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Original Article

Osteoporosis Risk Calculators

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Abstract

Osteoporosis is a silent disease until fractures occur, patient recognition is the greatest clinical challenge. Although more than 20 million women in the US are estimated to have established osteoporosis the majority are not appropriately identified. Bone densitometry is the current gold standard for diagnosis of osteoporosis; but may not be feasible or cost-effective to recommend for all postmenopausal women. Therefore, questionnaires incorporating risk factors have been developed to aid the clinician in identifying women with osteoporosis. We will review Qfracture, CAnadian Risk for Osteoporosis Calculator (CAROC), the Simple Calculated Osteoporosis Risk Index (SCORE), the Osteoporosis Risk Assessment Index (ORAI), the Osteoporotic Self-assessment Tool (OST), ABONE, and the United States Preventive Services Task Force recommendations.

Key Words: Asthma; diabetes; falls; glucocorticoids; osteopenia.

Introduction

Osteoporosis is a systemic skeletal disease characterized by decreased bone strength leading to an increased risk of fracture *(1)*. The disease can cause significant functional decline and disability, as well as increased mortality *(2)*. Osteoporotic fractures are a major and increasing cause of morbidity and pose a considerable burden to health services. The number of fractures in the elderly and the associated economic burden will continue to rise because of the aging of the world's population. The identification of individuals at risk of osteoporosis has been challenging. The United States Preventive Services Task Force (USPSTF) and the National Osteoporosis Foundation are recommending that women aged 65 yr and older be routinely screened for osteoporosis *(3,4)*. The National Osteoporosis Foundation also recommends that men be screened at the age of 70 yr *(3)*.

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Because osteoporosis is a silent disease until fractures occur, patient recognition is the greatest clinical challenge. Twenty million women in the United States are estimated to have established osteoporosis, but the majority are not appropriately identified and treated. Bone densitometry is the current gold standard for the diagnosis of osteoporosis; however, it may not be feasible or cost-effective to recommend bone densitometry for all postmenopausal women. Therefore, various questionnaires incorporating risk factors have been developed to aid the clinician in identifying women with osteoporosis.

Numerous risk factors for osteoporosis and fractures have been identified and tools have been developed to integrate risk factors into a single evaluation of fracture risk for individuals. Recently developed prediction tools, such as the World Health Organization Fracture Risk Assessment Tool (FRAX) algorithm *(5)*, the QFracture algorithm *(6)*, and the Garvan Fracture Risk Calculator, are aimed at assisting clinicians in the management of their patients through the calculation of the patient's 5- or 10-yr risk of fracture based on a combination of known risk factors.

This review will evaluate risk prediction tools including QFracture, Canadian Risk for Osteoporosis Calculator (CAROC), the Simple Calculated Osteoporosis Risk

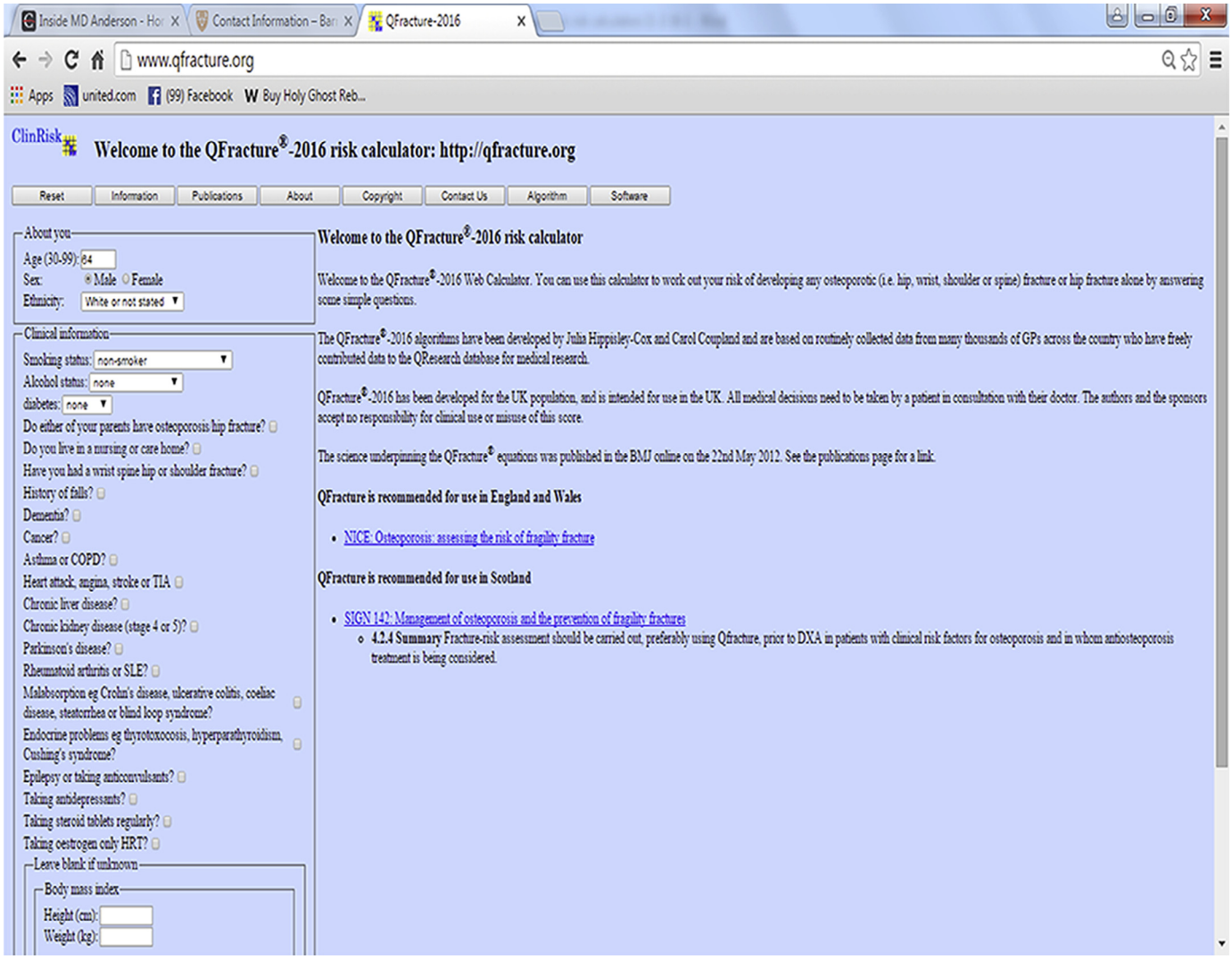
Estimation (SCORE), the Osteoporosis Risk Assessment Index (ORAI), the Osteoporotic Self-Assessment Tool (OST), Age Bulk One or Never Estrogens (ABONE), and the United States Preventive Services Task Force recommendations.

Fracture Risk Calculators

QFracture

This risk assessment tool was developed and validated in a large cohort of patients (3.6 million) from the QResearch database (www.fracture.org); two thirds were randomly allocated to model development and one third to model validation (United Kingdom). The QResearch database is a large database comprising over 12 million deidentified medical records from 600 practices throughout the United Kingdom. The QFracture was developed with 2.4 million patients, aged 30–85 yr of age, contributing to 2.4 million person-yr of observation, with 32,284 new osteoporotic fractures and 14,726 hip fractures between January 1, 1993, and June 30, 2008. The scores were derived using a Cox proportional hazards model. Fractional polynomials were used to model nonlinear risk relations with continuous risk factors, and the presence of interactions between risk factors was tested. The final model included 17 risk factors for women and 12 for men (Table 1). The performance was tested on 1.3 million patients from the QResearch database with 18,471 fractures and 7162 hip fractures. The development of the model and the initial internal validation study were both carried out using a random sample of data from the same population *(8)*.

The external validation QFracture was carried out by Collins et al using the THIN database (www.thin-uk.com) *(7)*. This database contains 20% of general practices in the United Kingdom. The 2 primary outcomes were the first (incident) diagnosis of an osteoporotic fracture and an incident diagnosis of hip fracture. Using the QFracture scores, the 10-yr estimated risk of fractures was calculated, with 2.2 million adults in a general practice, aged 30–85 (13 million person-yr), with 25,208 osteoporotic fractures



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