General model specification and development methods

Age (ten-year age bands from 30 to 100 years) and body mass index (BMI) (underweight, normal, overweight, obese, and super obese) were modelled using a categorical specification initially. We investigated the sensitivity of the community-based model to the choice of scale (proportional hazards or odds), with varying degrees of complexity in the specification of the reference survival (1 to 6 degrees of freedom for the spline terms). Models were compared using Akaike (AIC) and Bayesian (BIC) information criterion statistics. We also explored the complexity of the reference survival curve, in terms of the number of degrees of freedom for spline terms, using graphical methods.

Following selection of an appropriate scale and complexity, we explored the possibility of non-linear effects of continuous covariates such as age and BMI on survival. We considered linear, quadratic, and cubic effects of age and explored first and second degree fractional polynomial functions of BMI. The best-fitting fractional polynomial functions for BMI were determined using an alpha threshold of 0.01. We compared the continuous functions to models with a categorical or linear specification by graphical methods and comparing AIC statistics.

Violations of the proportionality assumptions were explored using time varying effects, modelled as interactions with spline terms in ln(t). We initially tested for non-proportionality in covariates using the same spline terms as the baseline hazard. Model fit was assessed using likelihood ratio tests and AIC and BIC statistics. We also explored the potential for interactions between model covariates. We sequentially tested for two-way interactions between all covariates. Likelihood ratio tests and AIC and BIC statistics were used to compare model fit. We also compared models with and without interaction terms using graphical methods.

We repeated the above model selection process for our clinic-based model including the further covariates applicable to the secondary care setting. The model results are shown as hazard ratios (HR) with 95% confidence intervals (95% CI) and p-values (p).

The final flexible parametric models for one-year mortality after hip or knee arthroplasty are shown in Supplementary Tables i and x, respectively.

NJR mortality models after hip arthroplasty

A proportional hazards model with 4 degrees of freedom for the spline terms was selected to model mortality after hip arthroplasty (Supplementary Figure a). A quadratic function for age (Supplementary Figure b) and a fractional polynomial (-2, -0.5) for BMI (Supplementary Figure c) provided best fit to the data in the community-based hip model. Comparison of hazards over time for different age ± time varying effect gave similar results (Supplementary Figure d). Results for the supervised hip model were similar and we selected the same function for age (Supplementary Figure e). A fractional polynomial (-1, -1) was selected for BMI in the clinic-based hip model (Supplementary Figure f). We did not find evidence for substantial non-proportionality (Supplementary Tables ii, iii, and v) or interaction effects (Supplementary Tables iii and v) for either hip model in our data.

Table i. Final flexible parametric regression model results for mortality in the year after hip arthroplasty using the National Joint Registry for England and Wales dataset. Functions of age and body mass index are centred to zero at mean values of age and body mass index.

Variable		Community-based			Clinic-based		
		HR	95% CI	p	HR	95% CI	p
Age (yrs)	$(age/10)^2$	1.05	1.05 to 1.06	< 0.01	1.05	1.05 to 1.05	< 0.01
BMI (kg/m^2) (b=BMI/10)	b^{-2}	1.0×10^5	5.8×10^3 to 1.8×10^6	< 0.01			
	$b^{-0.5}$	1.6×10^{-4}	9.2×10^{-6} to 2.8×10^{-3}	< 0.01			
	b^{-1}				4.27	2.47 to 7.39	< 0.01
	$b^{-1}\ln(b)$				3.7×10^{-6}	1.1×10^{-7} to 1.3×10^{-4}	< 0.01
Sex	Female	1.00	N/A	N/A	1.00	N/A	N/A
	Male	1.77	1.65 to 1.89	< 0.01	1.76	1.63 to 1.89	< 0.01
ASA class	1	0.58	0.49 to 0.69	< 0.01	0.60	0.50 to 0.71	< 0.01
	2	1.00	N/A	N/A	1.00	N/A	N/A
	3	2.45	2.28 to 2.64	< 0.01	2.48	2.29 to 2.67	< 0.01
	4	7.14	5.88 to 8.67	< 0.01	7.25	5.93 to 8.86	< 0.01
Fixation	Cemented				1.06	0.96 to 1.17	0.25
	Uncemented				1.00	N/A	N/A
	Hybrid				1.01	0.91 to 1.12	0.86
	Reverse Hybrid				1.20	0.96 to 1.49	0.10
Bearing	MoP				1.00	N/A	N/A
	CoC				0.85	0.73 to 0.98	0.03
	CoP				0.86	0.76 to 0.98	0.02
Head size (mm)	<32				1.03	0.94 to 1.13	0.50
	32				1.00	N/A	N/A
	>32				1.04	0.95 to 1.14	0.42
Chemical thrombo-prophylaxis	None				0.98	0.81 to 1.18	0.80
	Aspirin only				1.12	0.98 to 1.29	0.10
	Heparin				1.00	N/A	N/A
	Other				1.01	0.93 to 1.10	0.74
Mechanical thrombo-prophylaxis	None				1.06	0.91 to 1.24	0.47
	Active*				1.01	0.92 to 1.11	0.86
	Passive†				1.05	0.97 to 1.15	0.23
	Both				1.00	N/A	N/A
	Other				1.05	0.84 to 1.30	0.68
Anaesthetic	General only				1.00	N/A	N/A
	Regional only				1.05	0.96 to 1.15	0.27
	Both				1.13	1.01 to 1.28	0.04
Surgical approach	Other				1.00	N/A	N/A
	Posterior				1.08	1.00 to 1.16	0.04

*Foot pump and/or calf compression.
†Thromboembolic disease stockings.

ASA, American Society of Anesthesiologists; BMI, body mass index; CI, confidence interval; CoC, ceramic on ceramic; CoP, ceramic on polyethylene; HR hazard ratio; N/A, not applicable as this is the referent variable; P, p-value; MoP, metal on polyethylene.

Table ii. Fit statistics for flexible parametric survival models for hip mortality with varying scale and complexity for the baseline hazard.

Degrees of freedom	Proportional hazards		Proportional odds	
	AIC	BIC	AIC	BIC
1	42219.6	42323.6	42215.8	42319.9
2	42194.2	42304.4	42188.4	42298.6
3	42168.0	42284.3	42161.1	42277.4
4	42157.1	42279.6	42150.1	42272.5
5	42137.6	42266.2	42130.4	42259.0
6	42131.8	42266.5	42124.7	42259.3

AIC, Akaike information criterion; BIC, Bayesian information criterion.

Table iii. Fit statistics for hip mortality community-based model including time varying effects.

Time varying effect	AIC	BIC	p-value
None	42026.6	42106.2	N/A
Age	42017.1	42121.2	0.002
Male	42030.5	42134.6	0.389
ASA	42036.3	42189.4	0.282
BMI	42028.1	42156.7	0.069

AIC, Akaike information criterion; ASA, American Society of Anesthesiologists; BIC, Bayesian information criterion; BMI, body mass index; N/A, not applicable.

Table iv. Fit statistics for hip mortality community-based model including interactions.

Interaction		AIC	BIC	p-value
None		42026.6	42106.2	N/A
Age	Sex	42028.3	42114.0	0.548
	BMI	42023.4	42115.2	0.027
	ASA	42005.3	42103.2	< 0.001
Sex	BMI	42029.8	42121.6	0.655
	ASA	42032.1	42130.1	0.915
ASA	BMI	42021.4	42137.7	0.008

AIC, Akaike information criterion; ASA, American Society of Anesthesiologists; BIC, Bayesian information criterion; BMI, body mass index; N/A, not applicable.

Table v. Fit statistics for hip mortality clinic-based model including time varying effects.

Time varying effect	AIC	BIC	p-value
None	39719.4	39901.4	N/A
Age	39711.3	39917.5	0.003
Sex	39723.0	39929.3	0.349
ASA	39728.6	39983.4	0.249
BMI	39717.9	39948.5	0.025
Fixation	39736.0	39990.8	0.828
Bearing	39731.4	39961.9	0.852
Chemical thrombo-prophylaxis	39735.9	39990.7	0.819
Mechanical thrombo-prophylaxis	39719.7	39998.8	0.011
Head size	39717.9	39948.4	0.025
Surgical approach	39722.0	39928.2	0.243
Anaesthetic	39730.9	39961.4	0.806

AIC, Akaike information criterion; ASA, American Society of Anesthesiologists; BIC, Bayesian information criterion; BMI, body mass index; N/A, not applicable.

Table vi. Fit statistics for hip mortality clinic-based model including interactions.

Interaction		AIC	BIC	p-value
None		39719.4	39901.4	N/A
	Sex	39720.3	39908.4	0.292
	ASA	39704.7	39904.9	< 0.001
	BMI	39716.9	39911.0	0.038
	Fixation	39713.8	39914.0	0.009
Age	Bearing	39718.7	39912.9	0.095
	Chemical thrombo-prophylaxis	39722.7	39922.9	0.432
	Mechanical thrombo-prophylaxis	39725.8	39932.1	0.802
	Anaesthetic	39722.7	39916.8	0.677
	Headsize	39722.1	39916.3	0.520
	Approach	39721.0	39909.0	0.485
	ASA	39724.5	39924.7	0.815
	BMI	39723.3	39917.4	0.923
	Fixation	39715.6	39915.8	0.020
	Bearing	39722.8	39916.9	0.728
Sex	Chemical thrombo-prophylaxis	39724.5	39924.7	0.823
	Mechanical thrombo-prophylaxis	39719.1	39925.3	0.079
	Anaesthetic	39715.5	39909.6	0.019
	Headsize	39723.3	39917.4	0.938
	Approach	39719.7	39907.8	0.193
	BMI	39714.3	39932.7	0.009
	Fixation	39732.9	39969.5	0.869
	Bearing	39723.5	39941.8	0.239
ASA	Chemical thrombo-prophylaxis	39731.8	39968.4	0.778
	Mechanical thrombo-prophylaxis	39735.2	39990.0	0.769
	Anaesthetic	39722.9	39941.3	0.199
	Headsize	39727.4	39945.8	0.675
	Approach	39723.3	39923.5	0.538

	Fixation	39726.8	39945.2	0.594
	Bearing	39722.3	39928.6	0.274
	Chemical thrombo-prophylaxis	39728.4	39946.8	0.804
BMI	Mechanical thrombo-prophylaxis	39730.9	39961.4	0.802
	Anaesthetic	39721.7	39927.9	0.216
	Headsize	39726.4	39932.7	0.904
	Approach	39723.4	39917.5	0.983
	Fixation	39729.6	39966.2	0.553
Chemical thrombo-prophylaxis	Bearing	39729.6	39948.0	0.934
	Mechanical thrombo-prophylaxis	39736.7	39991.5	0.873
	Anaesthetic	39725.0	39943.4	0.377
	Headsize	39723.0	39941.4	0.205
	Approach	39724.9	39925.1	0.899
	Fixation	39734.3	39989.1	0.694
Mechanical thrombo-prophylaxis	Bearing	39729.1	39959.7	0.611
	Anaesthetic	39728.8	39959.4	0.578
	Head size	39726.4	39956.9	0.339
	Approach	39725.9	39932.1	0.812
	Fixation	39731.0	39949.4	0.998
Anaesthetic	Bearing	39723.0	39929.3	0.348
	Head size	39723.6	39929.8	0.420
	Surgical Approach	39720.4	39914.6	0.223
Fixation	Bearing	39716.3	39934.7	0.020
	Head size	39728.5	39946.9	0.818
	Surgical approach	39725.4	39925.6	0.999
Bearing	Head size	39721.5	39927.8	0.206
	Surgical approach	39721.6	39915.8	0.401
Head size	Surgical approach	39722.7	39916.8	0.689

AIC, Akaike information criterion; ASA, American Society of Anesthesiologists; BIC, Bayesian information criterion; BMI, body mass index; N/A, not applicable.
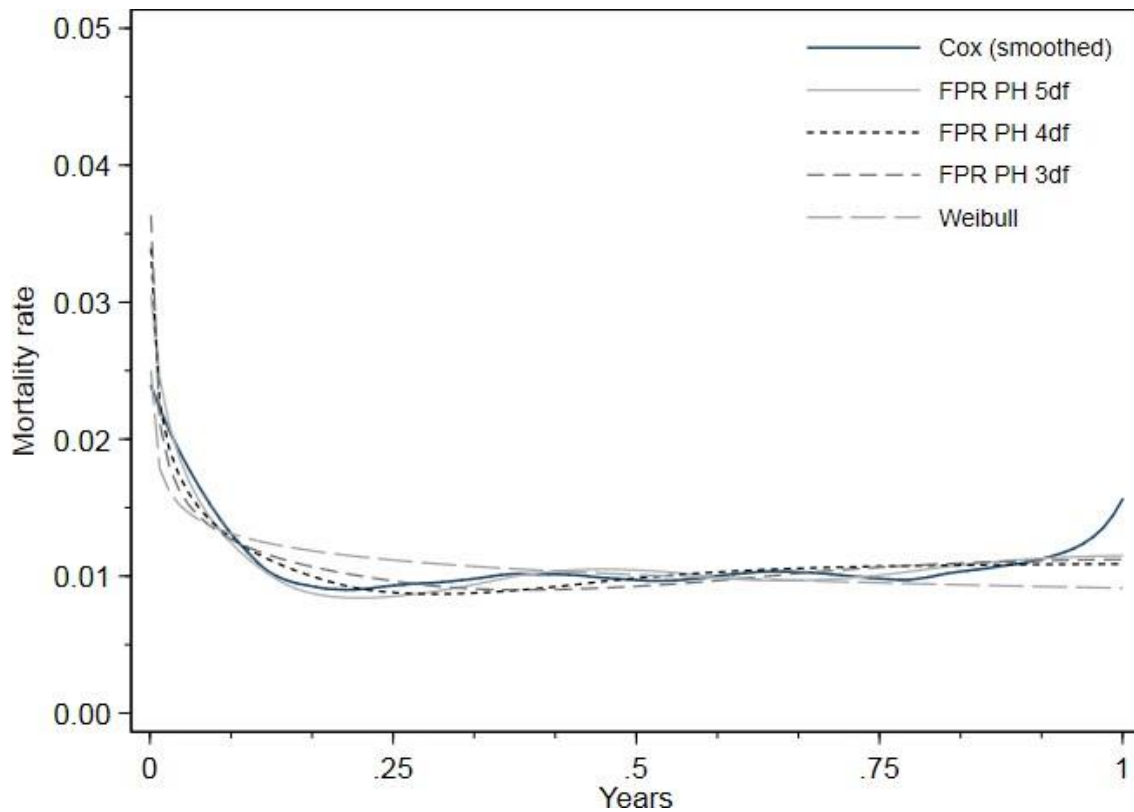
Fig. a. Comparison of hip mortality reference hazard curves from Cox regression and flexible parametric survival models with varying spline degrees of freedom.

FPR, flexible parametric survival regression; PH, proportional hazards; df, degrees of freedom. Weibull is a FPR PH model with 1 df.
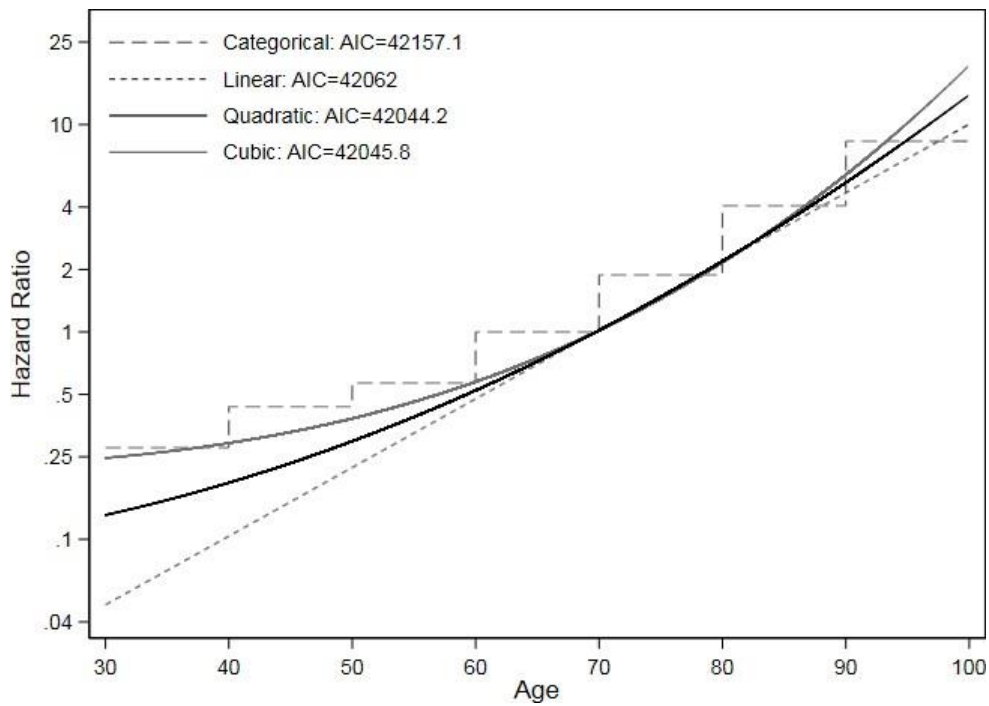
Community-based Model

Fig. b. Comparison of hip mortality hazard ratios for categorical, linear, quadratic, and cubic functions of age in community-based model.

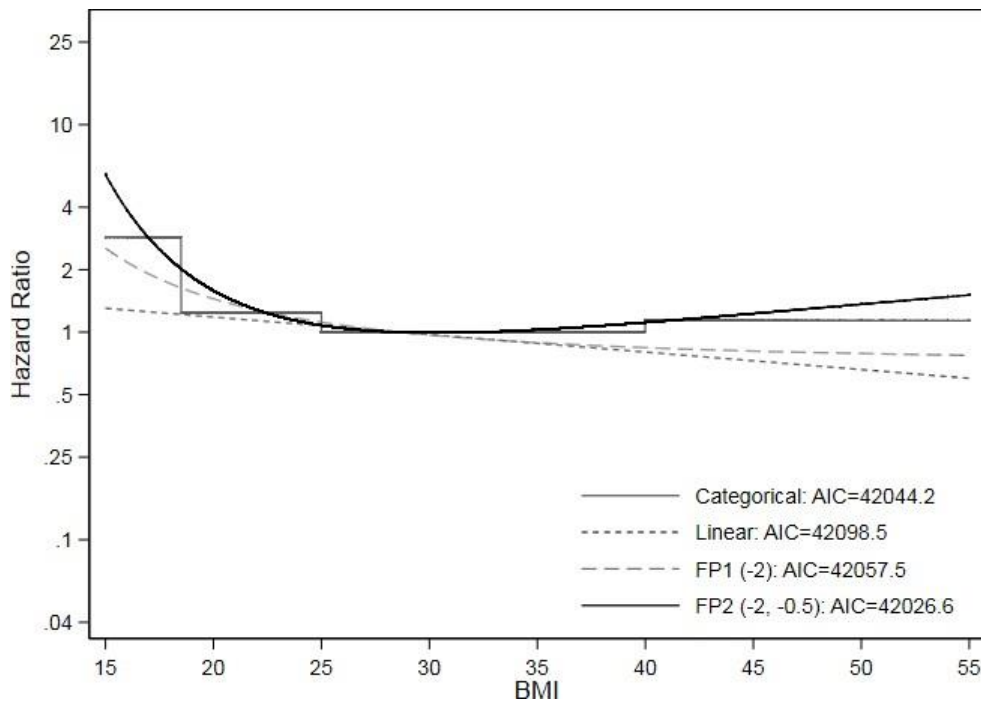AIC, Akaike information criterion.

Fig. c. Comparison of hip mortality hazard ratios for categorical, linear and non-linear fractional polynomial functions of body mass index (BMI) in community-based model.

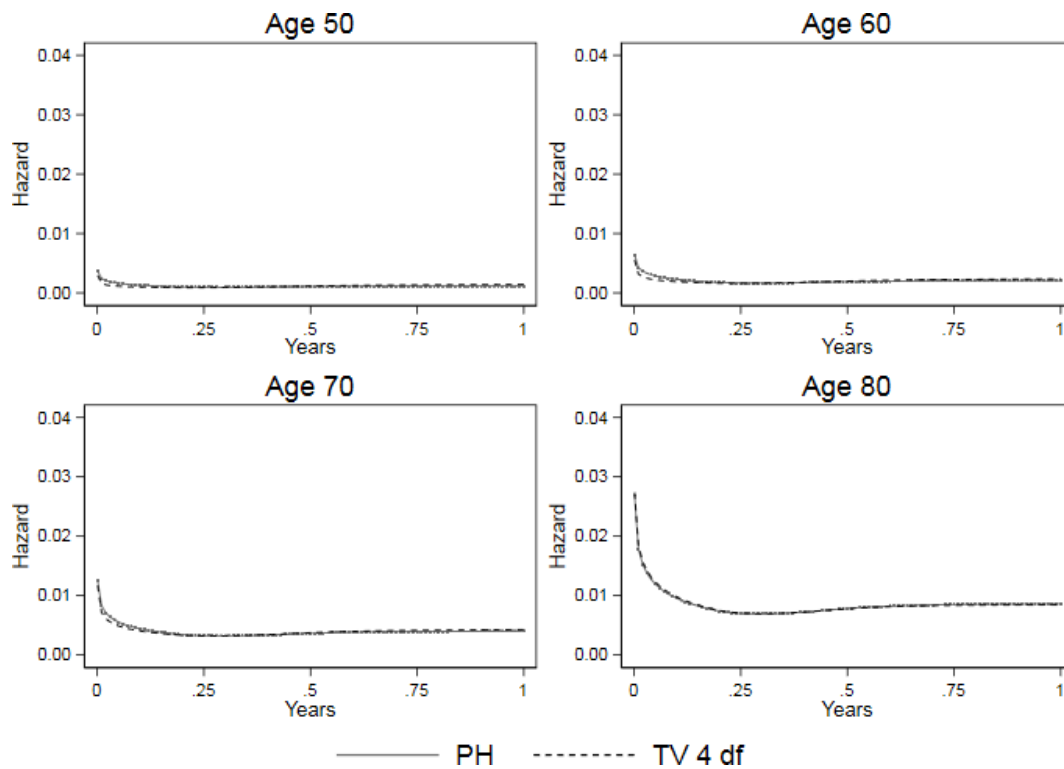AIC, Akaike information criterion; FP, flexible parametric survival regression.

Fig. d. Comparison of hazards over time for different ages in community-based model with and without a time varying effect of age.
PH, proportional hazards (no time varying effect of age); TV 4df, time varying effect of age with 4 degrees of freedom for spline terms.
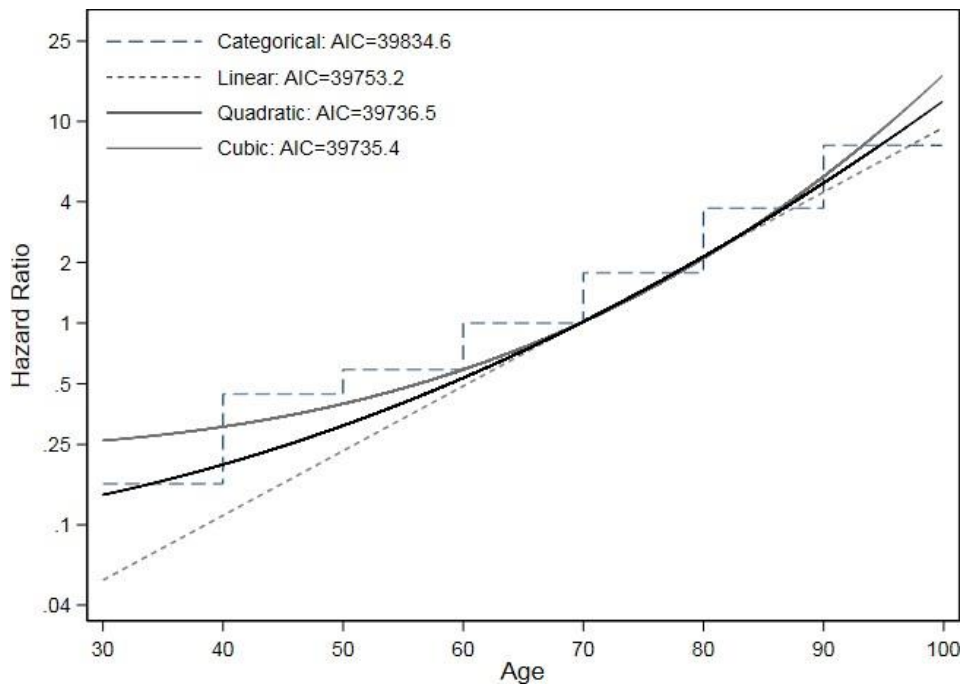
<u>Clinic-based Model</u>

Fig. e. Comparison of hip mortality hazard ratios for categorical, linear, quadratic and cubic functions of age in clinic-based model.
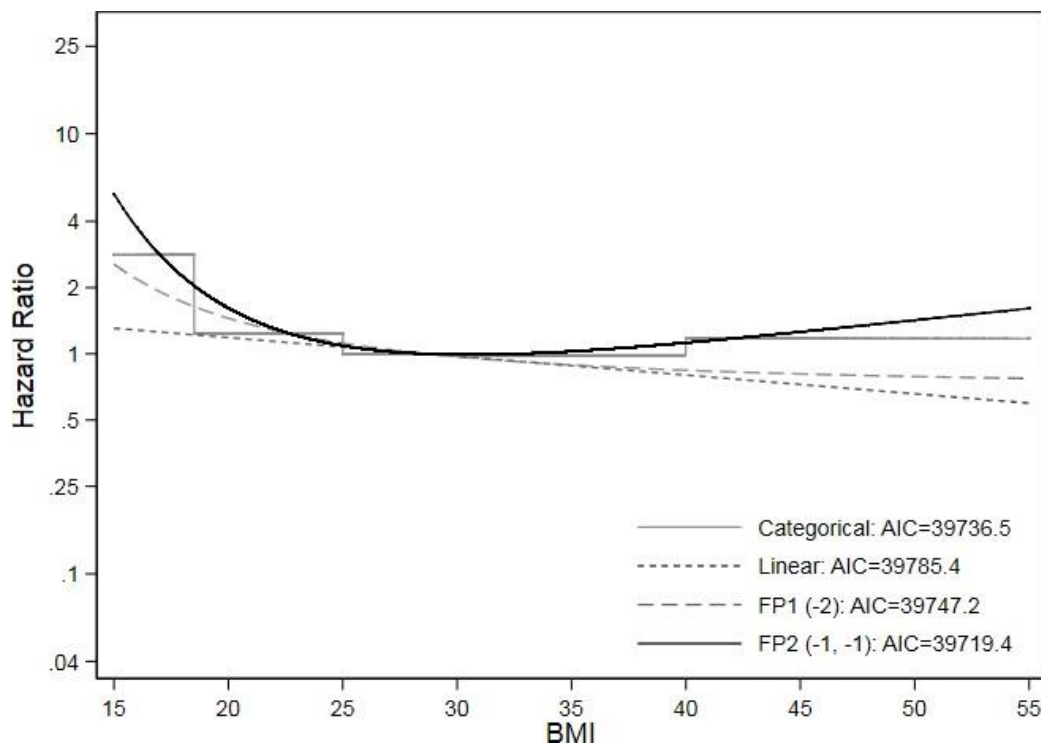AIC, Akaike information criterion.

Fig. f. Comparison of hazard ratios for categorical, linear and non-linear fractional polynomial functions of body mass index (BMI) in clinic-based model.
AIC, Akaike information criterion; FP, flexible parametric survival regression.

Validation of the NJR hip mortality models

Table vii. Internal validation of the National Joint Registry for England and Wales hip mortality models by time-dependent Brier score.

Time (mths)	Community-based Model		Clinic-based Model	
	Brier Score	**95 % CI**	**Brier Score**	**95 % CI**
1	0.0015	0.0015 to 0.0015	0.0015	0.0015 to 0.0015
3	0.0031	0.0031 to 0.0031	0.0030	0.0030 to 0.0030
6	0.0055	0.0055 to 0.0055	0.0054	0.0054 to 0.0054
9	0.0079	0.0079 to 0.0079	0.0078	0.0078 to 0.0078
12	0.0103	0.0103 to 0.0103	0.0102	0.0102 to 0.0102

CI, confidence interval.

Table viii. External validation of the National Joint Registry for England and Wales hip mortality models by time-dependent Brier score using the Norwegian Arthroplasty Register data.

Time (mths)	Community-based		Clinic-based	
	Brier Score	**95 % CI**	**Brier Score**	**95 % CI**
1	0.0010	0.0010 to 0.0010	0.0010	0.0010 to 0.0010
3	0.0024	0.0024 to 0.0024	0.0023	0.0023 to 0.0023
6	0.0042	0.0042 to 0.0042	0.0040	0.0040 to 0.0040
9	0.0065	0.0065 to 0.0065	0.0064	0.0064 to 0.0064
12	0.0088	0.0088 to 0.0088	0.0086	0.0086 to 0.0086

CI, confidence interval.

Modelling mortality after hip arthroplasty using the NAR dataset

Table ix. Flexible parametric regression model results for mortality in the year after hip arthroplasty in the Norwegian Arthroplasty Register models. Functions of age and body mass index are centred to zero at mean values of age and body mass index.

Variable		Community-based			Clinic-based		
		HR	95% CI	p	HR	95% CI	p
Age (yrs)	$(age/10)^2$	1.07	1.06 to 1.07	< 0.01	1.07	1.06 to 1.08	< 0.01
Sex	Female	1.00	N/A	N/A	1.00	N/A	N/A
	Male	1.91	1.62 to 2.25	< 0.01	1.99	1.67 to 2.37	< 0.01
ASA class	1	0.74	0.52 to 1.04	0.08	0.71	0.49 to 1.02	0.06
	2	1.00	N/A	N/A	1.00	N/A	N/A
	3	2.58	2.17 to 3.08	< 0.01	2.47	2.05 to 2.98	< 0.01
	4	11.25	7.17 to 17.66	< 0.01	10.6	6.45 to 17.44	< 0.01
Fixation	Cemented				1.43	1.01 to 2.02	0.04
	Uncemented				1.00	N/A	N/A
	Hybrid				1.27	0.59 to 2.76	0.54
	Reverse hybrid				1.11	0.79 to 1.57	0.55
Bearing	MoP				1.00	N/A	N/A
	CoC				1.26	0.6 to 2.61	0.54
	CoP				1.37	1.06 to 1.77	0.02
Head size (mm)	< 32				1.18	0.97 to 1.44	0.1
	32				1.00	N/A	N/A
	> 32				0.68	0.36 to 0.93	0.11
Chemical thrombo-prophylaxis	None				1.00	N/A	N/A
	Aspirin only				1.08	0.15 to 7.84	0.94
	Other				1.02	0.74 to 1.40	0.9
Surgical approach	Other				1.00	N/A	N/A
	Posterior				1.19	0.97 to 1.47	0.1

ASA, American Society of Anesthesiologists; CI, confidence interval; CoC, ceramic on ceramic; CoP, ceramic on polyethylene; HR hazard ratio; N/A, not applicable as this is the referent variable; P, p-value; MoP, metal on polyethylene.
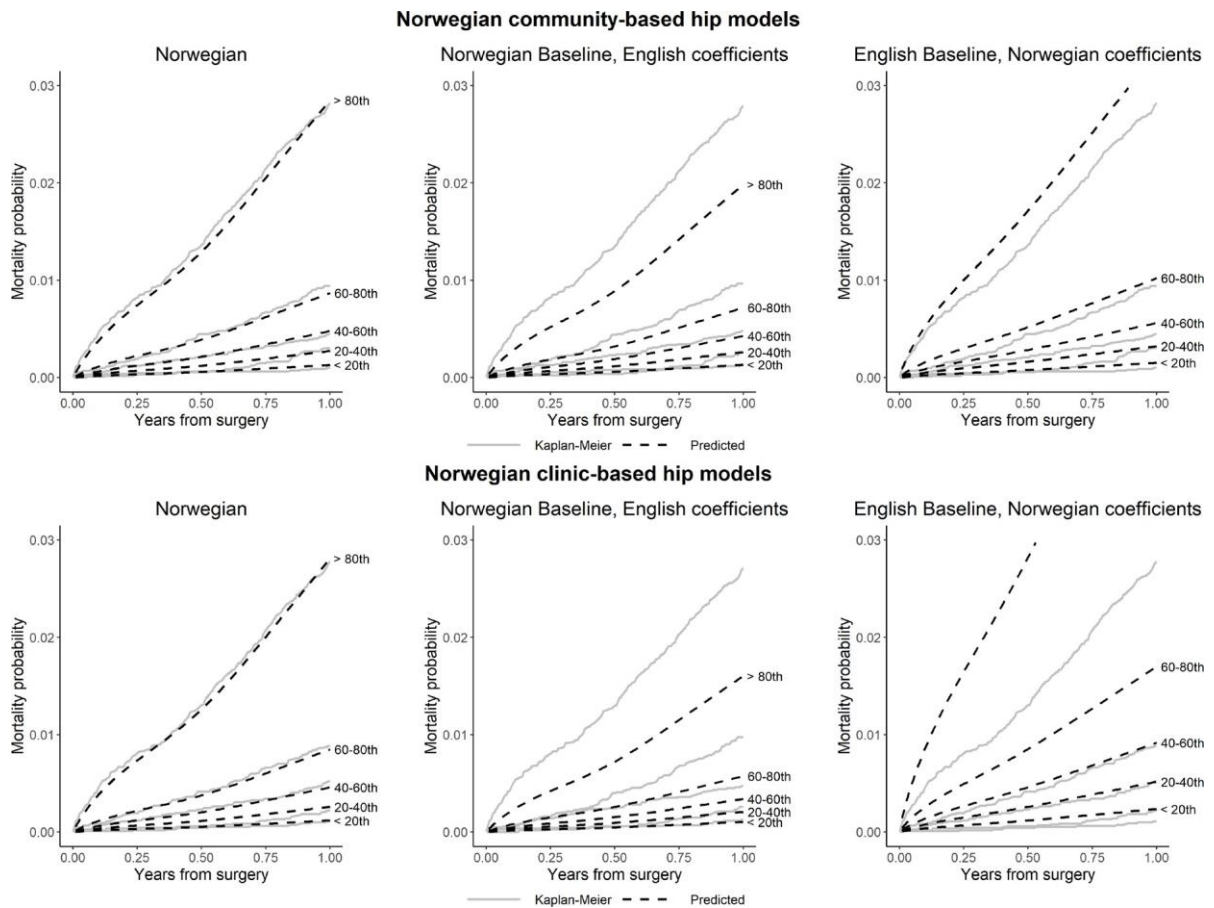
Fig. 9. Calibration plots showing performance of community-based (top panels) and clinic-based (bottom panels) hip mortality models generated using the Norwegian Arthroplasty Register (NAR) hip dataset, subdivided by risk quintile. Left panels show the results of internal cross validation using Norwegian baseline hazard function and risk coefficients; middle panels show results of a hybrid model using the Norwegian baseline hazard function and the English risk coefficients; right panel shows a hybrid model using the English baseline hazard function and the Norwegian risk coefficients.

Table x. Final flexible parametric regression model for mortality in the year after knee arthroplasty using the National Joint Registry for England and Wales dataset. Functions of age and body mass index are centred to zero at mean values of age and body mass index.

Variable		Community-based model			Clinic-based model		
		HR	95% CI	p	HR	95% CI	p
Age (yrs)	$(age/10)^2$	1.06	1.06 to 1.07	< 0.01	1.06	1.06 to 1.07	< 0.01
BMI (Kg/m^2)	$ln(b)$	6.8×10^{-4}	1.6×10^{-4} to 2.9×10^{-3}	< 0.01	7.7×10^{-4}	1.8×10^{-4} to 3.4×10^{-3}	< 0.01
	$(ln(b))^2$	27.1	13.9 to 52.6	< 0.01	25.5	12.9 to 50.4	< 0.01
Sex	Female	1.00	N/A	N/A	1.00	N/A	N/A
	Male	1.82	1.70 to 1.95	< 0.01	1.83	1.70 to 1.96	< 0.01
ASA class	1	0.62	0.53 to 0.75	< 0.01	0.65	0.54 to 0.77	< 0.01
	2	1.00	N/A	N/A	1.00	N/A	N/A
	3	1.94	1.80 to 2.09	< 0.01	1.99	1.85 to 2.15	< 0.01
	4	5.61	3.94 to 6.40	< 0.01	5.08	3.96 to 6.52	< 0.01
Knee type	Total				1.00	N/A	N/A
	UKA				0.65	0.54 to 0.78	< 0.01
	PFJ				1.04	0.66 to 1.66	0.86
Chemical thrombo-prophylaxis	None				1.00	N/A	N/A
	Aspirin only				1.04	0.86 to 1.25	0.70
	Heparin				0.93	0.80 to 1.09	0.36
	Other				0.98	0.83 to 1.16	0.84
Mechanical thrombo-prophylaxis	None				1.00	N/A	N/A
	Active*				0.96	0.82 to 1.12	0.59
	Passive†				0.98	0.84 to 1.15	0.82
	Both				0.95	0.82 to 1.11	0.52
	Other				0.81	0.58 to 1.13	0.21
Anaesthetic	General only				0.99	0.90 to 1.08	0.76
	Regional only				1.00	N/A	N/A
	Both				0.98	0.89 to 1.08	0.67

*Foot pump and/or calf compression.
†Thromboembolic disease stockings.
ASA, American Society of Anesthesiologists; BMI, body mass index; CI, confidence interval; HR, hazard ratio; N/A, not applicable as this is the referent variable and holds default HR of 1.0; P, p-value; PFR, patellofemoral joint replacement; UKA, unicompartmental knee arthroplasty.

A proportional hazards model with 4 degrees of freedom for the spline terms was selected for the knee mortality models (Supplementary Table xi and Supplementary Figure h). A quadratic function for age (Supplementary Figure i) and a fractional polynomial (0, 0) for body mass index (Supplementary Figure j) provided best fit to the data in both community-based and clinic-based knee models. We did not find evidence for substantial non-

proportionality (Supplementary Tables xii and xiv) or interaction effects (Supplementary Tables xiii and xv) for either knee model in the NJR data.

Table xi. Fit statistics for flexible parametric survival models with varying scale and complexity for the baseline hazard.

Degrees of freedom	Proportional hazards		Proportional odds	
	AIC	BIC	AIC	BIC
1	45077.9	45194.8	45076.7	45193.5
2	45021.8	45144.8	45018.4	45141.3
3	44926.0	45055.2	44920.7	45049.9
4	44902.9	45038.2	44897.6	45032.9
5	44877.3	45018.8	44871.9	45013.4
6	44866.2	45013.8	44860.9	45008.4

AIC, Akaike information criterion; BIC, Bayesian information criterion.
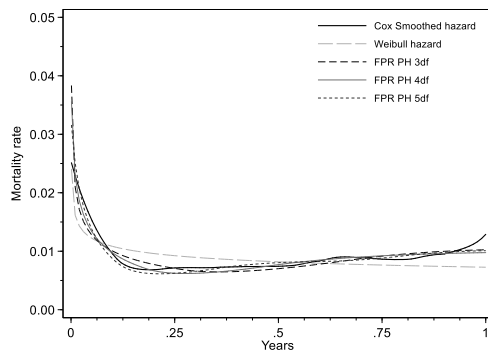

Fig. h. Comparison of reference hazard curves from Cox regression and flexible parametric survival models with varying spline degrees of freedom. FPR, flexible parametric survival regression; PH, proportional hazards; df, degrees of freedom.
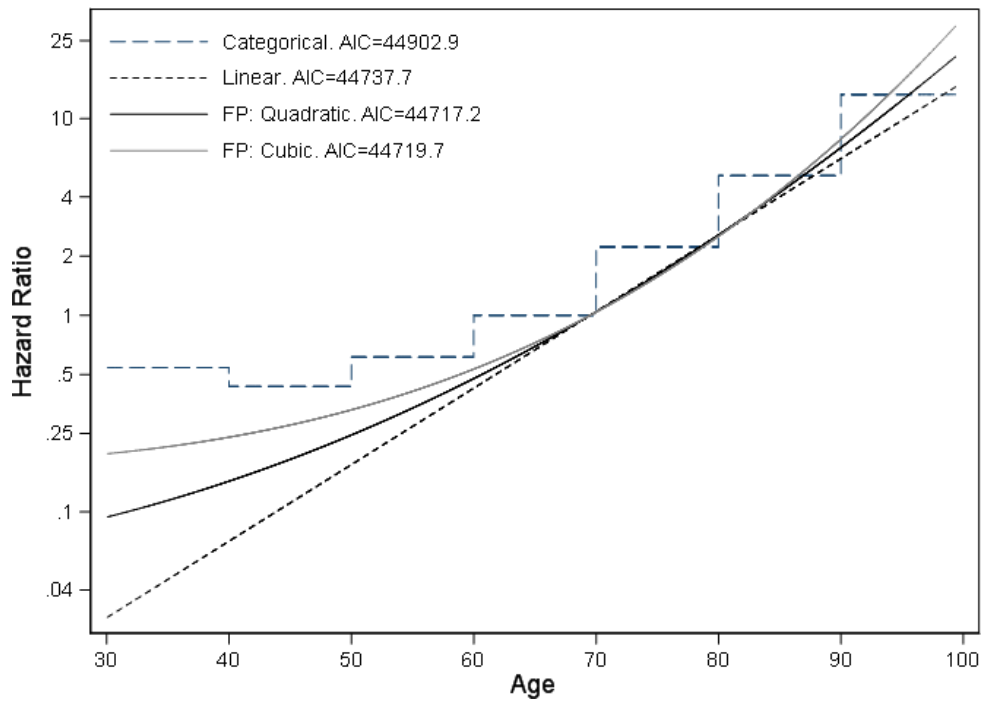
Fig. i. Comparison of hazard ratios for categorical, linear, quadratic, and cubic functions of age.
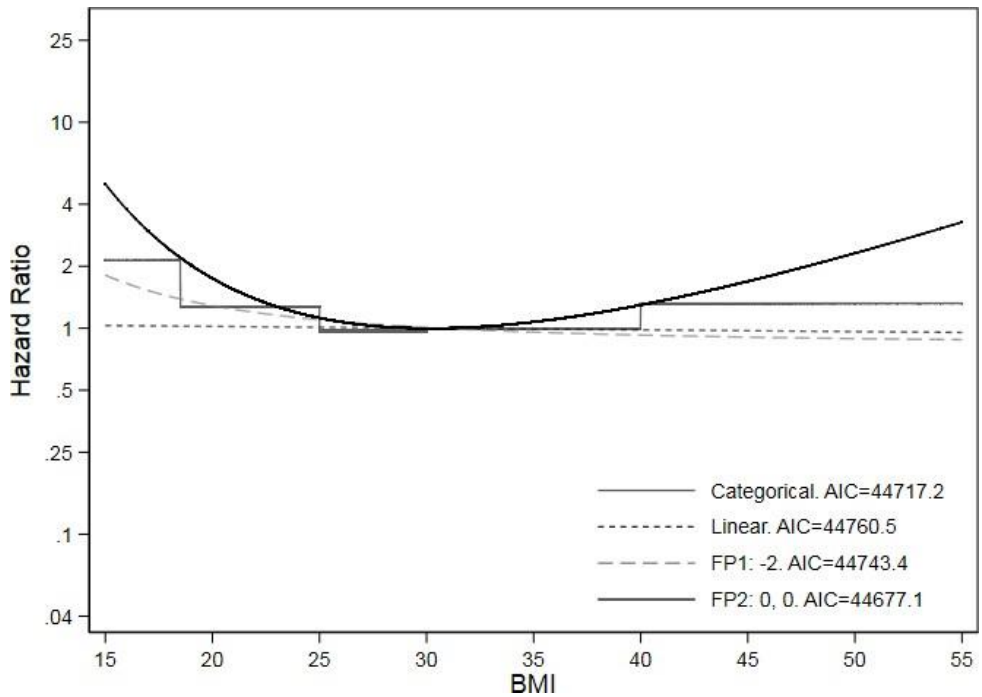AIC, Akaike information criterion.

Fig. j. Comparison of hazard ratios for categorical, linear and non-linear fractional polynomial functions of body mass index (BMI).
AIC, Akaike information criterion; FP, flexible parametric survival regression.

Community-based Model

Table xii. Fit statistics for community-based model including time varying effects.

Time varying effect	AIC	BIC	p-value
None	44677.1	44769.3	-
Age	44665.8	44782.6	< 0.01
Male	44684.8	44801.6	0.99
ASA	44683.7	44849.7	0.14
BMI	44676.0	44817.4	0.03
Fixation	44681.0	44822.4	0.15

AIC, Akaike information criterion; BIC, Bayesian information criterion.

Table xiii. Fit statistics for community-based model including interactions.

Interaction		AIC	BIC	p-value
None		44677.1	44769.3	< 0.01
Knee type	Age	44676.3	44774.7	0.10
	Sex	44676.8	44775.1	0.13
	ASA	44676.8	44787.4	0.10
	BMI	44678.7	44783.3	0.31
Age	Sex	44678.8	44777.2	0.62
	ASA	44670.6	44781.3	0.01
	BMI	44674.3	44778.8	0.03
Sex	ASA	44668.0	44778.7	< 0.01
	BMI	44669.8	44774.4	< 0.01
ASA	BMI	44679.5	44808.6	0.14

ASA, American Society of Anesthesiologists; AIC, Akaike information criterion; BIC, Bayesian information criterion; BMI, body mass index.

Clinic-based Model

Table xiv. Fit statistics for clinic-based model including time varying effects.

Time varying effect	AIC	BIC	p- value
None	43134.1	43280.8	-
Knee type	43135.6	43331.2	0.07
Age	43123.5	43294.6	< 0.01
Sex	43141.7	43312.8	0.98
ASA	43140.2	43360.1	0.12
BMI	43132.4	43327.9	0.02
Chemical thromboprophylaxis	43145.3	43365.3	0.38
Mechanical thromboprophylaxis	43143.9	43388.4	0.14
Anaesthetic	43141.8	43337.3	0.40

ASA, American Society of Anesthesiologists; AIC, Akaike information criterion; BIC, Bayesian information criterion; BMI, body mass index.

Table xv. Fit statistics for clinic-based model including interactions.

Interactions		AIC	BIC	p-value
None		43134.1	43280.8	N/A
Knee type	Age	43133.9	43292.8	0.12
	Sex	43135.9	43294.8	0.33
	ASA	43136.1	43319.5	0.13
	BMI	43133.8	43304.9	0.08
	Chemical thromboprophylaxis	43139.7	43323.0	0.37
	Mechanical thromboprophylaxis	43142.7	43338.3	0.50
	Anaesthetic	43138.5	43309.6	0.47
Age	Sex	43135.7	43288.5	0.55
	ASA	43127.7	43292.7	0.01
	BMI	43131.5	43290.4	0.04
	Chemical thromboprophylaxis	43138.5	43303.5	0.65

		AIC	BIC	p
	Mechanical thromboprophylaxis	43139.9	43311.0	0.70
	Anaesthetic	43137.2	43296.1	0.63
Sex	ASA	43124.9	43289.9	< 0.01
	BMI	43128.3	43287.2	0.01
	Chemical thromboprophylaxis	43131.4	43296.4	0.03
	Mechanical thromboprophylaxis	43138.8	43310.0	0.51
	Anaesthetic	43132.5	43291.4	0.06
ASA	BMI	43137.4	43320.7	0.19
	Chemical thromboprophylaxis	43138.0	43339.6	0.12
	Mechanical thromboprophylaxis	43145.8	43365.8	0.42
	Anaesthetic	43142.0	43325.3	0.66
BMI	Chemical thromboprophylaxis	43141.9	43325.3	0.65
	Mechanical thromboprophylaxis	43138.7	43334.2	0.18
	Anaesthetic	43141.7	43312.8	0.98
Chemical thromboprophylaxis	Mechanical thromboprophylaxis	43151.2	43371.2	0.86
	Anaesthetic	43142.0	43325.3	0.66
Mechanical	Anaesthetic	43141.4	43336.9	0.36

ASA, American Society of Anesthesiologists; AIC, Akaike information criterion; BIC, Bayesian information criterion; BMI, body mass index; N/A, not applicable.

Validation of the NJR knee mortality models

Table xvi. Internal validation of the National Joint Registry for England and Wales knee mortality models by time-dependent Brier score.

Time (mths)	Community-based Model		Clinic-based Model	
	Brier Score	**95% CI**	**Brier Score**	**95% CI**
1	0.0014	0.0014 to 0.0014	0.0014	0.0014 to 0.0014
3	0.0026	0.0026 to 0.0026	0.0025	0.0025 to 0.0025
6	0.0044	0.0044 to 0.0044	0.0043	0.0043 to 0.0043
9	0.0064	0.0064 to 0.0064	0.0063	0.0063 to 0.0064
12	0.0085	0.0085 to 0.0085	0.0084	0.0084 to 0.0084

CI, confidence interval.

Table xvii. External validation of the National Joint Registry for England and Wales knee mortality models by time-dependent Brier score using the Norwegian Arthroplasty Register data.

Time (mths)	Community-based Model		Clinic-based model	
	Brier Score	**95% CI**	**Brier Score**	**95% CI**
1	0.0007	0.0007 to 0.0007	0.0007	0.0007 to 0.0007
3	0.0014	0.0014 to 0.0014	0.0014	0.0014 to 0.0014
6	0.0025	0.0025 to 0.0025	0.0025	0.0025 to 0.0025
9	0.0040	0.0040 to 0.0040	0.0040	0.0040 to 0.0040
12	0.0058	0.0058 to 0.0058	0.0058	0.0058 to 0.0058

CI, confidence interval.

Modelling mortality after knee arthroplasty using the NAR dataset

Table xviii. Flexible parametric regression model results for mortality in the year after primary knee arthroplasty in the Norwegian Arthroplasty Register models.

		Community-based model			Clinic-based model		
		HR	95% CI	p	HR	95% CI	p
Age	$(age/10)^2$	1.06	1.05 to 1.07	< 0.01	1.06	1.05 to 1.07	< 0.01
Sex	Female	1.00	N/A	N/A	1.00	N/A	N/A
	Male	1.48	1.16 to 1.9	< 0.01	1.48	1.16 to 1.91	< 0.01
ASA	1	0.83	0.5 to 1.38	0.46	0.78	0.46 to 1.32	0.36
	2	1.00	N/A	N/A	1.00	N/A	N/A
	3	2.25	1.73 to 2.92	< 0.01	2.27	1.74 to 2.95	< 0.01
	4	7.1	2.26 to 22.35	< 0.01	7.4	2.35 to 23.27	< 0.01
Chemical thrombo-prophylaxis	None				1.00	N/A	N/A
	Aspirin only				1.51	0.21 to 10.79	0.68
	Other				0.66	0.38 to 1.13	0.13
Knee type	Total				1.00	N/A	N/A
	UKA				0.71	0.42 to 1.2	0.2

ASA, American Society of Anesthesiologists; CI, confidence interval; HR, hazard ratio; N/A, not applicable as this is the referent variable; P, p-value; UKA, unicompartmental knee arthroplasty.
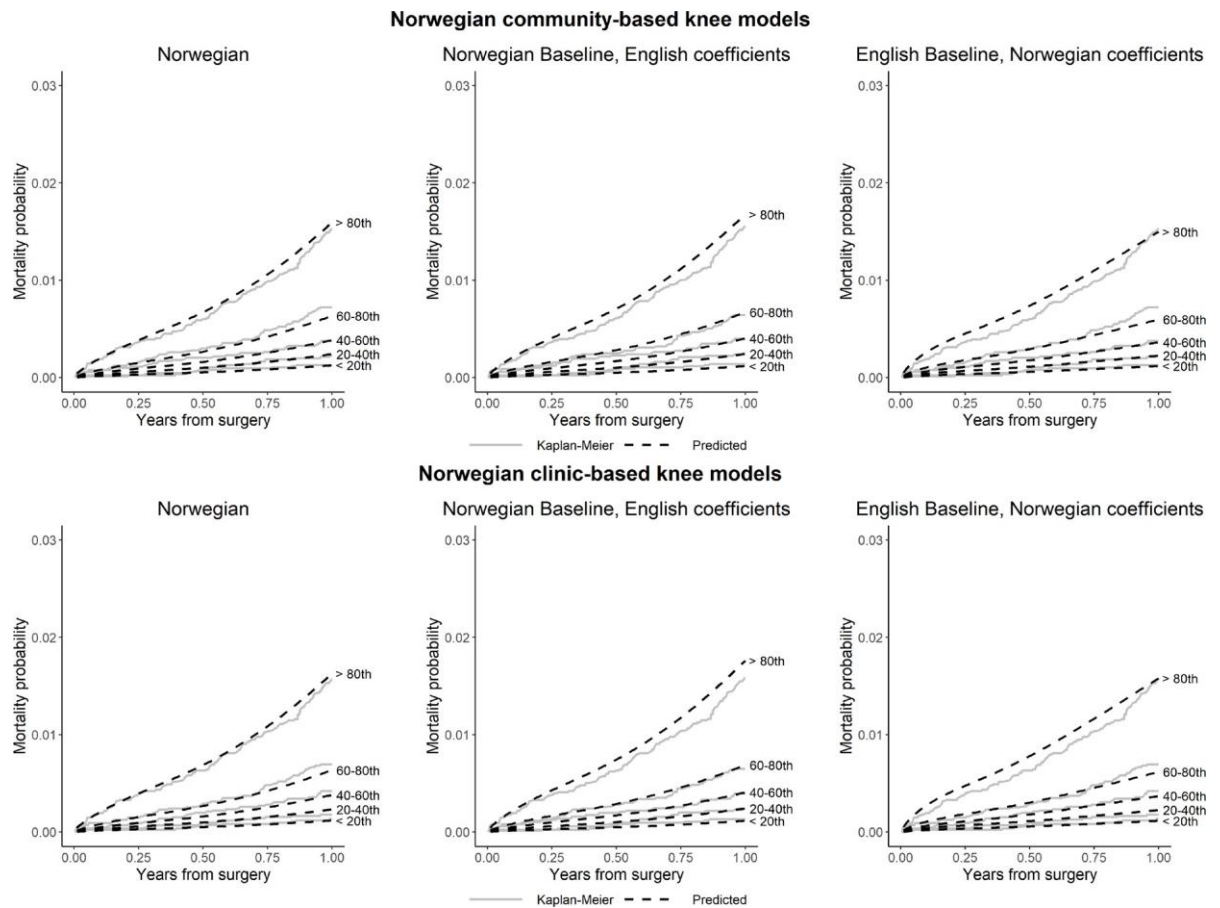
Fig. k. Calibration plots showing performance of community-based (top panels) and clinic-based (bottom panels) knee mortality models generated using the Norwegian Arthroplasty Register (NAR) dataset, subdivided by risk quintile. Left panels show the results of internal cross validation using Norwegian baseline hazard function and risk coefficients; middle panels show results of a hybrid model using the Norwegian baseline hazard function and the English risk coefficients; right panel shows a hybrid model using the English baseline hazard function and the Norwegian risk coefficients.