Sieklucka Ewa, Ogurkowski Karol, Stocka Barbara, Hagner-Derengowska Magdalena. Fracture Risk Assessment Tool (FRAX)®. Journal of Education, Health and Sport. 2019;9(2):317-324. eISNN 2391-8306. DOI http://dx.doi.org/10.5281/zenodo.2574320
http://ojs.ukw.edu.pl/index.php/johs/article/view/6616

The journal has had 7 points in Ministry of Science and Higher Education parametric evaluation. Part B item 1223 (26/01/2017).
1223 Journal of Education, Health and Sport eISSN 2391-8306 7

The authors declare that there is no conflict of interests regarding the publication of this paper.

Received: 30.01.2019. Revised: 30.01.2019. Accepted: 21.02.2019.

Fracture Risk Assessment Tool (FRAX)®

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Abstract

For many years, there were no models for Polish population. Prospective studies showed that the use of British data model is reliable for the Polish patients, as supported by Przedlacki21,26,27 and others. Lately, a new version of the FRAX® method, including Polish data was introduced28,29. This triggered writing of the current paper, to continue farther studies of this population. Use of the described method to monitor treatment or to evaluate patients already treated, is pointless. Still, the method should be popularized, since only 10% of patients after an osteoporotic fracture are treated for the underlying condition3. The goal should be prevention of future fractures, return of independence in the activities of daily living and mobility.

Key words: **frax; osteoporosis**

Until now, in medical practice, bone density measurements, BMD, were done over lumbar area, distal forearm or hip, using dual energy X-ray absorptiometry (DEXA) scan. This was the only, indicated method of diagnosing osteoporosis[1.] The results are obtained as bone density over specific area and compared to bone density of a healthy 35-year old adult (T-score) and a healthy person of the same age (Z-score). The results are reported as standard deviation (SD) of the normal values.

According to WHO, T-score of >-1.0 SD is classified as Normal, -1.0 to -2.5 SD, as osteopenia and <-2.5 SD as osteoporosis[2]. Normal results of bone density testing does not eliminate risk of fracture. According to medical literature, most of fractures (75%) happens in patients with undiagnosed osteoporosis[3,4] and up to 55 t0 75%with T score within normal or osteopenic range[5-8].

BMD testing assesses bone density , that only partially relates to bone strength. The test, does not incorporate other, non-skeletal risk factors. Lately, the most important progression in the field of osteoporosis , was introduction of new risk assessment methods, particularly, the Fracture Risk Assessment Tool (FRAX®)[9]. This model, developed by J. A. Kanis, under the auspices of World Health Organization (WHO) and introduced in 2008, assesses 10 year risk of osteoporotic fracture, expressed in percentage[10.]

The FRAX® algorithm evaluates risks separately of proximal and distal hip fractures. Calculations are done by a computer program and are specific to gender and race. The FRAX® method was introduced into medical practice in many countries[11-15,] since it does not require access to actual bone density scanning[16]. It allows, within 30 seconds, to calculate the risk of fracture based on: age, gender, Bone Mineral Density - not absolutely required, Body Mass Index (BMI), family history of fractures, smoking, alcohol abuse, secondary osteoporosis (due to Type I Diabetes Mellitus, hypogonadism, premature menopause, chronic, untreated hyperthyroidism, rickets, chronic malnutrition or chronic liver disease), rheumatoid conditions and chronic corticosteroid treatment. FRAX® calculation is available online at www.osteoporoza.pl, www.shef.ac.uk . This evaluation is more accurate when done using FRAX specific for a country, when available[17]. In Poland, a simple calculator was developed by E. Czerwiński, allowing evaluation without any additional equipment and based on an interview, weight and use of measuring tape[18] .Table 2 is showing specific questions, that are used.

The FRAX® method is based on identified and statistically important, BMD independent, individual, fracture risk factors[19]. This tool is utilized to identify patients with fracture risks but normal or slightly lower BMD. The bone density results should be the deciding factor in cases of indeterminate FRAX results and vice versa[10,20,21.]

There are many factors increasing the fracture risk, that are included or omitted in the FRAX® method (Table 1). According to the global recommendations by WHO, ISCD (International Society for Clinical Densitometry) and IOF (International Osteoporosis Foundation), the integration of independent fracture risk factors together with the 10 year absolute probability of the osteoporotic fracture, should serve as a goal in diagnosis of osteoporosis[22-24]. Use of only BMD value as deciding diagnostic marker should no longer be included in clinical practice[25.] It should be treated only as an additional tool in the clinical assessment of a patient, but not the final, deciding factor in initiating treatment. FRAX® together with BMD value estimates the fracture risk much better.

For many years, there were no models for Polish population. Prospective studies showed that the use of British data model is reliable for the Polish patients, as supported by Przedlacki[21,26,27] and others. Lately, a new version of the FRAX® method, including Polish data was introduced[28,29]. This triggered writing of the current paper, to continue farther studies of this population.

Use of the described method to monitor treatment or to evaluate patients already treated, is pointless. Still, the method should be popularized, since only 10% of patients after an osteoporotic fracture are treated for the underlying condition[3.] The goal should be prevention of future fractures, return of independence in the activities of daily living and mobility. The holistic approaches to osteoporosis treatment include addressing calcium and vitamin D deficiencies, plus use of appropriate pharmacological therapy (bisfosfonian,calcitonin,oestrogens, derivatives SERM-y, calcium and vit. D, alendronian, ryzedronian, ranelinian strontu i teryparatyd, denosumab, PTH)[32,33] and physiotherapy. The rehabilitation program should include at least 20 minutes of physical activity daily, directed towards decreasing risks of falls: posture improvements, core muscle strengthening, stimulation of bone synthesis, equilibrium and coordination exercises, breathing exercises, motor-sensory exercises with static and dynamic supported elements, general fitness, flexibility and endurance promoting exercises. There are indications for mechanical loading

stimulating skeletal system, conducted in the upright position eg. walking, jogging, dance, twisting exercises with and without equipment. Detailed descriptions of the indicated activities for patients suffering from osteoporosis, are widely reported in literature[34-36].

(A) (B)

Figure 1. Pictures of the FRAX® manual calculator [18]. (A) Calculating the risk of breaking on the basis of BMD, (B) – calculating fracture risk based on BMI.

Table 1. Description of comments to questions FRAX® [19,37].

The risk factors used in FRAX®	Comments	The risk factors not used in FRAX®
Age, Sex	The model accepts ages only between 40 and 90 years.	
Race	Included black, Caucasian, white Spanish type and Asian	
Weight - entered in kg. Height - entered in cm.	Calculation BMI	Change in BMD values, the value of bone turnover markers.
Previous fracture	Only fractures after the age of 20 have been considered.	Time from the occurrence of the previous fracture.
Parent fractured hip	This enquires for a history of hip fracture in the patient's mother or father.	Falls, fractures in siblings, other fractures in the parents than in the femur, the number of vertebral fractures, Genant's degree of fracture.
Glucocorticoids	Enter yes if the patient is currently exposed to oral glucocorticoids or has been exposed to oral glucocorticoids for more than 3 months at a dose of prednisolone of 5mg daily or more (or equivalent doses of other glucocorticoids)	
Smoking	Current smoking	Time and number of cigarettes
Rheumatoid arthritis	Enter yes where the patient has a confirmed diagnosis of rheumatoid arthritis.	
Secondary osteoporosis	Enter yes if the patient has a disorder strongly associated with osteoporosis. These include type I (insulin dependent) diabetes, osteogenesis imperfecta in adults, untreated long-standing hyperthyroidism, hypogonadism or premature menopause (<45 years), chronic malnutrition, or malabsorption and chronic liver disease	
Alcohol 3 or more units/day	Enter yes if the patient takes 3 or more units of alcohol daily. A unit of alcohol varies slightly in different countries from 8-10g of alcohol. This is equivalent to a standard glass of beer (285ml), a single measure of spirits (30ml), a medium- sized glass of wine (120ml), or 1 measure of an aperitif (60ml)	

Table 2.Questionnaire questions FRAX® calculator[38] .

	Questionnaire questions FRAX® calculator
1	Gender, age, height (cm), weight (kg).
2	Have you ever suffered a fractured bone as a result of adulthood? low-energy injury (eg stumbling, falling from the height of the body)?
3	Have any of your parents ever suffered a fractured hip low-energy injury (eg stumbling, falling from the height of the body)?
4	Are you currently smoking cigarettes?
5	Have you ever taken glucocorticosteroids (eg enucleon in tablets, for more than a few weeks)?
6	Have you ever been diagnosed with rheumatoid arthritis? distinguish from degenerative disease)?
7	Did you ever suffer from disorders that may cause osteoporosis: early menopause (before the age of 45), prolonged menstrual atrophy (not related to pregnancy), reduced mobility (eg after stroke, illness Parkinson's, backbone injury), Crohn's disease, ulcerative colitis, insulin-dependent diabetes, hyperthyroidism and other secondary osteoporosis?
8	Do you drink on average more than 3 units of alcohol per day (alcohol unit: a pint of beer, a glass of vodka, a glass of wine)?

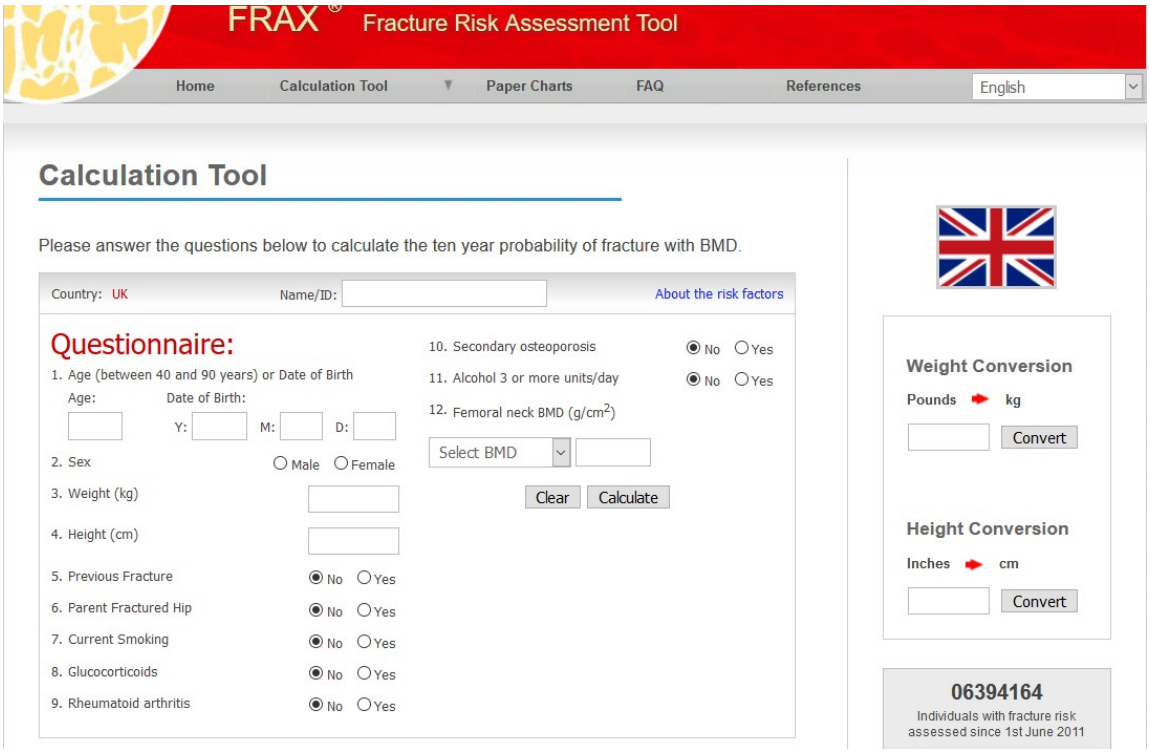

Figure 2. Online fracture risk calculator WHO FRAX®[38].

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