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POSITION PAPER

Worldwide uptake of FRAX

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Abstract
Summary The worldwide uptake of FRAX is described.
Introduction The aim of this report was to determine the usage of FRAX worldwide over a 1-year period from 1 May 2012.
Methods The number of FRAX calculations from each country was assessed over a 1-year period and expressed as calculations per million of the population aged 50 years or more. Countries were colour coded according to usage to populate a world map.
Results Over the index year, there were estimated to be 2,391,639 calculations sourced from 173 counties. Uptake was high in North America, the Antipodes and most countries of Europe; intermediate in Latin America and the Middle East; and very low in Africa and much of South East Asia.
Conclusions It is expected that the comparative data will encourage the development of new FRAX models and the uptake of FRAX into assessment guidelines.

Keywords FRAX · Fracture risk assessment

Background and aims

FRAX is an algorithm that determines fracture probability in individuals by integrating the weight of important clinical risk factors for fracture and mortality risk, with or without information on BMD. Each tool is country specific and calibrated to the national epidemiology of fracture and mortality. FRAX was developed by the WHO Collaborating Centre for Metabolic Bone Diseases at Sheffield, UK, and launched in 2008 [1, 2]. The FRAX tool (www.shef.ac.uk/FRAX) computes the 10-year probability of hip fracture and/or a major osteoporotic fracture. A major osteoporotic fracture is a clinical spine, hip, forearm and humerus fracture. The use of the tool improves risk assessment compared to the use of BMD alone [3].

FRAX is now a component of many national guidelines for the assessment of osteoporosis and international guidelines for postmenopausal osteoporosis and glucocorticoid-induced osteoporosis [4, 5]. The aim of this report was to determine the usage of FRAX worldwide in 2013.

Methods

FRAX models (58 in 53 countries) are available for Argentina, Armenia (surrogate), Austria, Australia, Belgium, Brazil, Canada, Chile, Czech, China, Colombia, Denmark, Ecuador, France, Finland, Germany, Greece, Hong Kong, Hungary, Iceland, India (surrogate), Indonesia, Ireland, Italy, Japan, Jordan, South Korea, Lebanon, Lithuania, Malta, Mexico, Morocco, Netherlands, New Zealand, Norway, Palestine (surrogate), Philippines, Poland, Portugal, Romania, Russia, Singapore, Slovakia, Sri Lanka (surrogate), Spain, Sweden, Switzerland, Taiwan, Thailand, Tunisia, Turkey, UK and US. In five of these countries (Armenia, Brazil, Iceland, Monaco and Thailand), the model became available after the study period.

Each FRAX model on the web counts the number of actual calculations performed for that particular country model. A

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problem with these data is that some countries, particularly those without a country-specific FRAX model, may use a surrogate. For example, the UK model was adopted as a surrogate in Poland before the advent of a Polish model, and the Greek model is used in Cyprus. For this reason, we assessed the number of calculations by the source of the calculation (Google Analytics). Google Analytics determines the location from a visitor's IP address. Data at the country level are described as accurate worldwide; Google states that access via mobile devices or VPN can lead to inaccuracies in tracking the source, but usually at levels within the country of origin (e.g. assigned to the wrong city). FRAX usage was computed as the number of calculations originating from each country and expressed as calculations/million of the general population over the age of 50 years during a period of 1 year (1 May 2012 to 30 April 2013).

The web site is not the sole portal for the calculation of fracture probabilities. For example, FRAX is available in BMD equipment, on the iPhone and, in some countries, through handheld calculators. Based on straw polls, it was assumed that 25 % of calculations were undertaken independent of the web site, and the annual number of FRAX calculations was upwardly revised pro rata. An exception was Japan where a survey of 2,119 practitioners indicated that 71 % of doctors used the widely available handheld calculators (Japanese Osteoporosis Foundation 2013; Nakatsuka, personal communication). The data from Japan were uplifted accordingly. Handheld calculators are also used in Poland (USA) and Russia, but the proportion of calculations undertaken using these tools are uncertain, and the adjustment factor of 1.25 was conservatively used.

The number of calculations over the index period was divided by the population over the age of 50 years for the year 2015, estimated using demography from the UN [6] (medium variant) and expressed as calculations/million. For several countries (Anguilla, Andorra, Antigua and Barbuda, Bermuda, Cayman Islands, Curacao, Gibraltar, Laos, Liechtenstein, Monaco, Northern Mariana Island, Sint Maarten, Taiwan, Turks and Caicos Islands), UN data were not available, and the population aged 55 years or more in 2013 was used as the denominator [7].

Colour coding

FRAX calculations/million of the population aged 50 years or more/year were categorised as given in Table 1. The colour coding used was that previously used for a European score-card [8].

Results

Over the index year, there were estimated to be 2,391,639 calculations sourced from 173 counties. The countries that used FRAX most frequently were the USA, UK, Canada, Spain, Japan, France, Belgium, Italy, Switzerland and Turkey. Collectively, these counties undertook more than 80 % of all calculations.

The usage of the FRAX models is shown in the Appendix expressed per capita of the population aged 50 years or more which shows a considerable heterogeneity in uptake. Of the larger countries (index population of >100,000), Belgium, Canada, Ireland, Lebanon, New Zealand, Slovenia, Sweden, Switzerland, UK and USA comprised the top 10 (Fig. 1). The lowest uptakes were seen in Afghanistan and the African countries of Benin, Burkina Faso, Burundi, Cameroon, Niger, Nigeria, Rwanda, Somalia and Tanzania.

In Europe, there was a high usage in the majority of countries. Low or very low use was noted in Albania, Belarus, Bulgaria, Bosnia and Herzegovina, Croatia, Germany, Latvia, Macedonia, Moldova, Serbia and Ukraine (Fig. 2).

Worldwide, there was a marked dearth of FRAX calculations in many of the countries of Africa and South East Asia (Fig. 3). High usage was a feature of North America and Western Europe

Discussion

Osteoporosis is a complex disease that can be treated and managed in a number of ways. Improvements in medication and diagnostic techniques in the past 25 years have served to reduce the risk of osteoporotic fractures. Worldwide, however, research has shown a significant heterogeneity in the different

Table 1 Criteria for allocating scores

Calculations/million		
>1200		High use
320-1200		Intermediate use
<320 >100		Low use
<100		Very low use

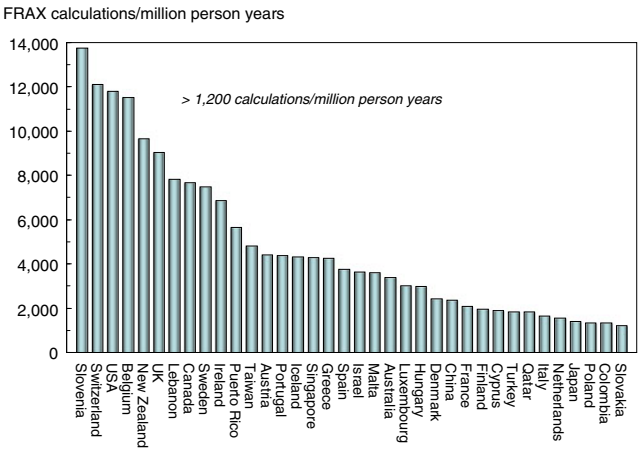

Fig. 1 High users of FRAX with more than 1,200 calculations/year per million of the population aged 50 years or more. Excludes countries with a population base of <100,000

national approaches to the management of the disease. The present report summarises one key indicator of the management of osteoporosis, namely, the assessment of fracture risk. The metric used was the number of FRAX calculations in each country per million person years. The aim was to draw attention to the disparities in health-care provision that can serve in the setting of benchmarks to inform patients, health-care providers and policy makers.

The present study illustrates an enormous heterogeneity in the uptake of FRAX. Although we estimate that approximately 2.3 million calculations per year are made, the usage varies from more than 10,000 calculations per million (Belgium, Bermuda, Slovenia, Switzerland and USA; see Appendix) to less than 10/million of the population at risk (in 37 counties). The thousandfold range in an uptake of FRAX is considerably greater than the 30-fold range of crude or 10-fold range of age-standardised hip fracture incidence worldwide [8–10] and indicates a large gap in the provision of service.

Reasons for the heterogeneity are speculative. Likely, reasons are the limited access to the Internet in many countries, a low risk of fracture with more urgent health-care priorities and the slow pace of incorporation of new technologies into assessment guidelines. Moreover, many countries have no assessment guidelines for osteoporosis. Variations in uptake are not closely related to the availability of a country-specific model. The availability of dual-energy X-ray absorptiometry (DXA) may play a role, but this is complex. For example, the uptake of FRAX is much higher in Slovenia than in Slovakia and, so too, is the availability of DXA [8], even though a country-specific model is not available for Slovenia. In contrast, the use of FRAX is low in some countries with a high availability of BMD such as Denmark, Japan, the Netherlands and Spain. In these countries, FRAX is not used as a gatekeeper to DXA, but as an aid in interpreting BMD. For these reasons, there is no significant correlation between the availability of BMD and uptake of FRAX.

There are several limitations in the present study noted in the methods. Of particular importance is that the calculations undertaken through the web site do not capture all calculations. Thus, FRAX is available on densitometers, on the iPhone and, in some countries, on handheld calculators. The quantum of this underestimate is uncertain, but the data at our disposal suggest that offline calculations range from 25 to 71 %. Although the range of the underestimate is large, it has a small impact on the categorisation of uptake of FRAX given the greater than a thousandfold range in usage between countries.

A further limitation is that alternative risk assessment tools are available in some countries. The present data underestimate the use of risk assessment in Germany. Fracture risk assessment comprises a component of national guidelines but is not FRAX

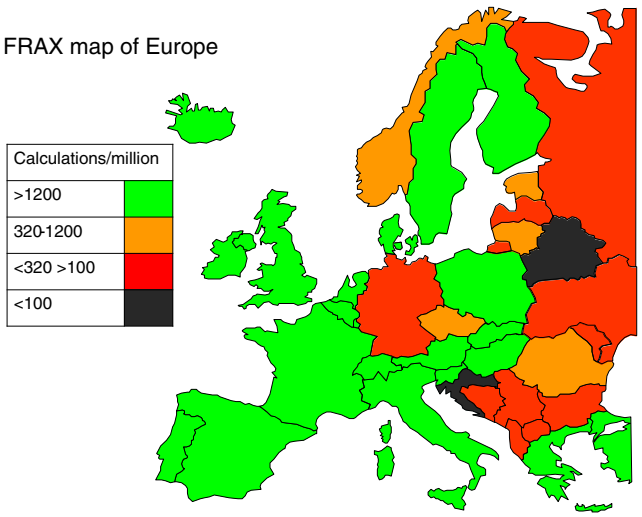

Fig. 2 Uptake of FRAX in Europe

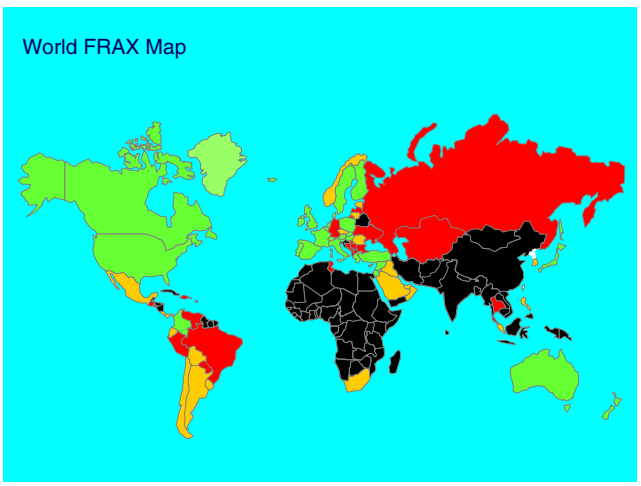

Fig. 3 Uptake of FRAX worldwide. See Fig. 2 for colour coding. No data available for North Korea

based [11]. Alternative assessment algorithms are also available in the UK, Australia and the Netherlands [12–14].

The estimates above are likely to be conservative. Even so, there are reasons to believe that FRAX is underutilised. For example, the use of FRAX in Denmark in 2010 (942 calculations/million of the total population per year) was much lower than the number of BMD tests/year (18,500/million per year) [8]. Thus, a colour code of green should not be interpreted as a sign of appropriate uptake.

Acknowledgments Maps are courtesy of Presentation Magazine available at www.presentationmagazine.com accessed 20th June 2013.

Conflicts of interest None

Appendix

Estimated number of FRAX calculations per year together with colour coding

Country	Number of calculations	Population (thousands)	Colour code	Number of calculations /million of the population aged 50+ years
Bermuda	1,950	21		93,257
Slovenia	11,313	823		13,745
Switzerland[a]	36,790	3,037		12,114
USA[a]	1,299,575	110,064		11,807
Belgium[a]	48,780	4,239		11,507
New Zealand[a]	14,733	1,527		9,648
UK[a]	211,055	23,388		9,024
Lebanon[a]	7,538	964		7,819
Canada[a]	102,570	13,376		7,668
Sweden[a]	27,605	3,691		7,479
Ireland[a]	9,641	1,406		6,857
Cayman Islands	73	13		5,684
Puerto Rico	6,581	1,165		5,649
Taiwan[a]	27,179	5,662		4,800
Austria[a]	14,795	3,366		4,395
Portugal[a]	18,464	4,219		4,376
Iceland[a,b]	456	106		4,304
Singapore[a]	7,864	1,832		4,292
Greece[a]	19,014	4,473		4,251
Spain[a]	65,911	17,598		3,745
Israel	7,526	2,078		3,622
Malta[a]	586	163		3,597
Turks &Caicos Islands	15	4		3,451
Monaco	45	13		3,423
Australia[a]	26,795	7,895		3,394
Luxembourg	543	181		2,997
Hungary[a]	10,876	3,666		2,967
Gibraltar	20	8		2,663

Table (continued)

Country	Number of calculations	Population (thousands)	Colour code	Number of calculations /million of the population aged 50+ years
Liechtenstein	26	11		2,439
Denmark [a]	5,208	2,141		2,432
China, Hong Kong [a]	6,938	2,960		2,344
France [a]	50,296	24,330		2,067
Finland [a]	4,329	2,224		1,946
Cyprus	670	352		1,903
Turkey [a]	29,468	15,960		1,846
Qatar	406	222		1,830
Guam	75	45		1,667
Italy [a]	42,438	25,586		1,659
Netherlands [a]	10,171	6,502		1,564
Anguilla	4	3		1,494
Japan [a]	78,638	56,878		1,383
Poland [a]	18,815	13,944		1,349
Colombia [a]	13,123	9,934		1,321
Slovakia [a]	2,279	1,858		1,226
Romania [a]	8,628	7,277		1,186
UAE	1,031	874		1,180
Bolivia	1,760	1,561		1,127
Chile [a]	5,508	4976		1,107
Andorra	21	22		950
Costa Rica	1,001	1,118		896
Norway [a]	1,484	1,781		833
Kuwait	286	347		825
Mexico [a]	18,219	23,736		768
Philippines [a]	11,076	14,506		764
Czech Republic [a]	2,886	3,908		739
Jordan [a]	561	789		711
China, Macao	125	187		668
S Korea [a]	10,410	16,964		614
Malaysia	3,621	5,958		608
Argentina [a]	6,279	10,714		586
Panama	445	777		573
Saudi Arabia	1,905	3,780		504
Aruba	19	38		493

Table (continued)

Country	Number of calculations	Population (thousands)	Colour code	Number of calculations /million of the population aged 50+ years
South Africa	4,201	8,575		490
New Caledonia	31	64		488
Bahamas	43	89		478
Estonia	233	499		466
Oman	211	462		457
Barbados	39	95		408
Sint Maarten	3	7		404
Lithuania[a]	444	1,181		376
Bahrain	79	211		373
Ecuador[a]	1,056	2,914		362
Réunion	83	228		362
Uruguay	365	1,042		350
Trinidad &Tobago	100	344		291
Antigua & Barbuda	4	14		283
Russian Federation[a]	13,800	49,514		279
Peru	1,533	5,683		270
Brunei	20	75		267
Tunisia[a]	591	2,381		248
Bhutan	29	119		242
Montenegro	50	209		239
El Salvador	265	1119		237
Guatemala	454	1931		235
Brazil[a,b]	10026	46343		216
Venezuela	1235	6046		204
Kazakhstan	773	3783		204
Thailand[a,b]	3994	20392		196
Martinique	29	155		185
Germany[a]	6504	35881		181
Serbia	583	3371		173
Jamaica	105	610		172
Bulgaria	489	2854		171
Palestine[a]	73	450		161
Netherlands Antilles	11	70		161
Georgia	229	1505		152
Mauritius	54	355		151

Table (continued)

Country	Number of calculations	Population (thousands)	Colour code	Number of calculations /million of the population aged 50+ years
Albania	129	886		145
N Mariana Islands	1	7		144
Bosnia & Herzegovina	198	1383		143
Dominican Republic	281	2001		141
Ukraine	2195	16028		137
Sri Lanka[a]	745	5549		134
Latvia	99	834		118
French Polynesia	8	65		115
Paraguay	129	1132		114
Macedonia	70	667		105
Moldova	119	1141		104
Guadeloupe	16	156		104
Maldives	5	52		96
Cape Verde	8	84		89
Virgin Islands	4	42		89
Croatia	148	1736		85
Morocco[a, b]	543	6484		84
Belize	4	45		83
Belarus	258	3304		78
Armenia[a, b]	74	957		77
Viet Nam	1435	19260		75
Indonesia[a]	3456	48261		72
Saint Lucia	3	35		71
Iraq	225	3533		64
Mongolia	28	461		60
Grenada	1	21		60
Mayotte	1	21		60
Iran	774	13789		56
Egypt	829	15361		54
Syria	165	3098		53
Libya	51	987		52
Namibia	16	312		52
Algeria	316	6261		51
Honduras	53	1098		48

Table (continued)

Country	Number of calculations	Population (thousands)	Colour code	Number of calculations /million of the population aged 50+ years
Botswana	14	289		48
Samoa	1	28		45
Suriname	5	115		43
Nicaragua	38	892		42
Kyrgyzstan	35	900		39
India [a]	8101	227771		36
Bangladesh	685	23707		29
Guyana	4	131		29
Fiji	5	176		28
Curacao	1	38		27
Azerbaijan	61	2313		26
Pakistan	583	25668		23
Kenya	86	4199		21
Djibouti	3	119		21
Myanmar	158	9807		16
Nepal	64	4364		15
China [a]	4821	377263		13
Timor-Leste	1	130		10
Mauritania	4	411		9
Swaziland	1	134		9
Yemen	19	2398		8
Cambodia	18	2269		8
Senegal	10	1185		8
Gambia	1	163		8
Uzbekistan	35	4718		7
Ghana	23	3335		7
Dominica	15	2001		7
Laos	4	576		7
Ethiopia	61	10094		6
Madagascar	16	2524		6
Ivory Coast	15	2570		6
Gabon	1	226		6
Sudan	28	5772		5
Cuba	19	3850		5
Haiti	8	1456		5

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Table (continued)

Country	Number of calculations	Population (thousands)	Colour code	Number of calculations /million of the population aged 50+ years
Togo	4	734		5
Congo	3	494		5
Lesotho	1	248		5
Uganda	11	2908		4
Malawi	6	1554		4
Zimbabwe	6	1424		4
Turkmenistan	4	858		4
Mozambique	8	2682		3
Angola	6	1925		3
Zambia	4	1223		3
Nigeria	46	18641		2
Afghanistan	5	3056		2
Cameroon	5	2344		2
Burkina Faso	4	1557		2
Rwanda	3	1129		2
Somalia	3	1038		2
Tanzania	5	4894		1
Burundi	1	983		1
Benin	1	997		1
Niger	1	1648		1
Totals	2391639	1602792		
		1492		

[a]FRAX model available

[b]FRAX model available from May 2013

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