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DEVELOPMENT OF A *RISK SCORING SYSTEM* TO PREDICT A RISK OF OSTEOPOROTIC VERTEBRAL FRACTURES IN POSTMENOPAUSAL WOMEN

***D. Colangelo*, L. A. Nasto, M. Mormando,**

E. Pola (Rome)

Division of Spine Surgery, Department of Orthopaedic Surgery, Catholic University of Rome, Rome, Italy

INTRODUCTION

- **Osteoporosis is a disease characterized by reduced bone mineral density (BMD) and increased risk of fracture; it typically affects women in post-menopausal years.[1]**
- **Osteoporosis accounts for 1.4 million new vertebral compression fractures (VCFs) per year in the World; Europe and US account for half of them (~ 700.000 VCFs/year).[2]**
- **BMD (or T-Score), as measured by X-ray absorptiometry (DXA), is a primary predictor of fracture risk and is commonly used to establish a clinical diagnosis of osteoporosis.[1]**
- **Unfortunately, almost every spine surgeon knows how simplified and inaccurate BMD can be in estimating risk of new VCFs. Therefore, using BMD (or T-Score) alone to estimate fracture risk is largely unsatisfactory.[3]**
- **The aim of this study was to develop a risk scoring system to identify and gauge the risk of developing a first osteoporotic VCF in post-menopausal women.**

1. *Kanis J.A., Osteoporos Int 1997*
2. *Johnell O., Kanis J.A., Osteoporos Int 2006*
3. *Kanis J.A., Johnell O., Oden A., et al. Osteoporos Int 2008*

MATERIALS AND METHODS

• A retrospective cross-sectional study on 985 post-menopausal women consecutively visited at our outpatient service for Osteoporosis was designed.

• Only patients with either no previous VCFs or one or more recent (< 4 months) VCFs were enrolled; moreover, patients with > 2 years of antiresorptive and/or anabolic bone therapies were also excluded. A total of 477 patients were enrolled.

• Patients' medical records and spine imaging studies were thoroughly reviewed to identify clinical predictors of new onset VCFs. A total of 15 candidate risk factors were studied (age, BMI, weight, femoral neck T-Score and L1-L4 lumbar T-Score, femoral neck Z-Score and L1-L4 lumbar Z-Score, femoral neck BMD and L1-L4 lumbar bone mineral density, smoking habit, alcohol consumption, 25-OHvitamin D, bone alkaline phosphatase and total alkaline phosphatase, L4 vertebral volume).

MATERIALS AND METHODS

•Patient population was randomly split in a derivation (*n=242*) cohort and validation (*n= 235*) cohort. All statistical analysis and conclusions were drawn in the derivation cohort and then validated in the validation cohort.

• Clinical predictors of new onset VCFs were identified in the derivation cohort with an univariate analysis. Statistically significant risk factors were then used to build a multivariate model using logistic regression analysis. Finally, positive predictors of VCFs in the multivariate analysis were used to design a point-score system for risk assessment.

RESULTS

• A total of 477 post-menopausal women were enrolled (mean age 68.9), 205 patients had at least one recent VCF at the enrollment (255 total VCFs).

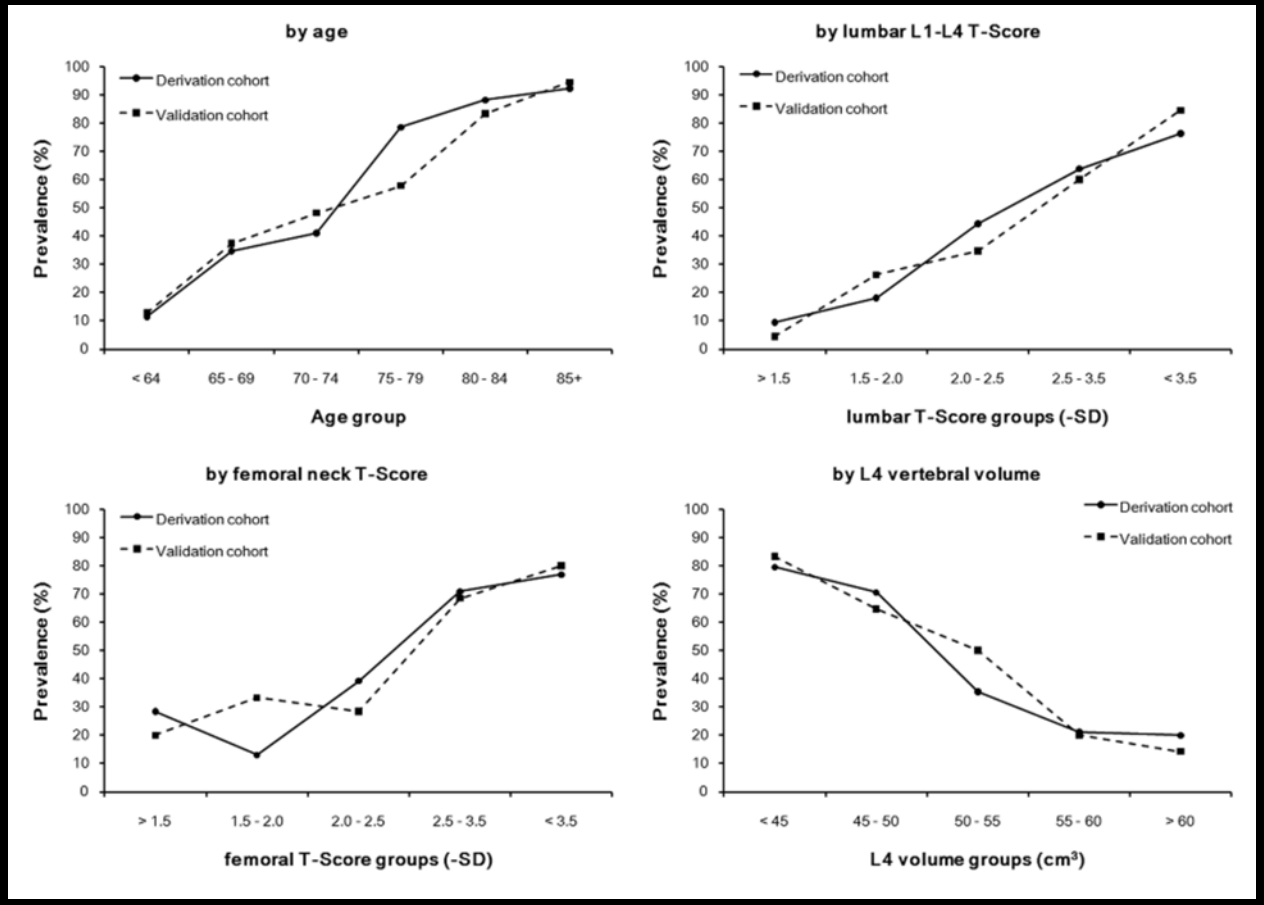
• Only five factors were significantly associated with increased risk of new onset VCFs in the univariate analysis, i.e. age (OR 3.125, $p<0.001$), L1-L4 T-Score (OR 2.471, $p<0.001$), femoral neck T-Score (OR 1.942, $p<0.001$), smoking habit (OR 2.097, $p<0.045$), and L4 vertebral volume (OR 2.614, $p<0.001$).

RESULTS

Variable (Risk factor)	*p value*	***OR (95% CI)***	***Regression Coefficient***
Age (+5 years)	<0.001	4.474 (1.916 – 6.301)	2.245
L1-L4 T-Score (-0.5 SD)	0.001	2.640 (1.520 – 4.588)	1.971
Femoral Neck T-Score (-0.5 SD)	0.008	1.941 (1.491 – 3.163)	1.325
L4 volume (-5.00 cm^3)	0.005	3.063 (1.545 – 6.418)	2.124
Smoke habit (yes/no)	0.007	2.854 (1.858 – 5.493)	2.049

Results of the multivariate analysis showing the identified predictors of VCFs in the derivation cohort

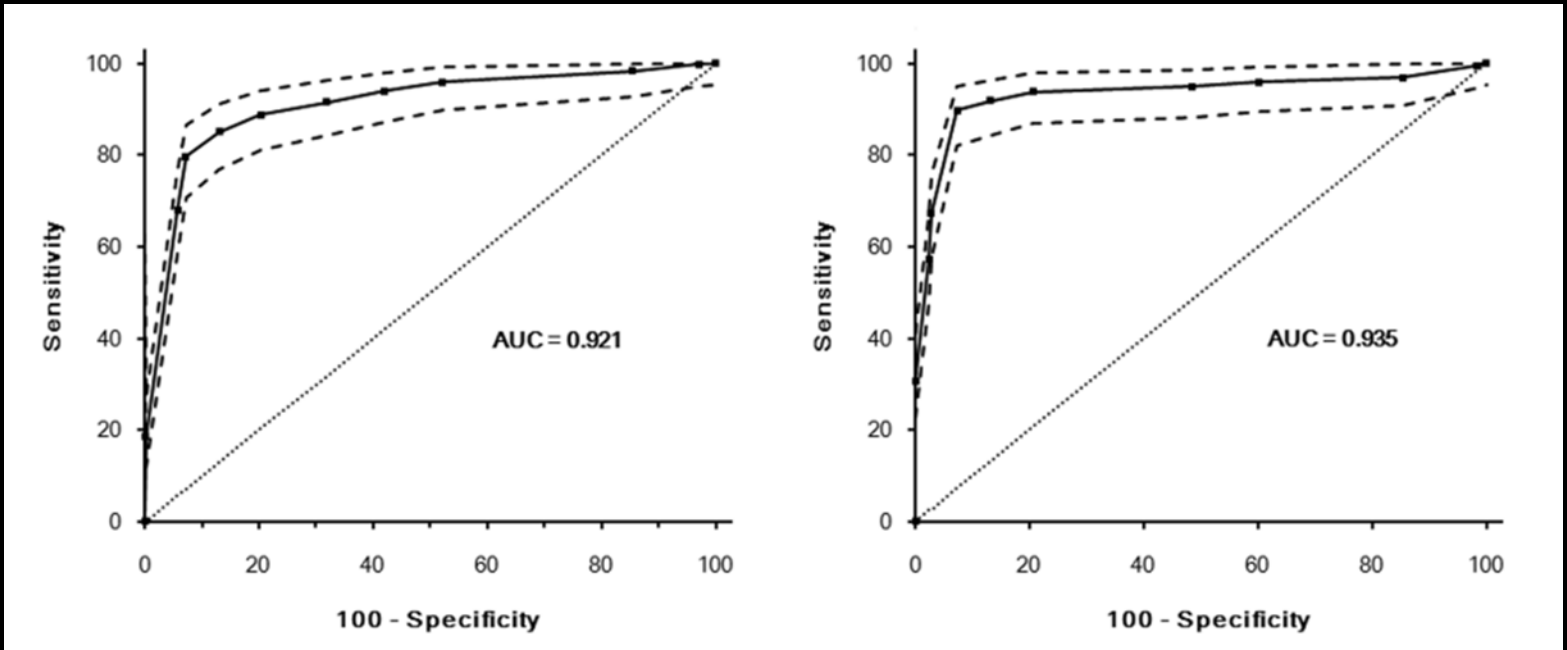
RESULTS



Observed prevalence of VCFs in derivation and validation cohorts classified by age groups, by lumbar L1-L4 T-Score, femoral neck T-Score, and L4 vertebral volume*

* L4 vertebral volume was calculated by lumbar DEXA scanning as $V=A^{3/2}$, where A is the projected area of L4 obtained by posteroanterior scanning.[4]

RESULTS



•Regression coefficients rounded to the nearest integer from the five identified risk factors were used to build a risk scoring system. All patients in the derivation and validation cohort were classified using the newly defined risk scoring system. The scoring system was tested performing a ROC analysis in both cohorts (AUC 0.921 in the derivation cohort, AUC 0.935 in the validation cohort).

RESULTS

- A new risk scoring system for the prevision of onset of the VCFs. A point score was assigned to each variable rounding the regression coefficient to the nearest integer.

Age (years)	*Score*	*Lumbar T-Score (-SD)*	*Score*	*Neck T-Score (-SD)*	*Score*	*L4 Volume (cm^3)*	*Score*	*Smoke (yes/no)*	*Score*
< 64	2	> 1.5	2	> 1.5	1	> 60	2	No	0
65 – 69	4	1.5 - 2.0	4	1.5 - 2.0	2	55 – 60	4	Yes	2
70 – 74	6	2.0 - 2.5	6	2.0 - 2.5	3	50 – 55	6	-	-
75 – 79	8	2.5 - 3.5	8	2.5 - 3.5	4	45 – 50	8	-	-
80 – 84	10	< 3.5	10	< 3.5	5	< 45	10	-	-
85+	12	-	-	-	-	-	-	-	-

EXAMPLE PATIENT

- A simple score from clinical history and routine diagnostic workout

Age (years)	*Score*	*Lumbar T-Score (-SD)*	*Score*	*Neck T-Score (-SD)*	*Score*	*L4 Volume (cm^3)*	*Score*	*Smoke (yes/no)*	*Score*
< 64	2	> 1.5	2	> 1.5	1	> 60	2	No	0
65 – 69	4	1.5 - 2.0	4	1.5 - 2.0	2	55 – 60	4	Yes	2
70 – 74	6	2.0 - 2.5	6	2.0 - 2.5	3	50 – 55	6	-	-
75 – 79	8	2.5 - 3.5	8	2.5 - 3.5	4	45 – 50	8	-	-
80 – 84	10	< 3.5	10	< 3.5	5	< 45	10	-	-
85+	12	-	-	-	-	-	-	-	-

Score: 6 + 8 + 3 + 6 + 2 = 25

High risk of developing a first osteoporotic VCF

CONCLUSION

- Our findings indicate that five simple and common clinical variables, namely age, L1-L4 T-Score, femoral neck T-Score, L4 vertebral volume and smoking habit, can be combined in a clinically relevant risk scoring system to accurately gauge the risk of new onset VCFs in post-menopausal women.

- Patients with higher scores can be assigned to more strict follow-up programs. Moreover, risk assessment should increase patients' awareness of osteoporosis and increase their adherence to therapy.

Disclosure

None of the authors has any potential conflict of interest