	X			2.74	(1.33-5.65)	33
9		X	X				3.12	(1.84-5.27)	67
10	>65			X			1.46	(1.14-1.86)	367
11			X	X			1.63	(1.03-2.59)	80
12		X				Non-rheumatic	1.91	(1.03-3.52)	47
13			X		X		2.10	(1.13-3.89)	42
14			X		X		1.52	(1.02-2.29)	98
15				X		Non-rheumatic	1.70	(1.18-2.45)	147
16			X			Non-rheumatic	1.44	(1.05-1.99)	191
17			X	X			1.74	(1.21-2.49)	141
18					X	Non-rheumatic	1.78	(1.13-2.81)	86
19		X	X				1.86	(1.40-2.47)	261
20		X			X		1.93	(1.25-2.98)	92
21		X		X			2.14	(1.53-2.98)	174
22					X	Non-rheumatic	1.78	(1.13-2.81)	86
23		X				Non-rheumatic	1.57	(1.13-2.18)	195
24		X	X	X			2.64	(1.41-4.95)	47
25		X	X		X		2.93	(1.36-6.31)	31

[a] Adjusted by: BMI, tobacco, alcohol, fracture on his/her mother, diagnoses and treatment.

6. Bibliography

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