The QFracture® 2016 Update

Revision History

Revision date	Document Version	Summary of Changes
29/07/2016	V1.0	First issue.
22/12/2022	V1.1	Correction of a type in table 1

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1 Purpose of document

This document details the 2016 update to the QFracture 10-year risk prediction algorithms derived from the QResearch® database. The update will be released in August 2016 and will go live on the QFracture website qfracture.org on 01 Oct 2016.

2 Rationale for updates of QFracture

Updates are sometimes required because of:

- **Changes in population characteristics** - for example, incidence of osteoporotic fracture is increasing; obesity is rising; smoking rates are falling;

- **Changes in requirements** for how the risk prediction scores can be used e.g. changes in age ranges.

- **Improvements in data quality** - for example the recording of exposures and also clinical outcomes becomes more complete over time. This is especially true for recording of ethnicity data which is becoming more complete. All 1243 practices in England currently contributing to the QResearch database (version 40) now have data linked at patient level from the Hospital Episode Statistics[1]. This means it is possible to identify patients who have been admitted to hospital for an osteoporotic fracture where this information is not already recorded on the GP record or linked mortality record from the Office of National Statistics (ONS). Both HES and ONS mortality data linkages extend back to 1997.

These factors occasionally require us to remodel the QFracture to the latest version of the QResearch® database to ensure the algorithm keeps up to date. If algorithms are not re-calculated, then their performance may gradually decay and their clinical value would diminish as a result.

We have re-fitted the QFracture algorithms using a three quarter sample of the QResearch® database (version 40, 31 Jan 2015) and incorporated this into the latest update of the software.

3 Summary of Changes to QFracture-2016

3.1 Changes to coefficients

We have updated the coefficients for the 10 year QFracture (2016) algorithm using the latest version of QResearch linked to HES and mortality data. The appendix shows details of fracture incidence rates and validation statistics.

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3.1 Amendments to the Read code list

Some of the code groups used for the calibration of this year's score have changed. Full details are available to those who license our software development kits in the code group documentation.

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4 Appendix1:

The QResearch database version 40 includes data from 1243 general practices. We identified an open cohort of patients registered with the practice from 01 Jan 1998 until 31 Jan 2015. There were 8.2 million patients in the derivation cohort and 2.7 million in the validation cohort which reflects the expansion of the database over the last few years.

Table 1 shows the incidence rates for osteoporotic fracture (vertebral, distal radius, proximal humerus, or hip fracture) and hip fracture (fractured neck of femur) for patients in the derivation cohort by sex, and calendar year between 1998 and 2015. The crude rates are per 1000 person years and include patients aged 30-99 years registered with practices in England. Patients with fracture are identified either from a diagnosis recorded in the GP record, or their linked mortality or linked hospital admission record.

Table 1: cases of fractured neck of femur and osteoporotic fracture recorded on GP or ONS or HES data in derivation cohort. Figures are incident cases, person years, rate per 1000 person years and 95% CI between 01 Jan 1998 to 31 Jan 2015

		Fractured neck of femur				All osteoporotic fracture			
		cases	Person years	Rate/10000	95% CI	cases	Person yrs	Rate/1000	95% CI
women	total	61029	26473924	23.1	(22.9 to 23.2)	134258	25488050	52.7	(52.4 to 53.0)
	1998	1944	1091026	17.8	(17.0 to 18.6)	3939	1066054	36.9	(35.8 to 38.1)
	1999	2257	1181933	19.1	(18.3 to 19.9)	4492	1152896	39.0	(37.8 to 40.1)
	2000	2517	1307714	19.2	(18.5 to 20.0)	5126	1272722	40.3	(39.2 to 41.4)
	2001	3134	1459058	21.5	(20.7 to 22.2)	6483	1417799	45.7	(44.6 to 46.9)
	2002	3354	1564973	21.4	(20.7 to 22.2)	7010	1518703	46.2	(45.1 to 47.3)
	2003	3636	1627122	22.3	(21.6 to 23.1)	7755	1576276	49.2	(48.1 to 50.3)
	2004	3631	1636591	22.2	(21.5 to 22.9)	8029	1582236	50.7	(49.6 to 51.9)
	2005	3817	1652555	23.1	(22.4 to 23.8)	8421	1594305	52.8	(51.7 to 54.0)
	2006	3865	1665835	23.2	(22.5 to 23.9)	8308	1604115	51.8	(50.7 to 52.9)

	2007	4112	1676381	24.5	(23.8 to 25.3)	8788	1611587	54.5	(53.4 to 55.7)
	2008	4037	1689973	23.9	(23.2 to 24.6)	8940	1622182	55.1	(54.0 to 56.3)
	2009	4265	1704090	25.0	(24.3 to 25.8)	9776	1633032	59.9	(58.7 to 61.1)
	2010	4175	1725288	24.2	(23.5 to 24.9)	9963	1650490	60.4	(59.2 to 61.6)
	2011	4316	1740575	24.8	(24.1 to 25.5)	9502	1662455	57.2	(56.0 to 58.3)
	2012	4274	1744402	24.5	(23.8 to 25.2)	9663	1664010	58.1	(56.9 to 59.2)
	2013	4002	1548350	25.8	(25.1 to 26.7)	9207	1473922	62.5	(61.2 to 63.8)
	2014	3415	1351957	25.3	(24.4 to 26.1)	8160	1284540	63.5	(62.2 to 64.9)
	2015	278	106105	26.2	(23.3 to 29.5)	696	100729	69.1	(64.1 to 74.4)
men	**total**	**22308**	**25833384**	**8.6**	**(8.5 to 8.7)**	**48701**	**25303188**	**19.2**	**(19.1 to 19.4)**
	1998	528	1045866	5.0	(4.6 to 5.5)	1133	1033127	11.0	(10.3 to 11.6)
	1999	701	1137022	6.2	(5.7 to 6.6)	1385	1122112	12.3	(11.7 to 13.0)
	2000	847	1261338	6.7	(6.3 to 7.2)	1625	1243325	13.1	(12.4 to 13.7)
	2001	952	1411949	6.7	(6.3 to 7.2)	2037	1390655	14.6	(14.0 to 15.3)
	2002	1046	1522438	6.9	(6.5 to 7.3)	2206	1498357	14.7	(14.1 to 15.4)
	2003	1181	1589716	7.4	(7.0 to 7.9)	2626	1563153	16.8	(16.2 to 17.5)
	2004	1202	1602345	7.5	(7.1 to 7.9)	2687	1573839	17.1	(16.4 to 17.7)
	2005	1281	1617844	7.9	(7.5 to 8.4)	2872	1587205	18.1	(17.4 to 18.8)
	2006	1422	1630217	8.7	(8.3 to 9.2)	3029	1597644	19.0	(18.3 to 19.6)
	2007	1451	1641543	8.8	(8.4 to 9.3)	3184	1607003	19.8	(19.1 to 20.5)
	2008	1552	1655611	9.4	(8.9 to 9.9)	3331	1619208	20.6	(19.9 to 21.3)
	2009	1631	1667751	9.8	(9.3 to 10.3)	3737	1629241	22.9	(22.2 to 23.7)
	2010	1717	1691592	10.2	(9.7 to 10.6)	3901	1650821	23.6	(22.9 to 24.4)
	2011	1678	1703136	9.9	(9.4 to 10.3)	3662	1660301	22.1	(21.4 to 22.8)
	2012	1796	1705708	10.5	(10.1 to 11.0)	3870	1661159	23.3	(22.6 to 24.0)
	2013	1709	1515066	11.3	(10.8 to 11.8)	3813	1473249	25.9	(25.1 to 26.7)
	2014	1508	1329646	11.3	(10.8 to 11.9)	3345	1291258	25.9	(25.0 to 26.8)
	2015	106	104597	10.1	(8.4 to 12.3)	258	101529	25.4	(22.5 to 28.7)

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4.1 Validation information

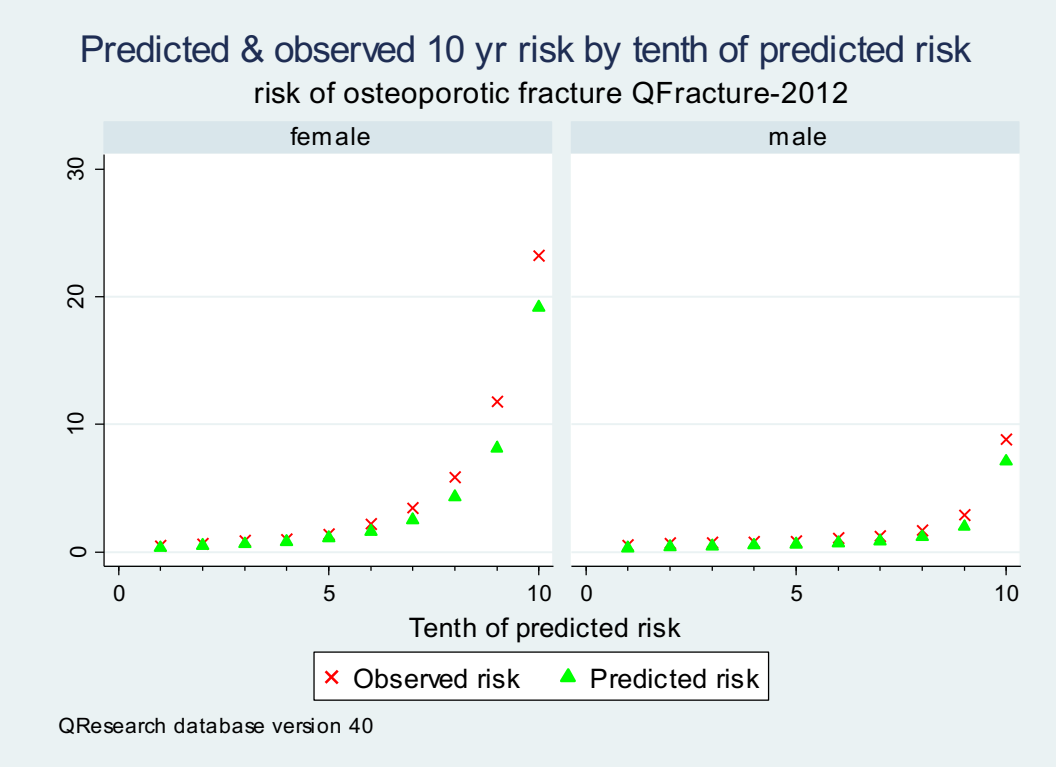
We validated the QFracture® 2016 algorithms using a one quarter sample of practices in version 40 of the QResearch® database. The table shows measures of the performance of the scores i.e. how accurate the scores are at identifying patients who have a fracture event and distinguishing them from patients who don't and how much of the 'variation' in risk is explained by the scores themselves. High values for these measures are better than low values. The models for QFracture-2016 showed comparable performance with QFracture-2012[2].

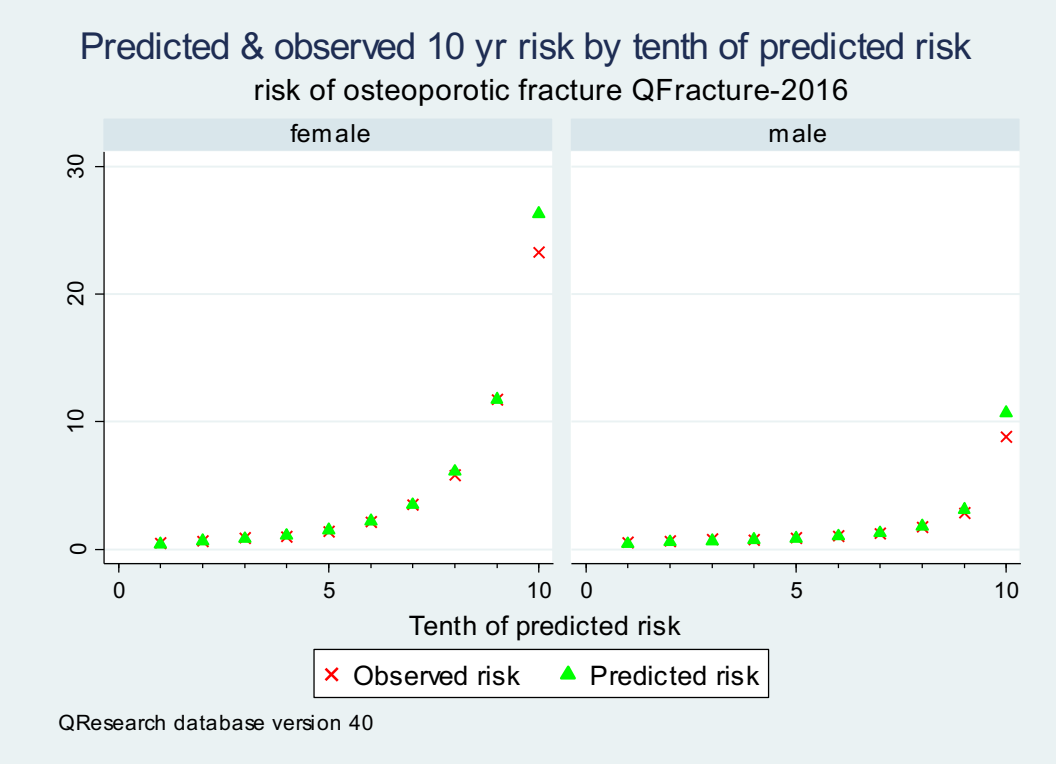
Table 2: Validation statistics QFracture-2016 using version 40 of the QResearch database (including linked HES) with QFracture-2012 (version 29 QResearch)

			2016 (version 40)			2012 (version 29)
			mean	lower CI	upper CI	Mean value
Women	**R^2**	Osteoporotic fracture	54.3	53.9	54.8	51.9
	D statistic	Osteoporotic fracture	2.23	2.21	2.25	2.13
	ROC	Osteoporotic fracture	0.81	0.81	0.81	0.79
	R^2	Hip fracture	69.6	69.1	70.0	71.73
	D statistic	Hip fracture	3.09	3.06	3.13	3.26
	ROC	Hip fracture	0.89	0.89	0.89	0.89
men			mean	lower CI	upper CI	
	R^2	Osteoporotic fracture	42.4	41.4	43.4	38.2
	D statistic	Osteoporotic fracture	1.76	1.72	1.79	1.61
	ROC	Osteoporotic fracture	0.74	0.73	0.74	0.71
	R^2	Hip fracture	69.6	69.1	70.0	70.4
	D statistic	Hip fracture	3.09	3.06	3.13	3.15
	ROC	Hip fracture	0.86	0.86	0.87	0.88

Figure 1 calibration of Qfracture-2016 and QFracture-2012 for hip and osteoporotic fracture

QFracture-2016 is well calibrated with close correspondence between observed and predicted values. There is a small degree of under prediction for QFracture-2012 which is likely to reflect the lower incidence rates in the dataset used to develop QFracture-2012 without linked HES data.





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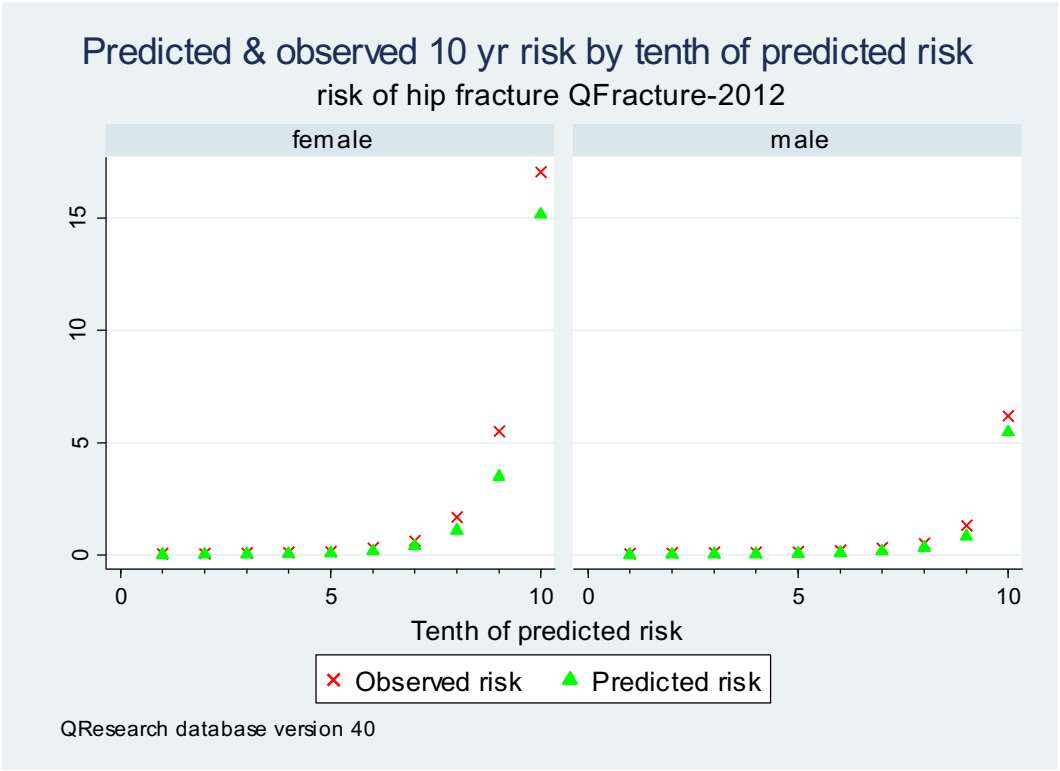
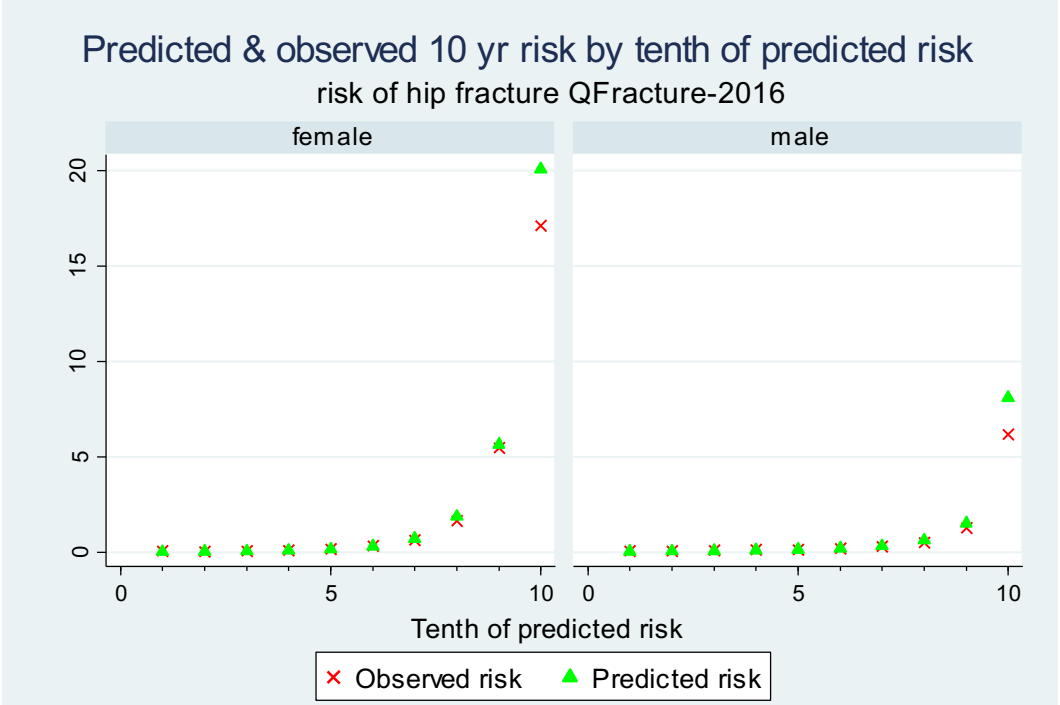


QResearch database version 40



QResearch database version 40

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5 References

1. Hospital Episode Statistics© 2015 reused with permission of the Health and Social Care Information Centre (all rights reserved).
2. Hippisley-Cox J, Coupland C. Derivation and validation of updated QFracture algorithm to predict risk of osteoporotic fracture in primary care in the United Kingdom: prospective open cohort study. BMJ 2012;**344**(may22 1):e3427-e27.

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