ACHE Online Supplements

Online Supplement 1 - Internal consistency

Table 1. Internal consistency: each item

N= Number of individuals with complete scales, ritem-rest=The correlation between an item and the scale that is formed by all other items, α=Cronbach alpha of the scale excluding all but on of the items, except where "Total" indicates Cronbach alpha for complete scale.

TABLE 59 Hip

			Pre-					**Post-**				
Measurement tool	Data	Item	N	Mean	SD	ritem-rest=	α=	N	Mean	SD	ritem-rest=	α=
EQ-5D-3L [1,3]	APEX	Total	302				0.66	266				0.82
		Mobility		1.92	(0.30)	0.36	0.64		1.32	(0.48)	0.72	0.75
		Self-care		1.61	(0.52)	0.42	0.60		1.20	(0.41)	0.56	0.80
		Usual Activities		2.09	(0.50)	0.48	0.57		1.40	(0.55)	0.68	0.76
		Pain/Discomfort		2.30	(0.53)	0.52	0.55		1.40	(0.53)	0.66	0.77
		Anxiety/Depression		1.53	(0.62)	0.34	0.65		1.17	(0.43)	0.47	0.82
	EUROHIP	Total	1228				0.66	883				0.81
		Mobility		1.88	(0.37)	0.39	0.63		1.32	(0.47)	0.67	0.75
		Self-care		1.48	(0.55)	0.48	0.58		1.16	(0.39)	0.55	0.79
		Usual Activities		1.96	(0.55)	0.53	0.55		1.36	(0.52)	0.73	0.72
		Pain/Discomfort		2.35	(0.51)	0.41	0.61		1.59	(0.59)	0.59	0.78
		Anxiety/Depression		1.49	(0.59)	0.31	0.67		1.23	(0.45)	0.46	0.81
SF-12	ADAPT	Total	119				0.86	104				0.89
		[1] would you say your health is:		2.61	(0.93)	0.35	0.86		2.31	(0.90)	0.6	0.88
		[2a] health limits...moderate activities.		1.61	(0.71)	0.6	0.85		2.38	(0.71)	0.74	0.87
		[2b] health limits...climbing several flights stairs.		1.57	(0.67)	0.58	0.85		2.4	(0.72)	0.71	0.87

		[3a] physical health...acomplished less...		1.22	(0.41)	0.58	0.85		1.66	(0.47)	0.66	0.88
		[3b] physical health...limited in kind of work.		1.17	(0.38)	0.46	0.86		1.64	(0.48)	0.63	0.88
		[4a] emotional problems...acomplished less...		1.62	(0.49)	0.59	0.85		1.85	(0.36)	0.57	0.89
		[4b] emotional problems...less carefully than usual.		1.71	(0.45)	0.55	0.85		1.85	(0.36)	0.57	0.89
		[5] pain intefere with your normal work		3.45	(1.11)	0.64	0.84		1.81	(1.12)	0.77	0.87
		[6a] past 4 weeks...felt calm and peaceful?		3.08	(1.36)	0.69	0.84		2.23	(1.13)	0.52	0.89
		[6b] past 4 weeks...lot of energy?		3.85	(1.31)	0.65	0.84		2.79	(1.26)	0.76	0.87
		[6c] past 4 weeks...down hearted blue?		4.7	(1.21)	0.58	0.85		5.27	(1.18)	0.38	0.9
		[7] physical emotional problems...social acitvities.		2.34	(1.18)	0.66	0.84		1.44	(0.94)	0.81	0.87
OHS	EUROHIP	Total	127				0.89	114				0.93
		Hip pain		0.46	(0.61)	0.63	0.88		3.23	(1.09)	0.79	0.92
		Up from chair		1.54	(0.84)	0.63	0.88		3.50	(0.73)	0.79	0.92
		Limping		0.59	(0.88)	0.48	0.89		3.12	(1.26)	0.65	0.92
		Spasms		1.31	(1.16)	0.54	0.89		3.61	(0.81)	0.55	0.93
		Work problem		1.28	(0.93)	0.77	0.87		3.39	(0.88)	0.82	0.92
		Bed trouble		0.98	(1.07)	0.55	0.89		3.44	(0.98)	0.72	0.92
		Drying		2.02	(0.95)	0.70	0.88		3.51	(0.78)	0.72	0.92
		Transport		1.63	(0.66)	0.63	0.88		3.28	(0.84)	0.79	0.92
		Socks		1.44	(0.96)	0.65	0.88		2.93	(0.92)	0.53	0.93
		Own shopping		1.37	(1.44)	0.64	0.88		3.03	(1.35)	0.69	0.92
		Sever pain walk		1.65	(1.21)	0.62	0.88		3.43	(1.01)	0.63	0.92
		Climb stairs		1.65	(0.79)	0.59	0.88		3.26	(0.91)	0.76	0.92

WOMAC Total	ADAPT	Total	112				0.97	102				0.98
		[Pain] ...walking on a flat surface?		2.1	(1.00)	0.66	0.97		0.46	(0.84)	0.88	0.98
		[Pain] ...going up or down stairs?		1.93	(0.99)	0.67	0.97		0.45	(0.84)	0.92	0.98
		[Pain] ...at night while in bed?		1.84	(1.09)	0.69	0.97		0.45	(0.75)	0.76	0.98
		[Pain] ...sitting or lying?		1.57	(1.04)	0.74	0.97		0.43	(0.78)	0.84	0.98
		[Pain] ...standing upright?		1.68	(0.99)	0.7	0.97		0.35	(0.82)	0.81	0.98
		[Physical Function] ...descending stairs?		1.55	(1.01)	0.82	0.97		0.26	(0.61)	0.8	0.98
		[Physical Function] ...ascending stairs?		1.79	(1.09)	0.79	0.97		0.31	(0.72)	0.87	0.98
		[Physical Function] ...rising from sitting?		1.72	(0.99)	0.8	0.97		0.4	(0.71)	0.82	0.98
		[Physical Function] ...standing?		1.63	(1.07)	0.74	0.97		0.36	(0.82)	0.88	0.98
		[Physical Function] ...bending to floor?		2.29	(1.15)	0.74	0.97		0.74	(1.00)	0.77	0.98
		[Physical Function] ...walking on flat?		1.51	(1.05)	0.79	0.97		0.26	(0.67)	0.87	0.98
		[Physical Function] ...getting in/out car?		2.13	(1.08)	0.84	0.97		0.58	(0.81)	0.8	0.98
		[Physical Function] ...going shopping?		1.88	(1.26)	0.8	0.97		0.35	(0.79)	0.91	0.98
		[Physical Function] ...put on sock/stock?		2.37	(1.04)	0.72	0.97		0.89	(1.02)	0.71	0.98
		[Physical Function] ...rising from bed?		1.63	(1.01)	0.83	0.97		0.36	(0.67)	0.73	0.98
		[Physical Function] ...taking off socks/stockings?		2.21	(1.05)	0.75	0.97		0.71	(0.92)	0.74	0.98
		[Physical Function] ...lying in bed?		1.5	(1.07)	0.74	0.97		0.32	(0.65)	0.75	0.98
		[Physical Function] ...get in/out bath/shower?		1.59	(1.19)	0.76	0.97		0.35	(0.79)	0.65	0.98
		[Physical Function] ...sitting?		1.27	(0.99)	0.81	0.97		0.24	(0.57)	0.77	0.98
		[Physical Function] ...on/off toilet?		1.42	(1.18)	0.78	0.97		0.26	(0.61)	0.71	0.98

	[Physical Function] ...heavy household chores?		2.48	(1.13)	0.81	0.97		0.79	(1.09)	0.85	0.98
	[Physical Function] ...light household chores?		1.39	(1.02)	0.84	0.97		0.28	(0.71)	0.88	0.98
	[Stiffness] ...first walk morning?		2	(1.09)	0.75	0.97		0.61	(0.90)	0.75	0.98
	[Stiffness] ...sitting/lying/resting later in day?		1.79	(0.99)	0.76	0.97		0.49	(0.81)	0.83	0.98
APEX	Total	261				0.96	234				0.98
	[Pain] ...walking on a flat surface?		2.52	(0.84)	0.69	0.96		0.47	(0.77)	0.8	0.97
	[Pain] ...going up or down stairs?		2.55	(0.88)	0.76	0.96		0.45	(0.82)	0.8	0.97
	[Pain] ...at night while in bed?		2.18	(1.01)	0.53	0.96		0.36	(0.72)	0.71	0.97
	[Pain] ...sitting or lying?		1.93	(0.94)	0.58	0.96		0.31	(0.67)	0.73	0.97
	[Pain] ...standing upright?		2.05	(0.99)	0.69	0.96		0.31	(0.64)	0.74	0.97
	[Physical Function] ...descending stairs?		1.95	(1.01)	0.72	0.96		0.43	(0.79)	0.82	0.97
	[Physical Function] ...ascending stairs?		2.3	(1.03)	0.7	0.96		0.55	(0.89)	0.84	0.97
	[Physical Function] ...rising from sitting?		2.33	(0.92)	0.74	0.96		0.53	(0.81)	0.83	0.97
	[Physical Function] ...standing?		1.95	(0.97)	0.75	0.96		0.34	(0.71)	0.79	0.97
	[Physical Function] ...bending to floor?		2.62	(1.01)	0.71	0.96		0.82	(0.98)	0.77	0.97
	[Physical Function] ...walking on flat?		2.21	(0.89)	0.67	0.96		0.36	(0.73)	0.76	0.97
	[Physical Function] ...getting in/out car?		2.63	(0.91)	0.75	0.96		0.62	(0.88)	0.83	0.97
	[Physical Function] ...going shopping?		2.41	(1.00)	0.76	0.96		0.44	(0.84)	0.85	0.97
	[Physical Function] ...put on sock/stock?		2.8	(1.04)	0.7	0.96		0.74	(0.96)	0.71	0.97
	[Physical Function] ...rising from bed?		2.14	(0.93)	0.81	0.96		0.34	(0.73)	0.85	0.97
	[Physical Function] ...taking off socks/stockings?		2.6	(1.06)	0.66	0.96		0.62	(0.91)	0.73	0.97

	[Physical Function] ...lying in bed?		1.9	(0.98)	0.68	0.96		0.27	(0.71)	0.75	0.97
	[Physical Function] ...get in/out bath/shower?		2.1	(1.06)	0.72	0.96		0.38	(0.79)	0.79	0.97
	[Physical Function] ...sitting?		1.74	(0.95)	0.73	0.96		0.29	(0.72)	0.8	0.97
	[Physical Function] ...on/off toilet?		1.92	(1.02)	0.77	0.96		0.37	(0.74)	0.79	0.97
	[Physical Function] ...heavy household chores?		2.8	(0.99)	0.79	0.96		0.78	(1.01)	0.83	0.97
	[Physical Function] ...light household chores?		1.87	(0.94)	0.77	0.96		0.29	(0.63)	0.8	0.97
	[Stiffness] ...first walk morning?		2.29	(1.02)	0.65	0.96		0.6	(0.77)	0.75	0.97
	[Stiffness] ...sitting/lying/resting later in day?		2.06	(1.01)	0.66	0.96		0.56	(0.77)	0.76	0.97
EUROHIP	Total	1243				0.95	865				0.98
	[Pain] ...walking on a flat surface?		2.36	(0.86)	0.65	0.95		0.73	(0.98)	0.78	0.98
	[Pain] ...going up or down stairs?		2.69	(0.87)	0.70	0.95		0.96	(1.08)	0.83	0.98
	[Pain] ...at night while in bed?		1.98	(1.05)	0.53	0.95		0.55	(0.85)	0.70	0.98
	[Pain] ...sitting or lying?		1.84	(0.95)	0.60	0.95		0.63	(0.89)	0.75	0.98
	[Pain] ...standing upright?		2.20	(0.97)	0.64	0.95		0.79	(1.03)	0.81	0.98
	[Physical Function] ...descending stairs?		2.30	(0.96)	0.69	0.95		0.83	(1.00)	0.82	0.98
	[Physical Function] ...ascending stairs?		2.62	(0.90)	0.71	0.95		0.99	(1.06)	0.84	0.98
	[Physical Function] ...rising from sitting?		2.48	(0.88)	0.73	0.95		1.00	(1.06)	0.85	0.98
	[Physical Function] ...standing?		2.20	(0.95)	0.66	0.95		0.81	(1.04)	0.85	0.98
	[Physical Function] ...bending to floor?		2.73	(0.97)	0.62	0.95		1.38	(1.15)	0.78	0.98
	[Physical Function] ...walking on flat?		2.23	(0.85)	0.67	0.95		0.67	(0.92)	0.82	0.98
	[Physical Function] ...getting in/out car?		2.72	(0.85)	0.71	0.95		1.09	(1.06)	0.83	0.98

	[Physical Function] ...going shopping?	2.53	(0.91)	0.70	0.95	0.90	(1.07)	0.85	0.98
	[Physical Function] ...put on sock/stock?	2.88	(0.91)	0.64	0.95	1.38	(1.15)	0.78	0.98
	[Physical Function] ...rising from bed?	2.28	(0.89)	0.76	0.95	0.85	(1.00)	0.87	0.98
	[Physical Function] ...taking off socks/stockings?	2.67	(0.97)	0.64	0.95	1.23	(1.11)	0.78	0.98
	[Physical Function] ...lying in bed?	1.96	(0.98)	0.64	0.95	0.59	(0.88)	0.77	0.98
	[Physical Function] ...get in/out bath/shower?	2.53	(1.00)	0.68	0.95	1.06	(1.16)	0.79	0.98
	[Physical Function] ...sitting?	1.82	(0.93)	0.68	0.95	0.64	(0.90)	0.80	0.98
	[Physical Function] ...on/off toilet?	2.14	(0.99)	0.74	0.95	0.74	(0.98)	0.85	0.98
	[Physical Function] ...heavy household chores?	2.84	(0.89)	0.68	0.95	1.44	(1.16)	0.80	0.98
	[Physical Function] ...light household chores?	1.96	(0.87)	0.70	0.95	0.68	(0.89)	0.84	0.98
	[Stiffness] ...first walk morning?	2.47	(0.96)	0.58	0.95	1.13	(1.05)	0.77	0.98
	[Stiffness] ...sitting/lying/resting later in day?	2.37	(0.86)	0.56	0.95	1.06	(0.98)	0.76	0.98

N= Number of individuals with complete scales

ritem-rest=The correlation between an item and the scale that is formed by all other items.

α=Cronbach’s alpha of the scale excluding all but on of the items, except where "Total" indicates Cronbach’s alpha for complete scale.

TABLE 60 Knee

			Pre-operation					Post-operation				
Measurement tool	Data	Item	N	Mean	SD	ritem-rest=	α=	N	Mean	SD	ritem-rest=	α=
EQ-5D-3L [1,3]	APEX	Total	298				0.66	261				0.80
		Mobility		1.91	(0.29)	0.35	0.64		1.46	(0.51)	0.63	0.75
		Self-care		1.28	(0.46)	0.45	0.59		1.16	(0.38)	0.52	0.79
		Usual Activities		2.00	(0.50)	0.52	0.56		1.57	(0.59)	0.67	0.74
		Pain/Discomfort		2.30	(0.48)	0.40	0.62		1.65	(0.61)	0.65	0.74
		Anxiety/Depression		1.48	(0.59)	0.40	0.63		1.24	(0.50)	0.50	0.79
	KAT	Total	2120				0.55	1939				0.79
		Mobility		1.97	(0.19)	0.25	0.55		1.50	(0.50)	0.66	0.72
		Self-care		1.30	(0.46)	0.35	0.47		1.20	(0.41)	0.50	0.77
		Usual Activities		1.95	(0.48)	0.38	0.46		1.60	(0.56)	0.65	0.72
		Pain/Discomfort		2.44	(0.51)	0.36	0.47		1.68	(0.57)	0.60	0.74
		Anxiety/Depression		1.44	(0.55)	0.30	0.52		1.26	(0.47)	0.45	0.79
SF-12	ADAPT	Total	116				0.81	96				0.89
		[1] would you say your health is:		2.95	(0.89)	0.44	0.79		2.86	(1.01)	0.66	0.88
		[2a] health limits...moderate activities.		1.52	(0.60)	0.33	0.8		2.04	(0.78)	0.74	0.88
		[2b] health limits...climbing several flights stairs.		1.23	(0.50)	0.46	0.8		1.77	(0.73)	0.72	0.88
		[3a] physical health...acomplished less...		1.15	(0.36)	0.49	0.8		1.42	(0.50)	0.63	0.89
		[3b] physical health...limited in kind of work.		1.11	(0.32)	0.5	0.8		1.4	(0.49)	0.57	0.89

	[4a] emotional problems...acomplished less...		1.57	(0.50)	0.48	0.8		1.73	(0.45)	0.56	0.89
	[4b] emotional problems...less carefully than usual.		1.59	(0.49)	0.42	0.8		1.77	(0.42)	0.52	0.89
	[5] pain intefere with your normal work		3.7	(0.83)	0.54	0.78		2.51	(1.20)	0.69	0.88
	[6a] past 4 weeks...felt calm and peaceful?		3.13	(1.21)	0.59	0.78		2.58	(1.32)	0.64	0.88
	[6b] past 4 weeks...lot of energy?		3.8	(1.27)	0.51	0.79		3.36	(1.29)	0.72	0.88
	[6c] past 4 weeks...down hearted blue?		4.55	(1.24)	0.52	0.79		4.96	(1.25)	0.57	0.89
	[7] physical emotional problems...social acitvities.		2.55	(1.20)	0.63	0.77		1.83	(1.02)	0.66	0.88
KAT			Pre-operation: Version 1					Pre-operation: Version 2			
	Total	116				-0.40	1791				0.38
	[1] would you say your health is:		2.57	(0.86)	0.02	-0.47		2.77	(0.84)	-0.20	0.45
	[2a] health limits...moderate activities.		1.59	(0.60)	0.10	-0.50		1.62	(0.63)	0.35	0.32
	[2b] health limits...climbing several flights stairs.		1.37	(0.52)	0.18	-0.53		1.34	(0.54)	0.30	0.34
	[3a] physical health...acomplished less...		1.13	(0.34)	0.21	-0.49		2.55	(1.04)	0.49	0.22
	[3b] physical health...limited in kind of work.		1.12	(0.33)	0.24	-0.50		2.54	(1.02)	0.47	0.23
	[4a] emotional problems...acomplished less...		1.52	(0.50)	0.02	-0.43		3.78	(1.24)	0.49	0.19
	[4b] emotional problems...less carefully than usual.		1.59	(0.49)	0.05	-0.45		3.78	(1.20)	0.50	0.19
	[5] pain intefere with your normal work		3.57	(1.02)	-0.40	-0.04		3.68	(0.92)	-0.51	0.54
	[6a] past 4 weeks...felt calm and peaceful?		2.90	(1.20)	-0.26	-0.14		2.60	(1.01)	-0.37	0.52
	[6b] past 4 weeks...lot of energy?		3.84	(1.42)	-0.20	-0.20		3.26	(1.06)	-0.30	0.51
	[6c] past 4 weeks...down hearted blue?		4.67	(1.22)	-0.21	-0.20		3.80	(1.06)	0.29	0.30

		[7] physical emotional problems...social acitvities.		3.25	(1.34)	-0.04	-0.47		3.33	(1.28)	0.40	0.23
OKS	KAT	Total	2112				0.86	1691				0.93
		OxPain		0.57	(0.67)	0.59	0.85		2.56	(1.20)	0.78	0.92
		Walk		1.80	(1.07)	0.50	0.86		3.18	(1.15)	0.59	0.93
		Meal		1.59	(0.85)	0.61	0.85		3.00	(0.96)	0.79	0.92
		Night		1.34	(1.22)	0.44	0.86		2.93	(1.25)	0.71	0.93
		Work		1.53	(0.88)	0.72	0.84		3.01	(1.03)	0.86	0.92
		WashDry		2.76	(1.01)	0.52	0.86		3.40	(0.86)	0.69	0.93
		Trans		1.92	(0.84)	0.58	0.85		2.74	(0.95)	0.73	0.93
		Limp		0.81	(1.02)	0.43	0.86		2.99	(1.22)	0.76	0.92
		Kneel		0.70	(0.87)	0.48	0.86		1.26	(1.29)	0.52	0.94
		GiveWay		1.89	(1.22)	0.54	0.86		3.45	(0.89)	0.68	0.93
		Shopping		1.51	(1.18)	0.63	0.85		2.92	(1.29)	0.72	0.93
		Stairs		1.57	(0.91)	0.64	0.85		2.72	(1.06)	0.75	0.93
WOMAC Total	ADAPT	Total	118				0.96	102				0.98
		[Pain] ...walking on a flat surface?		2.36	(0.86)	0.64	0.96		1.16	(1.10)	0.78	0.98
		[Pain] ...going up or down stairs?		2.69	(0.89)	0.68	0.96		1.35	(1.23)	0.85	0.98
		[Pain] ...at night while in bed?		2.1	(1.13)	0.56	0.96		0.87	(1.02)	0.76	0.98
		[Pain] ...sitting or lying?		1.81	(0.95)	0.73	0.96		0.75	(0.93)	0.84	0.98
		[Pain] ...standing upright?		2.3	(0.91)	0.71	0.96		1.1	(1.07)	0.87	0.98
		[Physical Function] ...descending stairs?		2.42	(0.90)	0.59	0.96		1.23	(1.12)	0.85	0.98
		[Physical Function] ...ascending stairs?		2.4	(0.91)	0.7	0.96		1.18	(1.17)	0.86	0.98
		[Physical Function] ...rising from sitting?		2.01	(0.93)	0.68	0.96		1.07	(1.11)	0.8	0.98
		[Physical Function] ...standing?		2	(0.92)	0.67	0.96		1.02	(1.08)	0.86	0.98

	[Physical Function] ...bending to floor?		2.17	(1.12)	0.54	0.96		1.31	(1.23)	0.83	0.98
	[Physical Function] ...walking on flat?		1.9	(0.81)	0.65	0.96		0.93	(1.03)	0.87	0.98
	[Physical Function] ...getting in/out car?		2.12	(0.94)	0.69	0.96		1.19	(1.07)	0.86	0.98
	[Physical Function] ...going shopping?		2.19	(1.01)	0.74	0.96		1.08	(1.10)	0.87	0.98
	[Physical Function] ...put on sock/stock?		1.84	(1.12)	0.76	0.96		1.09	(1.14)	0.81	0.98
	[Physical Function] ...rising from bed?		1.77	(1.02)	0.77	0.96		0.9	(1.05)	0.88	0.98
	[Physical Function] ...taking off socks/stockings?		1.77	(1.12)	0.74	0.96		0.99	(1.09)	0.81	0.98
	[Physical Function] ...lying in bed?		1.53	(1.01)	0.74	0.96		0.68	(0.91)	0.82	0.98
	[Physical Function] ...get in/out bath/shower?		1.94	(1.03)	0.69	0.96		0.88	(1.11)	0.76	0.98
	[Physical Function] ...sitting?		1.43	(0.93)	0.73	0.96		0.64	(0.83)	0.84	0.98
	[Physical Function] ...on/off toilet?		1.61	(1.03)	0.79	0.96		0.73	(0.91)	0.84	0.98
	[Physical Function] ...heavy household chores?		2.69	(0.93)	0.77	0.96		1.56	(1.28)	0.84	0.98
	[Physical Function] ...light household chores?		1.68	(0.90)	0.76	0.96		0.84	(0.97)	0.86	0.98
	[Stiffness] ...first walk morning?		2.42	(0.96)	0.67	0.96		1.28	(1.04)	0.71	0.98
	[Stiffness] ...sitting/lying/resting later in day?		2.09	(0.85)	0.57	0.96		1.1	(0.99)	0.71	0.98
APEX	Total	246				0.96	214				0.98
	[Pain] ...walking on a flat surface?		2.63	(0.73)	0.59	0.96		0.84	(0.98)	0.83	0.98
	[Pain] ...going up or down stairs?		2.78	(0.71)	0.57	0.96		1.06	(1.02)	0.84	0.98
	[Pain] ...at night while in bed?		1.92	(1.03)	0.5	0.96		0.65	(0.92)	0.77	0.98
	[Pain] ...sitting or lying?		1.75	(0.95)	0.67	0.96		0.57	(0.81)	0.8	0.98
	[Pain] ...standing upright?		2.36	(0.88)	0.68	0.96		0.72	(0.91)	0.82	0.98
	[Physical Function] ...descending stairs?		2.53	(0.85)	0.57	0.96		1.24	(1.02)	0.77	0.98

[Physical Function] ...ascending stairs?	2.49	(0.86)	0.62	0.96	1.07	(1.01)	0.83	0.98
[Physical Function] ...rising from sitting?	2.37	(0.84)	0.66	0.96	1.05	(1.01)	0.84	0.98
[Physical Function] ...standing?	2.15	(0.94)	0.7	0.95	0.79	(0.93)	0.8	0.98
[Physical Function] ...bending to floor?	2.46	(1.11)	0.61	0.96	1.21	(1.07)	0.76	0.98
[Physical Function] ...walking on flat?	2.24	(0.86)	0.67	0.96	0.69	(0.95)	0.87	0.98
[Physical Function] ...getting in/out car?	2.37	(0.91)	0.77	0.95	1.28	(1.06)	0.79	0.98
[Physical Function] ...going shopping?	2.46	(0.87)	0.71	0.95	0.92	(1.07)	0.87	0.98
[Physical Function] ...put on sock/stock?	2	(1.03)	0.7	0.95	0.92	(0.99)	0.79	0.98
[Physical Function] ...rising from bed?	1.97	(0.95)	0.79	0.95	0.75	(0.93)	0.88	0.98
[Physical Function] ...taking off socks/stockings?	1.97	(1.06)	0.74	0.95	0.78	(0.90)	0.82	0.98
[Physical Function] ...lying in bed?	1.59	(1.01)	0.77	0.95	0.54	(0.90)	0.8	0.98
[Physical Function] ...get in/out bath/shower?	2.12	(1.00)	0.69	0.95	0.91	(0.98)	0.81	0.98
[Physical Function] ...sitting?	1.51	(0.93)	0.79	0.95	0.53	(0.83)	0.86	0.98
[Physical Function] ...on/off toilet?	1.78	(0.99)	0.77	0.95	0.73	(0.91)	0.86	0.98
[Physical Function] ...heavy household chores?	2.67	(0.97)	0.77	0.95	1.28	(1.13)	0.83	0.98
[Physical Function] ...light household chores?	1.79	(0.88)	0.75	0.95	0.68	(0.88)	0.85	0.98
[Stiffness] ...first walk morning?	2.52	(0.95)	0.57	0.96	1.23	(0.93)	0.77	0.98
[Stiffness] ...sitting/lying/resting later in day?	2.15	(0.89)	0.63	0.96	1.03	(0.93)	0.73	0.98

N= Number of individuals with complete scales

ritem-rest=The correlation between an item and the scale that is formed by all other items.

α=Cronbach’s alpha of the scale excluding all but on of the items, except where "Total" indicates Cronbach’s alpha for complete scale.

Descriptive Statistics

KAT

Descriptive statistics of OKS total score, EQ-5D-3L Index, SF-12 Physical and SF-12 Mental summary scores are presented in the Table 4-1 and Table 4-2. The mean (SD) of OKS total score was 17.97 (7.54).

TABLE 61 Primary outcome scores

	Primary outcome	N Complete (2,217)	N Complete missing	% Complete missing	Mean	SD	Min	Max
Pre-operation	EQ-5D-3L Index	2120	97	4.38	0.38	0.31	-0.48	1.00
	OKS	2112	105	4.74	17.97	7.54	0.00	47.00
	SF-12 Physical	2087	130	5.86	31.02	8.16	7.65	64.72
	SF-12 Mental	2087	130	5.86	49.83	11.52	15.57	75.35
Post-operation	EQ-5D-3L Index	1939	278	12.54	0.73	0.25	-0.32	1.00
	OKS	1691	526	23.73	34.15	10.04	1.00	48.00
	SF-12 Physical	1904	313	14.12	40.28	10.62	5.78	64.62
	SF-12 Mental	1904	313	14.12	51.45	10.90	11.48	72.02

TABLE 62 Primary outcome change score (post – pre-operative score)

Primary outcome	N (2,217)	N missing	% missing	Mean	SD	Min	Max
EQ-5D-3L Index	1882	335	15.11	0.34	0.33	-1.01	1.32
OKS	1634	583	26.30	15.93	10.26	-30	42
SF-12 Physical	1820	397	17.91	9.17	10.87	-26.32	41.10
SF-12 Mental	1820	397	17.91	1.30	11.51	-42.99	38.32

EUROHIP

TABLE 63 Primary outcome scores

	Primary outcome	N Complete	N Complete missing	% Complete missing	Mean	SD	Min	Max
Pre-operation	EQ-5D-3L Index (N=1327)	1228	99	7.46	0.4	0.33	-0.59	1
	OHS (N=143)	127	16	11.19	15.91	7.97	3	39
	WOMAC Total (N=1327)	1243	84	6.33	59.15	16.06	2.08	100
Post-operation	EQ-5D-3L Index (N=908)	883	25	2.75	0.78	0.25	-0.43	1
	OHS (N=138)	114	24	17.39	39.72	8.74	11	48
	WOMAC Total (N=908)	865	43	4.74	76.93	20.94	6.25	100.0

TABLE 64 Primary outcome change score (post – pre-operative score)

Primary outcome	N	N missing	% missing	Mean	SD	Min	Max
EQ-5D-3L Index change (N=908)	859	49	5.40	0.34	0.34	-0.71	-1.32
OHS change (N=138)	103	35	25.36	23.47	9.71	1	44
WOMAC total change(N=908)	845	63	6.94	34.90	21.37	-32.29	100

TABLE 65 OKS Subscale change score (post – pre-operative score)

	Secondary outcome	N	N missing	% missing	Mean	SD	Min	Max
OHS (N=138)	OHS pain	113	25	18.12	57.82	22.06	-8.33	100
	OHS function	108	30	21.74	39.7	21.69	-16.67	87.5

EPOS

TABLE 66 OHS score

Primary outcome	N Complete (N=1,589)	N Complete missing	% Complete missing	Mean	SD	Min	Max
OHS (Pre-operation)	1517	72	4.53	16.10	7.97	0	47
OHS (Post-operation; 24months)	1239	350	22.03	39.63	9.35	2	48

TABLE 67 OHS change score (post – pre-operative score)

Primary outcome	N	N missing	% missing	Mean	SD	Min	Max
OHS change	1179	410	25.80	-22.97	10.12	-45	24

TABLE 68 OHS subscale change score (2 Year - Pre-)

Secondary outcome	N	N missing	% missing	Mean	SD	Min	Max
OHS Pain change	1196	393	24.73	13.49	5.64	-11	24
OHS Function change	1191	398	25.05	9.46	5.27	-13	22

Online Supplement 2 - SF-12 scores and Systemic review (WP1)- MIC, MDC, MCID, MID

TABLE 69 Theoretically possible scores of SF-12 both for Hip and Knee

	Version 1		**Version 2**	
	Min	Max	Min	Max
PCS	11.0	71.2	4.3	76.4
MCS	5.7	69.0	-1.1	79.6

TABLE 70 Systemic review (WP1) figures - MIC, MDC, MCID, MID

Candidate tools		**Site**	**MIC**	**MDC (±)**	**MCID**	**MID**
OKS		Knee	9 (Anchor-based) 1 7 (ROC) 1	4.151 (90% L/U)		
OHS		Hip	11 (Anchor-based) 8 (ROC)	4.851 (90% L/U)		
SF-12	PCS	Knee		9.782 (95% L/U)		
		Hip		12.182 (95% L/U)		
	MCS	Knee		13.712 (95% L/U)		
		Hip		14.142 (95% L/U)		
WOMAC	Total	Knee				9.2 4 (0.5 SD)
		Hip				
	Pain	Knee			13.4 3 (Anchor-based)	
		Hip				
	PF	Knee				
		Hip				
	Stiffness	Knee			11.9 3 (Anchor-based)	
		Hip				
KOOS-PS (no data)		Knee				
		Hip				

1: David et al. 2015

2: Poitras et al, 2012

3: Hawker et al, 2013 based on MCID (Anchor) definition by Angst et al, 2002

4: 0.5 SD, Hawker et al, 2013

Online Supplement 3 - Absolute threshold further findings

*Sensitivity: 100%

TABLE 71 OHS (0-48)

Dataset 1	**Dataset 2**		**Dataset 1**		**Dataset 2**
			Pre-op Threshold	Spec (95% CI)	Spec (95% CI)
NPROMs	**EPOS**	B	43	1.7 (1.4, 2.1)	1.7 (0.0, 9.1)
		C	38	6.5 (6.1, 7.0)	8.3 (4.1,14.8)
		D	42	2.2 (1.9, 2.6)	6.1 (1.7,14.8)
EPOS	**NPROMs**	B	43	1.7 (0.0, 9.1)	1.7 (1.4, 2.1)
		C	38	8.3 (4.1,14.8)	6.5 (6.1, 7.0)
		D	42	6.1 (1.7,14.8)	2.2 (1.9, 2.6)

TABLE 72 OKS (0-48)

Dataset 1	**Dataset 2**		**Dataset 1**		**Dataset 2**
			Pre-op Threshold	Spec (95% CI)	Spec (95% CI)
NPROMs	**KAT**	B	43	0.5 (0.4, 0.7)	0.9 (0.1 ,3.1)
		C	38	2.9 (2.7, 3.1)	2.8 (1.4 ,4.8)
		D	42	0.8 (0.6, 0.9)	2.4 (0.9 ,5.1)
KAT	**NPROMs**	B	43	0.9 (0.1 ,3.1)	0.5 (0.4, 0.7)
		C	38	2.8 (1.4, 4.8)	2.9 (2.7, 3.1)
		D	43	0.9 (0.1, 3.1)	0.5 (0.4, 0.7)

TABLE 73 SF-12 PCS - Hip (version 1: 11.0 ~ 71.2)

Dataset 1		**Dataset 1**	
		Pre-op Threshold	Spec (95% CI)
ADAPT	B	66	0 (0, 14)
	C	61	0 (0, 9)
	D	65	0 (0, 12)

*Ver1 with US weighting for ADAPT

TABLE 74 SF-12 MCS - Hip (version 1: 5.7 ~ 69.0)

Dataset 1		Dataset 1	
		Pre-op Threshold	Spec (95% CI)
ADAPT	B	65	0 (0, 7)
	C	58	15 (7, 26)
	D	63	0 (0, 6)

TABLE 75 SF-12 PCS - Knee (version 1 and version 2: 4.3 ~ 76.4)

Dataset 1	Dataset 2		Dataset 1		Dataset 2
			Pre-op Threshold	Spec (95% CI)	Spec (95% CI)
ADAPT	**KAT**	B	66	0 (0, 11)	0 (0, 1)
		C	63	0 (0, 9)	0 (0, 1)
		D	66	0 (0, 11)	0 (0, 1)
KAT	**ADAPT**	B	71	0 (0, 1)	0 (0, 11)
		C	67	0 (0, 1)	0 (0, 9)
		D	71	0 (0, 1)	0 (0, 11)

Version 1 possible range (11.0 ~71.2)

Version 2 possible range (4.3 ~ 76.4)

TABLE 76 SF-12 MCS - Knee (version 1 and 2:-1.1 ~ 79.6)

Dataset 1	Dataset 2		Dataset 1		Dataset 2
			Pre-op Threshold	Spec (95% CI)	Spec (95% CI)
ADAPT	**KAT**	B	65	2 (0, 13)	0.1 (0, 0.6)
		C	58	19 (10, 32)	26.9 (24.5, 29.5)
		D	63	2 (0, 10)	0.6 (0.2, 1.2)
KAT	**ADAPT**	B	74	0.3 (0.1, 0.9)	0 (0, 8)
		C	65	10.9 (9.3, 12.7)	2 (0, 9)
		D	72	0.9 (0.4, 1.6)	0 (0, 7)

Version 1 possible range (5.7 ~ 69.0)

Version 2 possible range (-1.1 ~ 79.6)

TABLE 77 WOMAC Total - Hip (0-100)

Dataset 1	Dataset 2	Dataset 3		Dataset 1		Dataset 2	Dataset 3
				Pre-op Threshold	Spec (95% CI)	Spec (95% CI)	Spec (95% CI)
ADAPT	**APEX**	**EUROHIP**	B	89	22 (6, 48)	0 (0, 31)	0 (0, 3)
			C	73	46 (31, 61)	38 (20, 59)	9.5 (6.3,13.6)
			D	85	32 (16, 52)	20 (3, 56)	2.6 (0.7, 6.6)
APEX	**ADAPT**	**EUROHIP**	B	91	0 (0, 31)	17 (4, 41)	0 (0, 3)
			C	78	23 (9, 44)	38 (24, 53)	4.7, (2.3, 8.2)
			D	87	20 (3, 56)	25 (11, 45)	0.7 (0.0, 4.0)
EUROHIP	**ADAPT**	**APEX**	B	90	0 (0, 2)	17 (4, 41)	0 (0, 31)
			C	80	4.9 (2.4, 8.7)	31 (19, 46)	19 (7, 39)
			D	89	0 (0, 3)	14 (4, 33)	0 (0, 31)

TABLE 78 WOMAC Pain - Hip (0-100)

Dataset 1	Dataset 2	Dataset 3		Dataset 1		Dataset 2	Dataset 3
				Pre-op Threshold	Spec (95% CI)	Spec (95% CI)	Spec (95% CI)
ADAPT	**APEX**	**EUROHIP**	B	90	21 (5, 51)	12 (1, 36)	2.9 (0.6, 8.3)
			C	72	51 (35, 67)	32 (18, 49)	19.4 (15.1,24.3)
			D	84	42 (23, 63)	18 (4, 43)	9.3 (5.5,14.5)
APEX	**ADAPT**	**EUROHIP**	B	89	18 (4, 43)	36 (13, 65)	4.2 (1.5, 8.8)
			C	77	24 (11, 40)	30 (17, 46)	12.4 (8.6,17.3)
			D	87	18 (4, 43)	19 (7, 39)	4.1 (1.5, 8.8)
EUROHIP	**ADAPT**	**APEX**	B	89	4.2 (1.5, 8.8)	36 (13, 65)	18 (4, 43)
			C	78	12.4 (8.6,17.3)	30 (17, 46)	24 (11, 40)
			D	87	4.1 (1.5, 8.8)	19 (7, 39)	18 (4, 43)

TABLE 79 WOMAC Physical Function - Hip (0-100)

Dataset 1	Dataset 2	Dataset 3		Dataset 1		Dataset 2	Dataset 3
				Pre-op Threshold	Spec (95% CI)	Spec (95% CI)	Spec (95% CI)
ADAPT	**APEX**	**EUROHIP**	B	89	33 (15, 57)	17 (2, 48)	1.5 (0.2, 5.3)
			C	72	58 (43, 72)	34 (20, 51)	11.8 (8.5,15.9)
			D	84	35 (20, 54)	15 (2, 45)	3.6 (1.3, 7.6)
APEX	**ADAPT**	**EUROHIP**	B	90	17 (2, 48)	29 (11, 52)	0.8 (0.0, 4.5)
			C	76	29 (15, 46)	44 (30, 59)	7.4 (4.5,11.1)
			D	87	15 (2, 45)	24 (11, 41)	3.3 (1.1, 7.5)
EUROHIP	**ADAPT**	**APEX**	B	90	0.8 (0.0, 4.5)	29 (11, 52)	17 (2, 48)
			C	79	6.8 (3.9,10.7)	40 (26, 55)	16 (6, 31)
			D	88	2.2 (0.4, 6.2)	24 (11, 41)	15 (2, 45)

TABLE 80 WOMAC Stiffness - Hip (0-100)

Dataset 1	Dataset 2	Dataset 3		Dataset 1		Dataset 2	Dataset 3
				Pre-op Threshold	Spec (95% CI)	Spec (95% CI)	Spec (95% CI)
ADAPT	**APEX**	**EUROHIP**	B	88	42 (15, 72)	29 (13, 49)	8.6 (4.6, 14.2)
			C	70	59 (44, 73)	43 (33, 53)	19.4 (15.7, 23.5)
			D	83	40 (23, 59)	27 (16, 40)	8.1 (5.1, 12.1)
APEX	**ADAPT**	**EUROHIP**	B	88	29 (13, 49)	42 (15, 72)	8.6 (4.6, 14.2)
			C	71	43 (33, 53)	59 (44, 73)	19.0 (15.7, 23.5)
			D	84	27 (16, 40)	40 (23, 59)	8.1 (5.1,12.1)
EUROHIP	**ADAPT**	**APEX**	B	86	8.1 (5.1,12.1)	50 (21, 79)	32 (16, 52)
			C	74	19.4 (15.7,23.5)	59 (44, 73)	43 (33, 53)
			D	85	8.1 (5.1,12.1)	40 (23, 59)	27 (16, 40)

TABLE 81 WOMAC Total - Knee (0-100)

Dataset 1	Dataset 2		Dataset 1 Pre-op Threshold	Spec (95% CI)	Dataset 2 Spec (95% CI)
ADAPT	**APEX**	B	90	7 (1, 24)	0 (0, 16)
		C	78	10 (3, 21)	13 (5, 26)
		D	88	6 (1, 20)	0 (0, 14)
APEX	**ADAPT**	B	91	0 (0, 16)	7 (1, 24)
		C	79	11 (4, 23)	10 (3, 21)
		D	88	0 (0, 14)	6 (1, 20)

TABLE 82 WOMAC Pain - Knee (0-100)

Dataset 1	Dataset 2		Dataset 1 Pre-op Threshold	Spec (95% CI)	Dataset 2 Spec (95% CI)
ADAPT	**APEX**	B	89	5 (0, 25)	0 (0, 12)
		C	76	4 (1, 15)	2 (0, 9)
		D	87	5 (0, 25)	0 (0, 12)
APEX	**ADAPT**	B	90	0 (0, 12)	0 (0, 17)
		C	79	2 (0, 9)	4 (1, 15)
		D	88	0 (0, 12)	5 (0, 25)

TABLE 83 WOMAC PF - Knee (0-100)

Dataset 1	Dataset 2		Dataset 1 Pre-op Threshold	Spec (95% CI)	Dataset 2 Spec (95% CI)
ADAPT	**APEX**	B	90	8 (1, 27)	7 (1, 24)
		C	77	12 (5, 23)	16 (8, 28)
		D	87	10 (3, 24)	9 (2, 24)
APEX	**ADAPT**	B	91	7 (1, 24)	8 (1, 27)
		C	78	14 (6, 26)	12 (5, 23)
		D	87	9 (2, 24)	10 (3, 24)

TABLE 84 WOMAC Stiffness - Knee (0-100)

Dataset 1	Dataset 2		Dataset 1 Pre-op Threshold	Spec (95% CI)	Dataset 2 Spec (95% CI)
ADAPT	**APEX**	B	88	8 (2, 21)	3 (0, 9)
		C	75	4 (1, 12)	6 (3, 12)
		D	86	8 (2, 21)	10 (4, 19)
APEX	**ADAPT**	B	88	3 (0, 9)	8 (2, 21)
		C	75	6 (3, 12)	4 (1, 12)
		D	86	10 (4, 19)	8 (2, 21)

Online Supplement 4 – Relative Threshold Further Findings

TABLE 85 OHS

Dataset 1	**Dataset 2**					**Dataset 1**			**Dataset 2**	
					Pre-op Threshold	Sen (95% CI)	Spec (95% CI)	AUC (95% CI)	Sen (95% CI)	Spec (95% CI)
NPROMs	EPOS	A								
			Linear regression		46	100 (100, 100)	0 (0, 1)	0.66 (0.66, 0.66)	100 (100, 100)	4 (0, 18)
			Logistic regression	0.5	49	100 (100, 100)	0 (0, 0)		100 (100, 100)	0 (0, 12)
				0.75	44	100 (100, 100)	1 (1, 1)		100 (100, 100)	4 (0, 18)
		B								
			Linear regression		40	100 (100, 100)	4 (4, 5)	0.65 (0.65, 0.66)	100 (99, 100)	3 (0, 12)
			Logistic regression	0.5	43	100 (100, 100)	2 (1, 2)		100 (100, 100)	2 (0, 9)
				0.75	38	100 (100, 100)	6 (6, 7)		99 (99, 100)	3 (0, 12)
		C								
			Linear regression		33	98 (98, 98)	17 (17, 18)	0.68 (0.67, 0.68)	99 (98, 99)	16 (10, 24)
			Logistic regression	0.5	35	99 (99, 99)	13 (12, 13)		100 (99, 100)	8 (4, 15)
				0.75	30	95 (95, 95)	26 (25, 27)		96 (95, 97)	21 (14, 29)
		D								
			Linear regression		39	100 (100, 100)	5 (5, 6)	0.65 (0.65, 0.66)	100 (99, 100)	8 (3, 17)
			Logistic regression	0.5	41	100 (100, 100)	3 (3, 3)		100 (100, 100)	6 (2, 15)
				0.75	37	99 (99, 99)	8 (7, 9)		100 (99, 100)	8 (3, 17)

EPOS	NPROMs	A								
			Linear regression		44	100 (100, 100)	4 (0, 18)	0.66 (0.63, 0.69)	100 (100, 100)	1 (1, 1)
			Logistic regression	0.5	47	100 (100, 100)	0 (0, 12)		100 (100, 100)	0 (0, 1)
				0.75	45	100 (100, 100)	4 (0, 18)		100 (100, 100)	1 (0, 1)
		B								
			Linear regression		40	100 (99, 100)	3 (0, 12)	0.62 (0.59, 0.64)	100 (100, 100)	4 (4, 5)
			Logistic regression	0.5	42	100 (99, 100)	2 (0, 9)		100 (100, 100)	2 (2, 3)
				0.75	39	100 (99, 100)	3 (0, 12)		100 (100, 100)	5 (5, 6)
		C								
			Linear regression		35	100 (99, 100)	8 (4, 15)	0.62 (0.60, 0.65)	99 (99, 99)	13 (12, 13)
			Logistic regression	0.5	36	100 (99, 100)	8 (4, 15)		100 (100, 100)	10 (10, 11)
				0.75	33	99 (98, 99)	16 (10, 24)		98 (98, 98)	17 (17, 18)
		D								
			Linear regression		39	100 (99, 100)	8 (3, 17)	0.62 (0.59, 0.64)	100 (100, 100)	5 (5, 6)
			Logistic regression	0.5	42	100 (100, 100)	6 (2, 15)		100 (100, 100)	2 (2, 3)
				0.75	39	100 (99, 100)	8 (3, 17)		100 (100, 100)	5 (5, 6)

TABLE 86 OKS

Dataset 1	**Dataset 2**					**Dataset 1**			**Dataset 2**	
					Pre-op Threshold	Sen (95% CI)	Spec (95% CI)	AUC (95% CI)	Sen (95% CI)	Spec (95% CI)
NPROMs	KAT	A								
			Linear regression		43	100 (100, 100)	1 (0, 1)	0.63 (0.63, 0.63)	100 (100, 100)	1 (0, 5)
			Logistic regression	0.50	46	100 (100, 100)	0 (0, 0)		100 (100, 100)	1 (0, 4)
				0.75	40	100 (100, 100)	2 (2, 2)		100 (99, 100)	3 (1, 8)
		B								
			Linear regression		37	100 (99, 100)	4 (4, 5)	0.62 (0.61, 0.62)	99 (99, 100)	4 (2, 7)
			Logistic regression	0.5	40	100 (100, 100)	2 (2, 2)		100 (100, 100)	3 (1, 6)
				0.75	33	98 (97, 98)	11 (10, 11)		97 (96, 98)	10 (6, 15)
		C								
			Linear regression		30	96 (96, 96)	18 (18, 19)	0.63 (0.63, 0.63)	97 (96, 98)	13 (10, 17)
			Logistic regression	0.5	33	99 (99, 99)	11 (10, 11)		99 (99, 100)	8 (6, 11)
				0.75	25	85 (84, 85)	35 (35, 36)		88 (86, 90)	30 (25, 34)
		D								
			Linear regression		36	99 (99, 99)	6 (5, 6)	0.62 (0.61, 0.62)	99 (99, 100)	4 (2, 8)
			Logistic regression	0.5	38	100 (100, 100)	3 (3, 4)		100 (99, 100)	3 (1, 6)
				0.75	32	97 (97, 97)	13 (13, 14)		98 (97, 98)	10 (7, 14)
KAT	NPROMs	A								
			Linear regression		42	100 (100, 100)	3 (1, 8)	0.64 (0.61, 0.66)	100 (100, 100)	1 (1, 1)
			Logistic regression	0.5	45	100 (100, 100)	1 (0, 4)		100 (100, 100)	0 (0, 0)

		0.75	35	99 (98, 99)	5 (2, 10)		98 (98, 99)	7 (6, 8)
B								
	Linear regression		35	99 (98, 99)	5 (3, 9)	0.62 (0.60, 0.65)	99 (99, 99)	7 (7, 8)
	Logistic regression	0.5	39	100 (100, 100)	3 (1, 6)		100 (100, 100)	3 (2, 3)
		0.75	29	94 (93, 95)	14 (10, 20)		92 (92, 92)	21 (20, 22)
C								
	Linear regression		28	94 (93, 96)	18 (14, 22)	0.63 (0.61, 0.65)	92 (92, 93)	25 (24, 25)
	Logistic regression	0.5	31	98 (97, 99)	12 (9, 15)		97 (97, 97)	15 (15, 16)
		0.75	26	90 (89, 92)	26 (22, 30)		88 (87, 88)	32 (31, 32)
D								
	Linear regression		34	99 (98, 99)	6 (3, 10)	0.62 (0.60, 0.65)	98 (98, 98)	9 (8, 9)
	Logistic regression	0.5	39	100 (100, 100)	3 (1, 6)		100 (100, 100)	2 (2, 3)
		0.75	29	94 (93, 95)	15 (11, 20)		93 (92, 93)	21 (21, 22)

*Integrated Discrimination Index

TABLE 87 SF-12 PCS (Hip)

Dataset 1				**Dataset 1**			
				Pre-op Threshold	Sen (95% CI)	Spec (95% CI)	AUC (95% CI)
ADAPT	A						
		Linear regression		NA	NA	NA	
		Logistic regression	0.50	NA	NA	NA	0.56 (0.43, 0.67)
			0.75	41	81 (69, 90)	20 (3, 56)	
	B						
		Linear regression		46	91 (80, 98)	24 (9, 45)	
		Logistic regression	0.50	47	94 (82, 99)	20 (7, 41)	0.58 (0.46, 0.7)
			0.75	35	66 (51, 79)	48 (28, 69)	
	C						
		Linear regression		38	89 (73, 97)	41 (25, 58)	
		Logistic regression	0.50	40	97 (85, 100)	35 (20, 53)	0.62 (0.5, 0.74)
			0.75	NA	NA	NA	
	D						
		Linear regression		44	91 (78, 97)	29 (13, 49)	
		Logistic regression	0.50	46	93 (81, 99)	25 (11, 45)	0.57 (0.45, 0.69)
			0.75	NA	NA	NA	

TABLE 88 SF-12 MCS (Hip)

Dataset 1				**Dataset 1**		
			Pre-op Threshold	Sen (95% CI)	Spec (95% CI)	AUC (95% CI)
ADAPT	A					
	Linear regression		50	68 (49, 83)	79 (63, 90)	
	Logistic regression	0.50	53	88 (73, 97)	71 (54, 85)	0.82 (0.71, 0.9)
		0.75	38	29 (15, 47)	97 (86, 100)	
	B					
	Linear regression		42	68 (43, 87)	91 (79, 97)	
	Logistic regression	0.50	39	53 (29, 76)	96 (87, 100)	0.93 (0.85, 0.98)
		0.75	37	53 (29, 76)	100 (93, 100)	
	C					
	Linear regression		35	64 (31, 89)	98 (91, 100)	
	Logistic regression	0.50	39	82 (48, 98)	95 (86, 99)	0.97 (0.9, 1)
		0.75	37	82 (48, 98)	98 (91, 100)	
	D					
	Linear regression		39	67 (38, 88)	96 (88, 100)	
	Logistic regression	0.50	39	67 (38, 88)	96 (88, 100)	0.96 (0.88, 0.99)
		0.75	37	67 (38, 88)	100 (94, 100)	

TABLE 89 SF-12 PCS (Knee)

Dataset 1	**Dataset 2**				**Dataset 1**				**Dataset 2**	
					Pre-op Threshold	Sen (95% CI)	Spec (95% CI)	AUC (95% CI)	Sen (95% CI)	Spec (95% CI)
ADAPT	KAT	A								
			Linear regression		42	92 (81, 98)	13 (2, 40)	0.57 (0.44, 0.69)	93 (92, 95)	22 (17, 27)
			Logistic regression	0.50	NA	NA	NA		-	-
				0.75	31	66 (51, 79)	47 (21, 73)		56 (53, 59)	65 (60, 71)
		B								
			Linear regression		36	91 (76, 98)	25 (11, 43)	0.64 (0.5, 0.75)		39 (35, 43)
			Logistic regression	0.5	34	88 (72, 97)	31 (16, 50)		73 (70, 76)	48 (43, 52)
				0.75	NA	NA	NA		-	-
		C								
			Linear regression		31	73 (52, 88)	44 (28, 60)	0.57 (0.44, 0.69)		58 (54, 61)
			Logistic regression	0.5	31	73 (52, 88)	44 (28, 60)		63 (59, 67)	58 (54, 61)
				0.75	NA	NA	NA		-	-
		D								
			Linear regression		36	91 (76, 98)	25 (11, 43)	0.64 (0.5, 0.75)		39 (35, 43)
			Logistic regression		34	88 (72, 97)	31 (16, 50)		74 (71, 77)	48 (44, 52)
					NA	NA	NA		-	-
KAT	ADAPT	A								
			Linear regression		46	97 (96, 98)	14 (10, 18)	0.67 (0.65, 0.69)	94 (83, 99)	7 (0, 32)
			Logistic regression	0.5	51	99 (99, 100)	5 (3, 8)		100 (93, 100)	0 (0, 22)
				0.75	37	81 (79, 84)	40 (35, 46)		84 (71, 93)	13 (2, 40)
		B						0.65 (0.63, 0.68)		

			Linear regression		39	91 (88, 92)	27 (23, 31)		97 (84, 100)	22 (9, 40)
			Logistic regression	0.5	43	96 (95, 97)	16 (13, 19)		97 (84, 100)	16 (5, 33)
				0.75	22	15 (13, 18)	94 (92, 96)		6 (1, 20)	94 (79, 99)
		C								
			Linear regression		31	63 (59, 67)	58 (54, 61)	0.66 (0.63, 0.68)	73 (52, 88)	44 (28, 60)
			Logistic regression	0.5	34	77 (74, 80)	45 (41, 48)		88 (70, 98)	28 (15, 45)
				0.75	13	2 (1, 3)	100 (99, 100)		0 (0, 13)	100 (91, 100)
		D								
			Linear regression		39	91 (89, 93)	27 (23, 30)	0.66 (0.63, 0.68)	97 (84, 100)	22 (9, 40)
			Logistic regression	0.5	42	95 (93, 96)	17 (14, 20)		97 (84, 100)	16 (5, 33)
				0.75	22	15 (13, 18)	94 (92, 96)		6 (1, 20)	94 (79, 99)

TABLE 90 SF-12 MCS (Knee)

Dataset 1	**Dataset 2**					**Dataset 1**			**Dataset 2**	
					Pre-op Threshold	Sen (95% CI)	Spec (95% CI)	AUC (95% CI)	Sen (95% CI)	Spec (95% CI)
ADAPT	KAT	A								
			Linear regression		51	78 (61, 90)	69 (49, 85)	0.73 (0.61, 0.84)	69 (65, 72)	71 (68, 74)
			Logistic regression	0.5	55	89 (74, 97)	45 (26, 64)		79 (76, 82)	60 (56, 64)
				0.75	36	14 (5, 29)	97 (82, 100)		18 (15, 21)	97 (95, 98)
		B								
			Linear regression		40	39 (20, 61)	93 (81, 99)	0.81 (0.7, 0.9)	40 (34, 42)	90 (88, 92)
			Logistic regression	0.5	49	70 (47, 87)	74 (58, 86)		76 (72, 80)	72 (69, 75)
				0.75	34	13 (3, 34)	100 (92, 100)		19 (15, 22)	96 (95, 97)

		C								
			Linear regression		34	38 (9, 76)	100 (94, 100)	0.95 (0.87, 0.99)	32 (25, 40)	94 (93, 95)
			Logistic regression	0.5	36	50 (16, 84)	96 (88, 100)		39 (32, 47)	93 (91, 94)
				0.75	34	38 (9, 76)	100 (94, 100)		32 (25, 40)	94 (93, 95)
		D								
			Linear regression		38	50 (23, 77)	94 (84, 99)	0.88 (0.77, 0.95)	34 (30, 39)	91 (90, 93)
			Logistic regression	0.5	36	29 (8, 58)	96 (87, 100)		25 (21, 30)	94 (92, 95)
				0.75	34	21 (5, 51)	100 (93, 100)		21 (17, 25)	95 (94, 97)
KAT	ADAPT	A								
			Linear regression		53	74 (71, 77)	66 (63, 70)	0.78 (0.75, 0.80)	81 (64, 92)	59 (39, 76)
			Logistic regression	0.5	57	85 (83, 88)	53 (49, 57)		94 (81, 99)	34 (18, 54)
				0.75	41	33 (30, 37)	93 (91, 95)		31 (16, 48)	90 (73, 98)
		B								
			Linear regression		43	52 (47, 56)	85 (83, 88)	0.82 (0.80, 0.84)	39 (20, 61)	79 (63, 90)
			Logistic regression	0.5	49	76 (72, 80)	72 (69, 75)		70 (47, 87)	74 (58, 86)
				0.75	26	5 (4, 8)	100 (99, 100)		0 (0, 15)	100 (92, 100)
		C								
			Linear regression		27	13 (9, 19)	99 (98, 99)	0.88 (0.86, 0.90)	13 (0, 53)	100 (94, 100)
			Logistic regression	0.5	25	9 (5, 14)	99 (99, 100)		0 (0, 37)	100 (94, 100)
				0.75	18	3 (1, 7)	100 (100, 100)		0 (0, 37)	100 (94, 100)
		D								
			Linear regression		38	34 (30, 39)	91 (90, 93)	0.83 (0.81, 0.85)	50 (23, 77)	94 (84, 99)
			Logistic regression	0.5	44	62 (57, 67)	82 (79, 84)		79 (49, 95)	78 (65, 89)
				0.75	23	4 (2, 6)	100 (99, 100)		0 (0, 23)	100 (93, 100)

TABLE 91 WOMAC Total (Hip)

Dataset 1	**Dataset 2**	**Dataset 3**					**Dataset 1**			**Dataset 2**		**Dataset 3**	
						Pre-op Threshold	Sen (95% CI)	Spec (95% CI)	AUC (95% CI)	Sen (95% CI)	Spec (95% CI)	Sen (95% CI)	Spec (95% CI)
ADAPT	APEX	EURO HIP	A										
				Linear regression		NA	NA	NA	0.75 (0.66, 0.83)	NA	NA	-	-
				Logistic regression	0.50	98	100 (97, 100)	20 (1, 72)		100 (98, 100)	0 (0, 52)	100(100, 100)	0(0, 6)
					0.75	96	99 (95, 100)	20 (1, 72)		100 (98, 100)	0 (0, 52)	100(100, 100)	0(0, 6)
			B										
				Linear regression		81	96 (89, 99)	50 (26, 74)	0.76 (0.67, 0.84)	99 (96, 100)	20 (3, 56)	99 (99, 100)	3 (1, 8)
				Logistic regression	0.5	85	99 (94, 100)	44 (22, 69)		100 (98, 100)	20 (3, 56)	100 (99, 100)	3 (1, 7)
					0.75	78	91 (84, 96)	56 (31, 78)		98 (95, 99)	20 (3, 56)	99 (98, 100)	5 (2, 10)
			C										
				Linear regression		63	90 (80, 96)		0.91 (0.84, 0.96)	89 (83, 93)	62 (41, 80)	95 (93, 97)	19 (15, 24)
				Logistic regression	0.5	63	90 (80, 96)	79 (65, 90)		89 (83, 93)	62 (41, 80)	95 (93, 97)	19 (15, 24)
					0.75	56	77 (65, 87)	90 (77, 97)		79 (72, 85)	65 (44, 83)	87 (84, 90)	31 (26, 37)
			D										
				Linear regression		74	91 (83, 96)	50 (31, 69)	0.8 (0.7, 0.86)	96 (92, 98)	20 (3, 56)	99 (98, 100)	8 (4, 13)
				Logistic regression	0.5	78	95 (88, 99)	50 (31, 69)		98 (95, 99)	20 (3, 56)	100 (99, 100)	6 (3, 10)
					0.75	68	82 (72, 89)	57 (37, 76)		92 (87, 95)	40 (12, 74)	96 (94, 97)	11 (7, 17)
APEX	ADAPT	EURO HIP	A										
				Linear regression			-	-	0.62 (0.54, 0.68)	-	-	-	-
				Logistic regression	0.5	-	-	-		-	-	-	-
					0.75	-	-	-		-	-	-	-
			B						0.61 (0.53, 0.67)				

				Linear regression		86	100 (98, 100)	20 (3, 56)		99 (94, 100)	44 (22, 69)	100 (99, 100)	2 (0, 6)
				Logistic regression	0.5	86	100 (98, 100)	20 (3, 56)		99 (94, 100)	44 (22, 69)	100 (99, 100)	2 (0, 6)
					0.75	82	99 (97, 100)	20 (3, 56)		97 (91, 99)	50 (26, 74)	100 (99, 100)	4 (1, 9)
			C										
				Linear regression		71	99 (96, 100)	46 (27, 67)	0.77 (0.71, 0.83)	98 (91, 100)	54 (39, 69)	99 (97, 99)	11 (8, 16)
				Logistic regression	0.5	72	100 (98, 100)	42 (23, 63)		100 (94, 100)	52 (37, 67)	100 (99, 100)	11 (7, 15)
					0.75	68	96 (92, 98)	50 (30, 70)		95 (87, 99)	58 (43, 72)	97 (96, 99)	14 (10, 19)
			D										
				Linear regression		82	99 (97, 100)	20 (3, 56)	0.61 (0.53, 0.67)	99 (93, 100)	39 (22, 59)	100 (99, 100)	4 (1, 8)
				Logistic regression	0.5	86	100 (98, 100)	20 (3, 56)		100 (96, 100)	32 (16, 52)	100 (99, 100)	1 (0, 5)
					0.75	82	99 (97, 100)	20 (3, 56)		99 (93, 100)	39 (22, 59)	100 (99, 100)	4 (1, 8)
EURO HIP	ADAPT	APEX	A										
				Linear regression		93	100 (100, 100)	0 (0, 1)	0.58 (0.54, 0.61)	98 (93, 100)	20 (1, 72)	100 (98, 100)	0 (0, 52)
				Logistic regression	0.5	96	100 (100, 100)	0 (0, 1)		99 (95, 100)	20 (1, 72)	100 (98, 100)	0 (0, 52)
					0.75	90	100 (100, 100)	0 (0, 1)		98 (93, 100)	20 (1, 72)	100 (98, 100)	0 (0, 52)
			B										
				Linear regression		83	100 (99, 100)	3 (1, 8)	0.56 (0.53, 0.59)	97 (91, 99)	50 (26, 74)	99 (97, 100)	20 (3, 56)
				Logistic regression	0.5	87	100 (100, 100)	1 (0, 5)		99 (94, 100)	33 (13, 59)	100 (98, 100)	20 (3, 56)
					0.75	80	99 (98, 100)	4 (1, 9)		95 (88, 98)	56 (31, 78)	98 (95, 100)	20 (3, 56)
			C										
				Linear regression		70	98 (97, 99)	12 (8, 17)	0.59 (0.56, 0.63)	97 (89, 100)	54 (39, 69)	98 (94, 99)	46 (27, 67)
				Logistic regression	0.5	72	99 (98, 100)	11 (7, 16)		100 (94, 100)	52 (37, 67)	100 (98, 100)	42 (23, 63)
					0.75	55	81 (78, 84)	30 (23, 36)		74 (62, 84)	90 (77, 97)	78 (71, 84)	65 (44, 83)
			D						0.55 (0.52, 0.59)				
				Linear regression		82	99 (99, 100)	3 (1, 8)		99 (93, 100)	39 (22, 59)	99 (97, 100)	20 (3, 56)

Logistic regression	0.5	87	100 (100, 100)	1 (0, 4)		100 (96, 100)	25 (11, 45)	100 (98, 100)	20 (3, 56)
	0.75	80	99 (98, 100)	4 (1, 9)		98 (91, 100)	46 (28, 66)	98 (95, 100)	20 (3, 56)

TABLE 92 WOMAC Pain (Hip)

Dataset 1	**Dataset 2**	**Dataset 3**					**Dataset 1**			**Dataset 2**		**Dataset 3**	
						Pre-op Threshold	Sen (95% CI)	Spec (95% CI)	AUC (95% CI)	Sen (95% CI)	Spec (95% CI)	Sen (95% CI)	Spec (95% CI)
ADAPT	APEX	EURO HIP	A										
				Linear regression		-	-	-	0.71 (0.61, 0.79)	-	-	-	-
				Logistic regression	0.50	98	100 (97, 100)	25 (1, 81)		100 (99, 100)	10 (0, 45)	100 (100, 100)	2 (0, 9)
					0.75	97	100 (97, 100)	25 (1, 81)		100 (99, 100)	10 (0, 45)	100 (100, 100)	2 (0, 9)
			B										
				Linear regression		83	94 (87, 98)	36 (13, 65)	0.66 (0.57, 0.75)	99 (97, 100)	18 (4, 43)	99 (98, 100)	6 (3, 12)
				Logistic regression	0.5	89	100 (96, 100)	36 (13, 65)		100 (99, 100)	18 (4, 43)	100 (100, 100)	4 (2, 9)
					0.75	82	94 (87, 98)	36 (13, 65)		99 (97, 100)	18 (4, 43)	99 (98, 100)	6 (3, 12)
			C										
				Linear regression		65	88 (78, 95)	58 (42, 73)	0.82 (0.73, 0.89)	95 (92, 98)	39 (24, 57)	95 (93, 97)	26 (21, 32)
				Logistic regression	0.5	67	88 (78, 95)	58 (42, 73)		95 (92, 98)	39 (24, 57)	95 (93, 97)	26 (21 ,32)
					0.75	57	73 (61, 83)	74 (59, 86)		85 (80, 89)	50 (33, 67)	83 (80 , 86)	42(37, 48)
			D										
				Linear regression		76	99 (94, 100)	46 (27, 67)	0.8 (0.71, 0.87)	98 (95, 99)	18 (4, 43)	99 (98, 99)	12 (7, 17)
				Logistic regression	0.5	77	99 (94, 100)	46 (27, 67)		98 (95, 99)	18 (4, 43)	99 (98, 99)	12 (7,17)
					0.75	70	92 (84, 97)	58 (37, 77)		96 (93, 98)	24 (7, 50)	96 (94, 97)	15 (10, 21)
APEX	ADAPT	EURO HIP	A										
				Linear regression		89	100 (98, 100)	20 (3, 56)	0.65 (0.6, 0.71)	96 (91, 99)	25 (1, 81)	100 (99, 100)	5 (1, 13)
				Logistic regression	0.5	93	100 (99, 100)	20 (3, 56)		25 (1, 81)	36 (13, 65)	100 (99, 100)	3 (0, 11)
					0.75	90	100 (98, 100)	20 (3, 56)		25 (1, 81)	36 (13, 65)	100 (99, 100)	3 (0, 11)
			B						0.65 (0.59, 0.7)				

				Linear regression		83	99 (97, 100)	18 (4, 43)		94 (87, 98)	36 (13, 65)	99 (98, 100)	6 (3, 12)
				Logistic regression	0.5	88	100 (99, 100)	18 (4, 43)		100 (96, 100)	36 (13, 65)	100 (100, 100)	4 (2, 9)
					0.75	83	99 (97, 100)	18 (4, 43)		94 (87, 98)	36 (13, 65)	99 (98, 100)	6 (3, 12)
			C										
				Linear regression		72	99 (97, 100)	32 (18, 49)	0.72 (0.67, 0.77)	100 (95, 100)	51 (35, 67)	98 (96, 99)	18 (14, 24)
				Logistic regression	0.5	73	99 (97, 100)	32 (18, 49)		100 (95, 100)	51 (35, 67)	98 (96, 99)	18 (14, 24)
					0.75	68	95 (92, 98)	39 (24, 57)		88 (78, 95)	58 (42, 73)	92 (90, 94)	23 (18, 29)
			D										
				Linear regression		81	99 (97, 100)	18 (4, 43)	0.65 (0.59, 0.7)	100 (96, 100)	42 (23, 63)	99 (98, 100)	6 (3, 12)
				Logistic regression	0.5	88	100 (99, 100)	18 (4, 43)		100 (96, 100)	19 (7, 39)	100 (100, 100)	4 (2, 9)
					0.75	83	99 (97, 100)	18 (4, 43)		100 (96, 100)	42 (23, 63)	99 (98, 100)	6 (3,12)
EURO HIP	ADAPT	APEX	A										
				Linear regression		97	100 (100, 100)	2 (0, 9)	0.62 (0.58, 0.65)	100 (97, 100)	25 (1, 81)	100 (99, 100)	10 (0, 45)
				Logistic regression	0.5	97	100 (100, 100)	2 (0, 9)		100 (97, 100)	25 (1, 81)	100 (99, 100)	10 (0, 45)
					0.75	90	100 (99, 100)	3 (0, 11)		98 (93, 100)	25 (1, 81)	100 (99, 100)	20 (3, 56)
			B										
				Linear regression		84	99 (98, 100)	6 (3, 12)	0.58 (0.55, 0.62)	94 (87, 98)	36 (13, 65)	99 (97, 100)	18 (4, 43)
				Logistic regression	0.5	89	100 (100, 100)	4 (2, 9)		100 (96, 100)	36 (13, 65)	100 (99, 100)	18 (4, 43)
					0.75	78	98 (96, 99)	8 (4, 14)		92 (84, 96)	36 (13, 65)	98 (95, 99)	18 (4, 43)
			C										
				Linear regression		69	92 (90, 94)	23 (18, 29)	0.65 (0.62, 0.68)	88 (78, 95)	58 (42, 73)	95 (92, 98)	39 (24, 57)
				Logistic regression	0.5	73	98 (96, 99)	18 (14, 24)		100 (95, 100)	51 (35, 67)	99 (97, 100)	32 (18, 49)
					0.75	54	72 (69, 76)	48 (41, 54)		61 (49, 73)	84 (69, 93)	76 (70, 81)	58 (41, 74)
			D						0.58 (0.54, 0.61)				
				Linear regression		82	99 (98, 100)	6 (3, 12)		100 (96, 100)	42 (23, 63)	99 (97, 100)	18 (4, 43)

				Logistic regression	0.5	88	100 (100, 100)	4 (2, 9)		100 (96, 100)	19 (7, 39)	100 (99, 100)	18 (4, 43)
					0.75	78	98 (96, 99)	8 (4, 14)		99 (94, 100)	46 (27, 67)	98 (95, 99)	18 (4, 43)

TABLE 93 WOMAC Physical Function (Hip)

Dataset 1	**Dataset 2**	**Dataset 3**				**Dataset 1**				**Dataset 2**		**Dataset 3**	
						Pre-op Threshold	Sen (95% CI)	Spec (95% CI)	AUC (95% CI)	Sen (95% CI)	Spec (95% CI)	Sen (95% CI)	Spec (95% CI)
ADAPT	APEX	EURO HIP	A										
				Linear regression		-	-	-	0.72 (0.62, 0.8)	-	-	-	-
				Logistic regression	0.50	99	100 (96, 100)	25 (3, 65)		100 (98, 100)	0 (0, 37)	100 (100, 100)	0 (0, 6)
					0.75	96	99 (95, 100)	25 (3, 65)		100 (98, 100)	0 (0, 37)	100 (100, 100)	0 (0, 6)
			B										
				Linear regression		81	93 (86, 97)	48 (26, 70)	0.82 (0.73, 0.89)	98 (96, 100)	17 (2, 48)	100 (99, 100)	5 (2, 11)
				Logistic regression	0.5	86	99 (94, 100)	43 (22, 66)		100 (98, 100)	17 (2, 48)	100 (99, 100)	3 (1, 8)
					0.75	78	90 (82, 95)	52 (30, 74)		98 (95, 99)	17 (2, 48)	99 (98, 100)	7 (3, 12)
			C										
				Linear regression		61	85 (73, 93)	82 (69, 91)	0.91 (0.84, 0.96)	88 (83, 93)	58 (41, 74)	96 (94, 97)	25 (20, 30)
				Logistic regression	0.5	63	92 (82, 97)	80 (66, 90)		90 (85, 94)	55 (38, 71)	96 (95, 98)	21 (17, 26)
					0.75	57	82 (70, 90)	86 (73, 94)		82 (75, 87)	66 (49, 80)	92 (89, 94)	30 (25, 36)
			D										
				Linear regression		75	95 (87, 99)	56 (38, 73)	0.85 (0.76, 0.91)	95 (91, 98)	15 (2, 45)	99 (98, 100)	7 (4, 12)
				Logistic regression	0.5	74	93 (85, 98)	56 (38, 73)		95 (91, 98)	15 (2, 45)	99 (97, 99)	7 (4, 12)
					0.75	65	80 (70, 89)	71 (53, 85)		87 (82, 92)	38 (14, 68)	94 (92, 95)	13 (8, 18)
APEX	ADAPT	EURO HIP	A						0.6 (0.52, 0.66)				

				Linear regression		-	-	-		-	-	-	-
				Logistic regression	0.5	95	100 (98, 100)	0 (0, 37)		98 (93, 100)	25 (3, 65)	100 (100, 100)	0 (0, 6)
					0.75	89	100 (97, 100)	13 (0, 53)		95 (89, 98)	25 (3, 65)	100 (99, 100)	2 (0, 9)
			B										
				Linear regression		86	100 (98, 100)	17 (2, 48)	0.65 (0.58, 0.72)	99 (94, 100)	43 (22, 66)	100 (99, 100)	3 (1, 8)
				Logistic regression	0.5	88	100 (98, 100)	17 (2, 48)		38 (18, 62)	33 (15, 57)	100 (100, 100)	2 (1, 7)
					0.75	83	98 (96, 100)	17 (2, 48)		48 (26, 70)	48 (26, 70)	100 (99, 100)	4 (1, 9)
			C										
				Linear regression		70	98 (94, 99)	39 (24, 57)	0.74 (0.68, 0.8)	98 (91, 100)	60 (45, 74)	98 (97, 99)	12 (8, 16)
				Logistic regression	0.5	70	98 (94, 99)	39 (24, 57)		100 (95, 100)	24 (11, 41)	98 (97, 99)	12 (8, 16)
					0.75	65	94 (90, 97)	53 (36, 69)		100 (95, 100)	44 (27, 62)	96 (94, 98)	16 (12, 21)
			D										
				Linear regression		81	98 (96, 100)	15 (2, 45)	0.63 (0.56, 0.69)	99 (93, 100)	44 (27, 62)	100 (99, 100)	5 (2, 10)
				Logistic regression	0.5	88	100 (98, 100)	15 (2, 45)		100 (95, 100)	24 (11, 41)	100 (100, 100)	2 (0, 6)
					0.75	83	99 (96, 100)	15 (2, 45)		100 (95, 100)	44 (27, 62)	100 (99, 100)	4 (2, 8)
EURO HIP	ADAPT	APEX	A										
				Linear regression		91	100 (99, 100)	0 (0, 6)	0.58 (0.55, 0.61)	96 (90, 99)	25 (3, 65)	100 (97, 100)	13 (0, 53)
				Logistic regression	0.5	94	100 (99, 100)	0 (0, 6)		98 (93, 100)	25 (3, 65)	100 (98, 100)	0 (0, 37)
					0.75	88	100 (99, 100)	2 (0, 9)		94 (88, 98)	25 (3, 65)	100 (97, 100)	13 (0, 53)
			B										
				Linear regression		82	100 (99, 100)	5 (2, 10)	0.55 (0.52, 0.58)	93 (86, 97)	48 (26, 70)	98 (96, 100)	17 (2, 48)
				Logistic regression	0.5	86	100 (99, 100)	3 (1, 8)		99 (94, 100)	43 (22, 66)	100 (98, 100)	17 (2, 48)
					0.75	79	99 (98, 100)	7 (3, 13)		90 (82, 95)	52 (30, 74)	98 (95, 99)	17 (2, 48)
			C						0.60 (0.56, 0.63)				
				Linear regression		70	98 (96, 99)	12 (8, 17)		98 (91, 100)	60 (45, 74)	98 (94, 99)	39 (24, 57)

	Logistic regression	0.5	71	98 (97, 99)	11 (8, 16)		100 (94, 100)	58 (43, 72)	98 (95, 100)	34 (20, 51)
		0.75	56	87 (84, 90)	27 (22, 34)		82 (70, 90)	88 (76, 95)	82 (75, 87)	66 (49, 80)
D										
	Linear regression		81	100 (99, 100)	5 (2, 10)	0.54 (0.50, 0.57)	99 (93, 100)	44 (27, 62)	98 (96, 100)	15 (2, 45)
	Logistic regression	0.5	86	100 (99, 100)	3 (1, 7)		100 (95, 100)	29 (15, 47)	100 (98, 100)	15 (2, 45)
		0.75	79	99 (98, 100)	7 (3, 12)		97 (91, 100)	53 (35, 70)	98 (95, 99)	15 (2, 45)

TABLE 94 WOMAC Stiffness (Hip)

Dataset 1	**Dataset 2**	**Dataset 3**			**Dataset 1**				**Dataset 2**		**Dataset 3**	
					Pre-op Threshold	Sen (95% CI)	Spec (95% CI)	AUC (95% CI)	Sen (95% CI)	Spec (95% CI)	Sen (95% CI)	Spec (95% CI)
ADAPT	APEX	EURO HIP	A									
			Linear regression		93	100 (96, 100)	42 (15, 72)	0.81 (0.72, 0.88)	100 (98, 100)	29 (13, 49)	100 (100, 100)	9 (5, 14)
			Logistic regression	0.50	91	100 (96, 100)	42 (15, 72)		100 (98, 100)	29 (13, 49)	100 (100, 100)	9 (5, 14)
				0.75	86	94 (87, 98)	50 (21, 79)		97 (94, 99)	32 (16, 52)	100 (99, 100)	11 (7, 17)
			B									
			Linear regression		82	94 (87, 98)	50 (21, 79)	0.81 (0.72, 0.88)	97 (94, 99)	32 (16, 52)	100 (99, 100)	11 (7, 17)
			Logistic regression	0.5	91	100 (96, 100)	42 (15, 72)		100 (98, 100)	29 (13, 49)	100 (100, 100)	9 (5, 14)
				0.75	86	94 (87, 98)	50 (21, 79)		97 (94, 99)	32 (16, 52)	100 (99, 100)	11 (7, 17)
			C									
			Linear regression		61	82 (70, 91)	76 (61, 87)	0.86 (0.79, 0.92)	88 (82, 93)	60 (50, 69)	94 (91, 96)	32 (27, 36)
			Logistic regression	0.5	62	82 (70, 91)	76 (61, 87)		88 (82, 93)	60 (50, 69)	94 (91, 96)	32 (27, 36)
				0.75	54	82 (70, 91)	76 (61, 87)		88 (82, 93)	60 (50, 69)	94 (91, 96)	32 (27, 36)
			D									
			Linear regression		76	100 (95, 100)	40 (23, 59)	0.77 (0.67, 0.84)	100 (98, 100)	27 (16, 40)	100 (99, 100)	8 (5, 12)
			Logistic regression	0.5	77	100 (95, 100)	40 (23, 59)		100 (98, 100)	27 (16, 40)	100 (99, 100)	8 (5, 12)
				0.75	69	85 (75, 92)	57 (37, 75)		91 (86, 94)	44 (31, 58)	96 (94, 97)	20 (15, 25)
APEX	ADAPT	EURO HIP	A									
			Linear regression		98	100 (98, 100)	29 (13, 49)	0.77 (0.71, 0.82)	100 (96, 100)	42 (15, 72)	100 (100, 100)	9 (5, 14)
			Logistic regression	0.5	90	100 (98, 100)	29 (13, 49)		100 (96, 100)	42 (15, 72)	100 (100, 100)	9 (5, 14)
				0.75	83	97 (94, 99)	32 (16, 52)		94 (87, 98)	50 (21, 79)	100 (99, 100)	11 (7, 17)
			B					0.77 (0.71, 0.82)				

			Linear regression		82	97 (94, 99)	32 (16, 52)		94 (87, 98)	50 (21, 79)	100 (99, 100)	11 (7, 17)
			Logistic regression	0.5	90	100 (98, 100)	29 (13, 49)		100 (96, 100)	42 (15, 72)	100 (100, 100)	9 (5, 14)
				0.75	83	97 (94, 99)	32 (16, 52)		94 (87, 98)	50 (21, 79)	100 (99, 100)	11 (7, 17)
			C									
			Linear regression		59	88 (82, 93)	60 (50, 69)	0.8 (0.75, 0.85)	82 (70, 91)	76 (61, 87)	94 (91, 96)	32 (27, 36)
			Logistic regression	0.5	61	88 (82, 93)	60 (50, 69)		82 (70, 91)	76 (61, 87)	94 (91, 96)	32 (27, 36)
				0.75	48	67 (59, 75)	78 (69, 86)		51 (38, 64)	90 (78, 97)	78 (74, 82)	59 (54, 64)
			D									
			Linear regression		76	100 (98, 100)	27 (16, 40)	0.75 (0.7, 0.8)	100 (95, 100)	40 (23, 59)	100 (99, 100)	8 (5, 12)
			Logistic regression	0.5	76	100 (98, 100)	27 (16, 40)		100 (95, 100)	40 (23, 59)	100 (99, 100)	8 (5, 12)
				0.75	66	91 (86, 94)	44 (31, 58)		85 (75, 92)	57 (37, 75)	96 (94, 97)	20 (15, 25)
EURO HIP	ADAPT	APEX	A									
			Linear regression		82	100 (99, 100)	11 (7, 17)	0.74 (0.71, 0.77)	94 (87, 98)	50 (21, 79)	97 (94, 99)	32 (16, 52)
			Logistic regression	0.5	80	100 (99, 100)	11 (7, 17)		94 (87, 98)	50 (21, 79)	97 (94, 99)	32 (16, 52)
				0.75	59	87 (84, 89)	42 (34, 50)		60 (50, 70)	75 (43, 95)	73 (67, 79)	64 (44, 81)
			B									
			Linear regression		65	96 (94, 97)	20 (15, 25)	0.71 (0.68, 0.74)	80 (70, 87)	75 (43, 95)	87 (82, 91)	54 (34, 72)
			Logistic regression	0.5	67	96 (94, 97)	20 (15, 25)		80 (70, 87)	75 (43, 95)	87 (82, 91)	54 (34, 72)
				0.75	36	45 (41, 49)	81 (75, 85)		27 (18, 36)	92 (62, 100)	31 (25, 37)	89 (72, 98)
			C									
			Linear regression		49	78 (74, 82)	59 (54, 64)	0.73 (0.70, 0.76)	51 (38, 64)	90 (78, 97)	67 (59, 75)	78 (69, 86)
			Logistic regression	0.5	49	78 (74, 82)	59 (54, 64)		51 (38, 64)	90 (78, 97)	67 (59, 75)	78 (69, 86)
				0.75	13	17 (13, 20)	95 (93, 97)		11 (5, 22)	98 (89, 100)	14 (9, 21)	97 (92, 99)
			D					0.71 (0.68, 0.74)				
			Linear regression		64	96 (94, 97)	20 (15, 25)		85 (75, 92)	57 (37, 75)	91 (86, 94)	44 (31, 58)

	Logistic regression	0.5	67	96 (94, 97)	20 (15, 25)		85 (75, 92)	57 (37, 75)	91 (86, 94)	44 (31, 58)
		0.75	36	45 (41, 49)	81 (75, 85)		29 (19, 40)	87 (69, 96)	33 (26, 40)	85 (73, 93)

TABLE 95 WOMAC Total (Knee)

Dataset 1	Dataset 2				Dataset 1				Dataset 2	
					Pre-op Threshold	Sen (95% CI)	Spec (95% CI)	AUC (95% CI)	Sen (95% CI)	Spec (95% CI)
ADAPT	APEX	A								
			Linear regression		93	100 (96, 100)	0 (0, 28)		100 (98, 100)	0 (0, 26)
			Logistic regression	0.50	-	-	-	0.52 (0.42, 0.62)	-	-
				0.75	-	-	-		-	-
		B								
			Linear regression		86	100 (96, 100)	7 (1, 24)		100 (98, 100)	5 (0, 24)
			Logistic regression	0.50	81	99 (93, 100)	15 (4, 34)	0.55 (0.46, 0.65)	99 (96, 100)	10 (1, 30)
				0.75	71	95 (88, 99)	19 (6, 38)		97 (93, 99)	24 (8, 47)
		C								
			Linear regression		69	98 (90, 100)	19 (10, 33)		98 (93, 100)	23 (12, 38)
			Logistic regression	0.50	65	84 (72, 92)	25 (14, 39)	0.6 (0.49, 0.69)	91 (84, 95)	32 (19, 47)
				0.75	11	4 (0, 12)	100 (93, 100)		3 (1, 8)	96 (85, 99)
		D								
			Linear regression		83	100 (95, 100)	12 (3, 28)		99 (96, 100)	4 (0, 20)
			Logistic regression	0.50	80	99 (93, 100)	12 (3, 28)	0.53 (0.43, 0.62)	99 (95, 100)	8 (1, 26)
				0.75	67	88 (78, 94)	18 (7, 35)		89 (82, 93)	20 (7, 41)
APEX	ADAPT	A								
			Linear regression		88	100 (98, 100)	0 (0, 26)		98 (93, 100)	0 (0, 28)
				0.50	97	100 (98, 100)	0 (0, 26)	0.56 (0.49, 0.64)	100 (96, 100)	0 (0, 28)

	Logistic regression	0.75	89	100 (98, 100)	0 (0, 26)		98 (93, 100)	0 (0, 28)
B								
	Linear regression		81	99 (96, 100)	10 (1, 30)		99 (93, 100)	15 (4, 34)
	Logistic regression	0.50	85	99 (96, 100)	5 (0, 24)	0.6 (0.53, 0.68)	100 (96, 100)	15 (4, 34)
		0.75	75	97 (93, 99)	10 (1, 30)		96 (90, 99)	15 (4, 34)
C								
	Linear regression		69	98 (93, 100)	23 (12, 38)		98 (90, 100)	19 (10, 33)
	Logistic regression	0.50	69	98 (93, 100)	23 (12, 38)	0.63 (0.56, 0.7)	98 (90, 100)	19 (10, 33)
		0.75	61	89 (82, 94)	38 (25, 54)		80 (68, 90)	31 (19, 45)
D								
	Linear regression		79	98 (94, 100)	8 (1, 26)		99 (93, 100)	12 (3, 28)
	Logistic regression	0.50	88	100 (98, 100)	0 (0, 14)	0.6 (0.52, 0.67)	100 (95, 100)	6 (1, 20)
		0.75	71	97 (92, 99)	20 (7, 41)		95 (87, 99)	15 (5, 32)

TABLE 96 WOMAC Pain (Knee)

Dataset 1	**Dataset 2**				**Dataset 1**				**Dataset 2**	
					Pre-op Threshold	Sen (95% CI)	Spec (95% CI)	AUC (95% CI)	Sen (95% CI)	Spec (95% CI)
ADAPT	APEX	A								
			Linear regression		85	99 (94, 100)	0 (0, 26)	0.62 (0.53, 0.71)	100 (99, 100)	0 (0, 20)
			Logistic regression	0.50	-	-	-		-	-
				0.75	-	-	-		-	-
		B								
			Linear regression		78	99 (94, 100)	5 (0, 25)	0.56 (0.46, 0.65)	100 (98, 100)	0 (0, 12)
			Logistic regression	0.50	82	100 (96, 100)	5 (0, 25)		100 (98, 100)	0 (0, 12)
				0.75	71	96 (89, 99)	10 (1, 32)		98 (96, 100)	3 (0, 17)
		C								
			Linear regression		64	89 (79, 95)	29 (16, 44)	0.57 (0.47, 0.66)	90 (85, 93)	17 (9, 29)
			Logistic regression	0.50	67	94 (85, 98)	24 (13, 40)		96 (92, 98)	9 (3, 19)
				0.75	8	3 (0, 11)	100 (92, 100)		3 (1, 6)	97 (88, 100)
		D								
			Linear regression		75	99 (94, 100)	5 (0, 25)	0.56 (0.46, 0.65)	100 (98, 100)	0 (0, 12)
			Logistic regression	0.50	82	100 (96, 100)	5 (0, 25)		100 (98, 100)	0 (0, 12)
				0.75	71	96 (89, 99)	10 (1, 32)		98 (96, 100)	3 (0, 17)
APEX	ADAPT	A								
			Linear regression		88	100 (99, 100)	0 (0, 20)		99 (94, 100)	0 (0, 26)

	Logistic regression	0.50	86	100 (99, 100)	0 (0, 20)	0.61 (0.54, 0.66)	99 (94, 100)	0 (0, 26)
		0.75	78	100 (98, 100)	0 (0, 20)		98 (93, 100)	0 (0, 26)
B								
	Linear regression		81	100 (98, 100)	0 (0, 12)	0.59 (0.53, 0.65)	100 (96, 100)	5 (0, 25)
	Logistic regression	0.50	NA	NA	NA		NA	NA
		0.75	85	100 (98, 100)	0 (0, 12)		100 (96, 100)	5 (0, 25)
C								
	Linear regression		71	99 (97, 100)	5 (1, 14)	0.57 (0.5, 0.63)	98 (92, 100)	11 (4, 24)
	Logistic regression	0.50	78	100 (98, 100)	2 (0, 9)		100 (94, 100)	4 (1, 15)
		0.75	59	83 (77, 88)	28 (17, 41)		78 (66, 87)	40 (26, 56)
D								
	Linear regression		79	100 (98, 100)	0 (0, 12)	0.59 (0.53, 0.65)	99 (94, 100)	5 (0, 25)
	Logistic regression	0.50	NA	NA	NA		NA	NA
		0.75	85	100 (98, 100)	0 (0, 12)		100 (96, 100)	5 (0, 25)

TABLE 97 WOMAC Physical Function (Knee)

Dataset 1	**Dataset 2**				**Dataset 1**				**Dataset 2**	
					Pre-op Threshold	Sen (95% CI)	Spec (95% CI)	AUC (95% CI)	Sen (95% CI)	Spec (95% CI)
ADAPT	APEX	A								
			Linear regression		94	98 (93, 100)	0 (0, 22)		100 (98, 100)	0 (0, 23)
			Logistic regression	0.50	-	-	-	0.39 (0.3, 0.49)	-	-
				0.75	-	-	-		-	-
		B								
			Linear regression		87	99 (94, 100)	13 (3, 32)		100 (98, 100)	11 (2, 29)
			Logistic regression	0.50	89	100 (96, 100)	8 (1, 27)	0.47 (0.37, 0.57)	100 (98, 100)	11 (2, 29)
				0.75	82	96 (90, 99)	13 (3, 32)		98 (95, 100)	15 (4, 34)
		C								
			Linear regression		58	73 (58, 84)	38 (26, 52)		81 (73, 87)	45 (31, 59)
			Logistic regression	0.50	65	80 (67, 90)	26 (15, 39)	0.58 (0.48, 0.67)	89 (83, 94)	34 (22, 48)
				0.75	8	2 (0, 10)	100 (94, 100)		2 (0, 5)	96 (88, 100)
		D								
			Linear regression		84	100 (95, 100)	13 (4, 27)		99 (96, 100)	9 (2, 24)
			Logistic regression	0.50	79	99 (92, 100)	15 (6, 30)	0.53 (0.43, 0.63)	97 (93, 99)	12 (3, 28)
				0.75	13	3 (0, 10)	100 (91, 100)		4 (1, 8)	97 (84, 100)
APEX	ADAPT	A								
			Linear regression		92	99 (97, 100)	0 (0, 23)	0.7 (0.62, 0.76)	98 (93, 100)	0 (0, 22)
				0.50	98	100 (98, 100)	0 (0, 23)		100 (96, 100)	0 (0, 22)

	Logistic regression	0.75	87	99 (96, 100)	7 (0, 34)		96 (89, 99)	0 (0, 22)
B								
	Linear regression		82	98 (95, 100)	15 (4, 34)		96 (90, 99)	13 (3, 32)
	Logistic regression	0.50	86	100 (98, 100)	11 (2, 29)	0.62 (0.55, 0.69)	99 (94, 100)	13 (3, 32)
		0.75	75	96 (91, 98)	19 (6, 38)		94 (87, 98)	13 (3, 32)
C								
	Linear regression		66	89 (83, 94)	34 (22, 48)		82 (69, 92)	26 (15, 39)
	Logistic regression	0.50	71	97 (92, 99)	27 (16, 40)	0.64 (0.57, 0.71)	92 (81, 98)	17 (9, 29)
		0.75	58	81 (73, 87)	45 (31, 59)		73 (58, 84)	38 (26, 52)
D								
	Linear regression		79	97 (93, 99)	12 (3, 28)		99 (92, 100)	15 (6, 30)
	Logistic regression	0.50	87	100 (98, 100)	9 (2, 24)	0.57 (0.5, 0.64)	100 (95, 100)	10 (3, 24)
		0.75	75	95 (91, 98)	15 (5, 32)		97 (90, 100)	15 (6, 30)

TABLE 98 WOMAC Stiffness (Knee)

Dataset 1	**Dataset 2**					**Dataset 1**			**Dataset 2**	
					Pre-op Threshold	Sen (95% CI)	Spec (95% CI)	AUC (95% CI)	Sen (95% CI)	Spec (95% CI)
ADAPT	APEX	A								
			Linear regression		89	100 (96, 100)	14 (3, 36)		100 (98, 100)	5 (1, 16)
			Logistic regression	0.50	78	100 (96, 100)	14 (3, 36)	0.69 (0.59, 0.77)	99 (96, 100)	12 (4, 26)
				0.75	64	97 (90, 99)	24 (8, 47)		95 (90, 97)	36 (22, 52)
		B								
			Linear regression		72	99 (92, 100)	18 (8, 34)		98 (94, 99)	28 (18, 39)
			Logistic regression	0.50	65	99 (92, 100)	18 (8, 34)	0.69 (0.59, 0.77)	98 (94, 99)	28 (18, 39)
				0.75	24	16 (8, 27)	97 (87, 100)		16 (11, 22)	96 (89, 99)
		C								
			Linear regression		42	74 (58, 87)	58 (45, 70)		78 (69, 85)	59 (50, 67)
			Logistic regression	0.50	21	18 (8, 34)	93 (84, 98)	0.7 (0.61, 0.79)	20 (13, 29)	95 (89, 98)
				0.75	NA	NA	NA		NA	NA
		D								
			Linear regression		67	99 (92, 100)	18 (8, 34)		98 (94, 99)	28 (18, 39)
			Logistic regression	0.50	65	99 (92, 100)	18 (8, 34)	0.69 (0.59, 0.77)	98 (94, 99)	28 (18, 39)
				0.75	24	16 (8, 27)	97 (87, 100)		16 (11, 22)	96 (89, 99)
APEX	ADAPT	A								
			Linear regression		87	99 (96, 100)	12 (4, 26)	0.74 (0.68, 0.79)	100 (96, 100)	14 (3, 36)

	Logistic regression	0.50	79	99 (96, 100)	12 (4, 26)		100 (96, 100)	14 (3, 36)
		0.75	61	84 (78, 88)	48 (32, 64)		78 (68, 66)	43 (22, 66)
B								
	Linear regression		68	98 (94, 99)	28 (18, 39)		99 (92, 100)	18 (8, 34)
	Logistic regression	0.50	65	98 (94, 99)	28 (18, 39)	0.71 (0.65, 0.77)	99 (92, 100)	18 (8, 34)
		0.75	34	39 (32, 47)	86 (76, 93)		32 (21, 44)	87 (73, 96)
C								
	Linear regression		46	78 (69, 85)	59 (50, 67)		74 (58, 87)	58 (45, 70)
	Logistic regression	0.50	39	78 (69, 85)	59 (50, 67)	0.73 (0.67, 0.79)	74 (58, 87)	58 (45, 70)
		0.75	11	6 (3, 13)	99 (96, 100)		10 (3, 24)	99 (92, 100)
D								
	Linear regression		64	98 (94, 99)	28 (18, 39)		99 (92, 100)	18 (8, 34)
	Logistic regression	0.50	65	98 (94, 99)	28 (18, 39)	0.71 (0.65, 0.77)	99 (92, 100)	18 (8, 34)
		0.75	34	39 (32, 47)	86 (76, 93)		32 (21, 44)	87 (73, 96)

Online Supplement 5 - Coefficients of the regression models using MCID 0.5 (B)

TABLE 99 Hip

Model	Data					R2 (Linear)/ H-L p (Logistic)
Linear regression	PROMs (OHS)	28.3	0.117	-0.032	0.000358	0.295
Logistic regression		3.75	-0.0652	0.00318	-8.90E-05	<0.001
Linear regression	APEX (WOMAC Total)	51.1	0.813	-0.0267	0.000134	0.416
Logistic regression		4.97	-0.196	0.00581	-4.91E-05	0.313

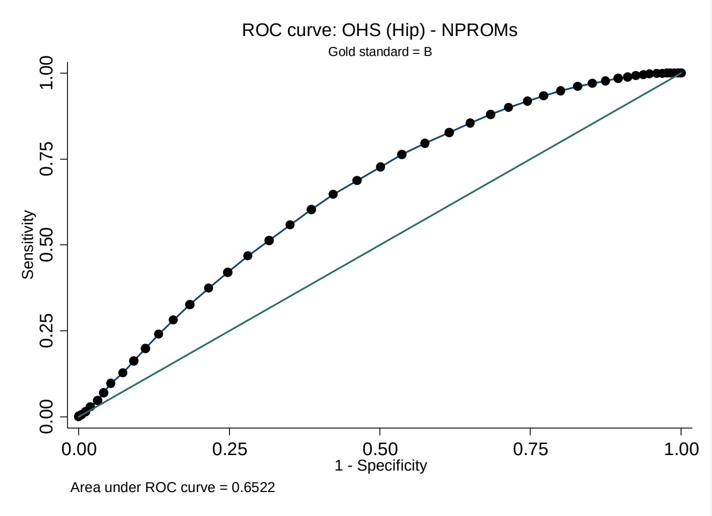
TABLE 100 Knee

Model	Data					R2 (Linear)/ H-L p (Logistic)
Linear regression	PROMs (OKS)	19.9	0.352	-0.0333	0.000343	0.171
Logistic regression		2.33	0.00162	0.0005	-5.17E-05	<0.001
Linear regression	APEX (WOMAC Total)	54.5	-0.956	0.0183	-0.000166	0.165
Logistic regression		2.17	-0.0101	0.00079	-1.14E-05	0.394

Online Supplement 6 - Calibration and ROC graphs

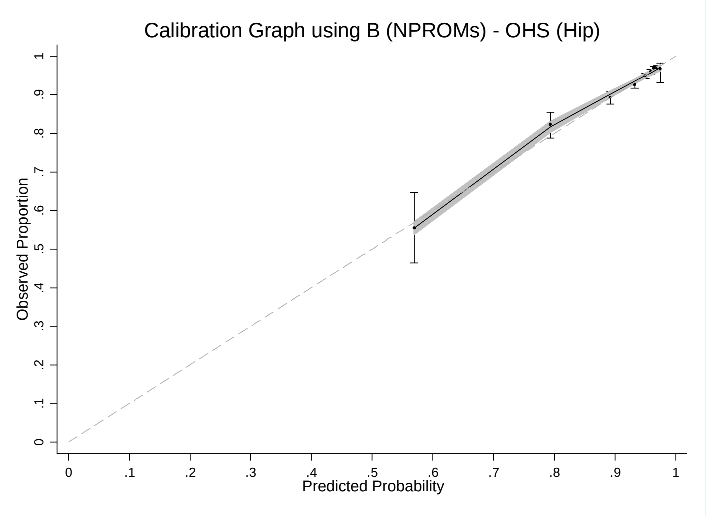
ROC curves and Calibration plots for OHS using NPROMs dataset under improvement criterion B for hip arthroplasty patients are given in Figure 63 & 64 respectively.

FIGURE 63 ROC curve OHS (his) - NPROMS dataset using improvement criterion B



Area under the curve was quite low 0.65 for OHS.

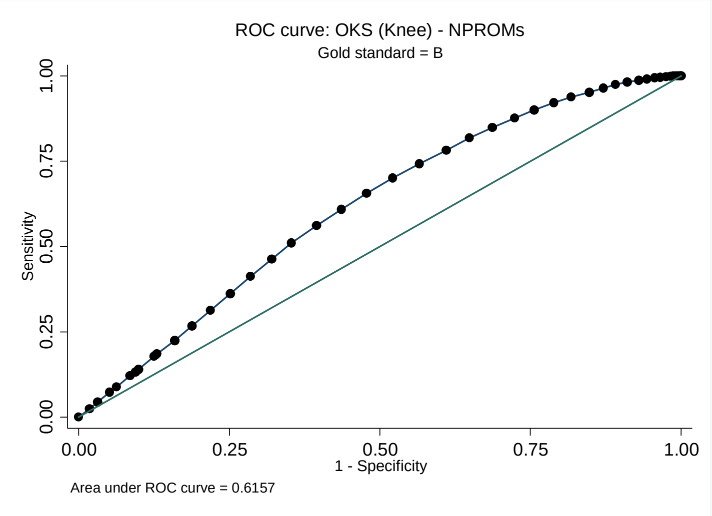
FIGURE 64 Calibration plot OHS (hip) - NPROMS dataset using improvement criterion B



Calibration appeared to be good for OHS.

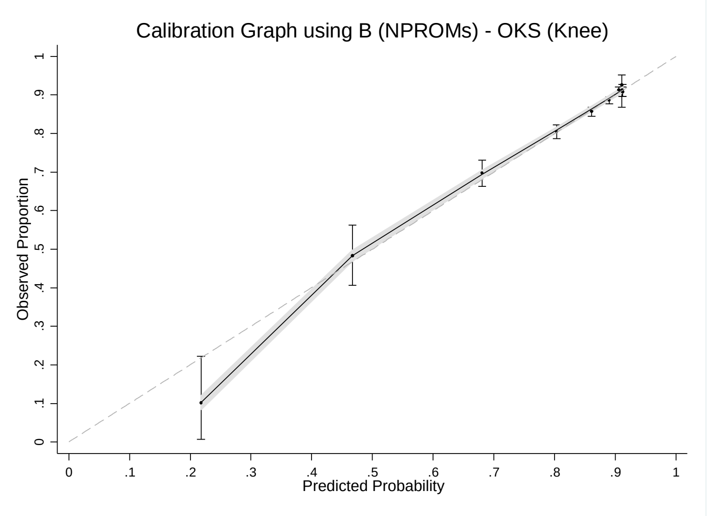
Equivalent figures for the OKS are given in Figures 65 and 66 respectively.

FIGURE 65 ROC curve OKS (knee) - NPROMS dataset using improvement criterion B



Area under the curve of for OKS was slightly lower at 0.62.

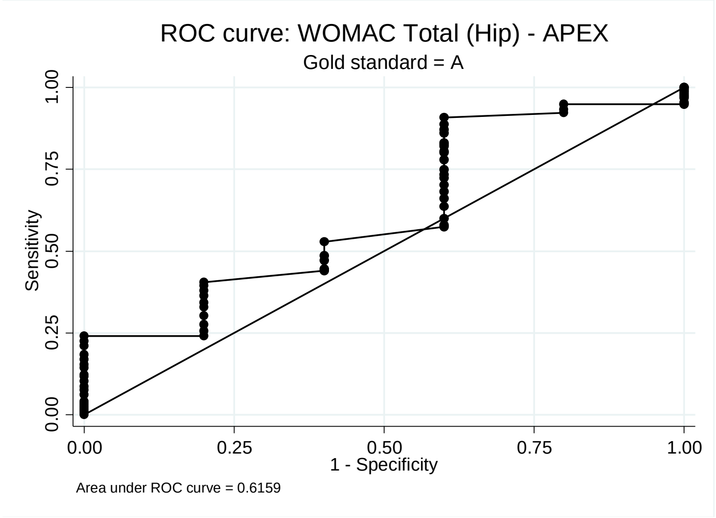
FIGURE 66 Calibration plot OKS (knee) - NPROMS dataset using improvement B criterion



Calibration was generally good though noticeably seemed poorer at lower predicted probabilities for OKS.

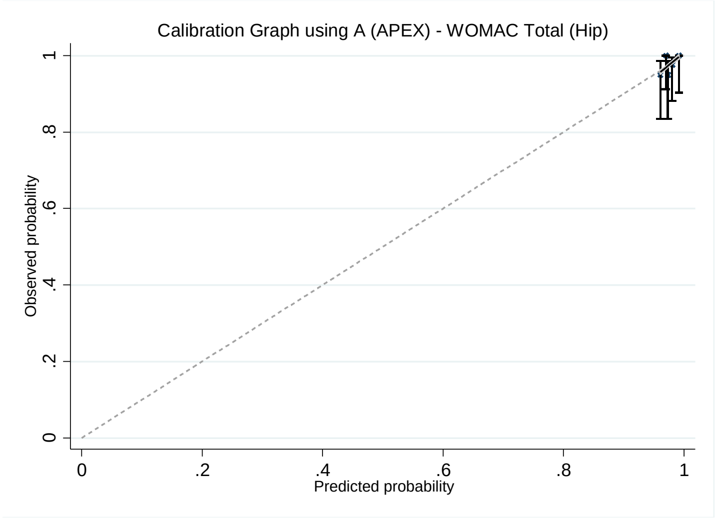
ROC curves and Calibration plots for WOMAC using the APEX dataset under improvement criterion A for hip arthroplasty patients are given in Figures 67 and 68 respectively.

FIGURE 67 ROC curve WOMAC (hip) - APEX dataset using improvement criterion A



Area under the curve of for OKS was relatively lower at 0.62.

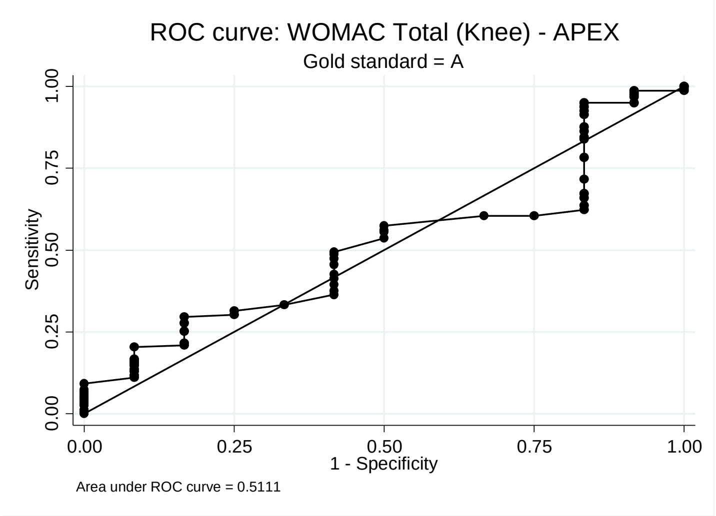
FIGURE 68 Calibration plot WOMAC (hip) – APEX dataset using improvement criterion A



Calibration seems reasonable good though noticeably seemed poorer at lower predicted probabilities for OKS.

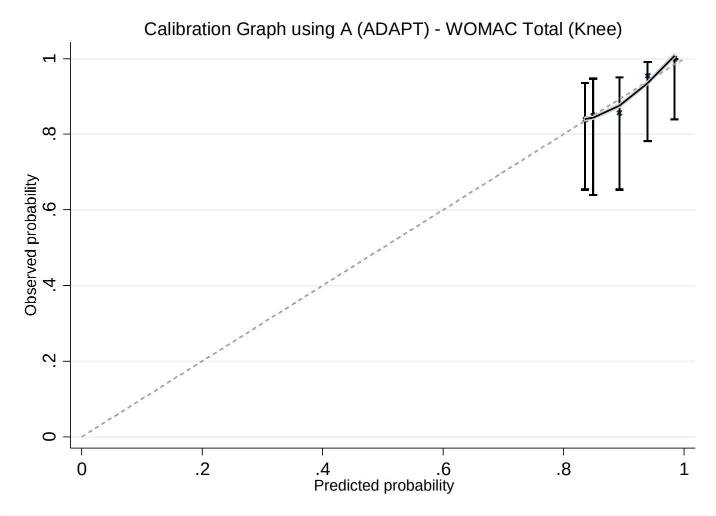
Curves and calibration plots for WOMAC using the ADAPT dataset under improvement criterion A for hip arthroplasty patients are given in Figures 69 and 70 respectively.

FIGURE 69 ROC curve WOMAC (hip) - ADAPT dataset using improvement criterionA



Area under the curve was very poor suggest no value over random guess (0.51).

FIGURE 70 Calibration plot WOMAC (hip) – ADAPT dataset using improvement criterion A



Calibration seems reasonable though noticeably there was a lot of uncertainty around the estimates due to the small sample size.

Online Supplement 7 - Literature review on previous economic evaluations, costing studies and decision analytical models

Search strategy:

- Reviewed all papers identified in any of the following systematic reviews:
  - Daigle et al 2012[209]
  - Pinedo Villanueva 2013[114]
  - Nwachukwu et al. 2015[210]
- Updated the PubMed search conducted by Daigle et al 2012[209] on 11th August 2015, looking only at papers published since January 2012: gave 69 hits published after 31 January 2012 using the search string:
  - ((((hip[Title] OR knee[Title] OR joint[Title]) AND (replacement[Title] OR arthroplasty[Title])) AND ((((Cost-utility[Title]) OR Cost-effective*[Title]) OR ("Arthroplasty, Replacement/economics"[Mesh] AND "Cost-Benefit Analysis"[Mesh] AND "Quality-Adjusted Life Years"[Mesh])) OR ("Cost-Benefit Analysis"[Mesh] AND ("Arthroplasty, Replacement/economics"[Mesh] OR "Joint Prosthesis/economics"[Mesh]))))) NOT (prophylaxis[Title] OR blood*[Title] OR rehab*[Title] OR thromboprophylaxis[Title] OR rivaroxaban[Title] OR transfusion[Title] OR autotransfusion*[Title] OR warfarin[Title] OR infect*[Title] OR hormone*[Title] OR discharge[Title])
- CRD searched 11 August 2015: http://www.crd.york.ac.uk/CRDWeb/ResultsPage.asp – searched NHSEED only and only looked at the hits that had publication dates 2012 onwards and had knee arthroplast*OR knee replacement OR hip arthroplast*OR hip replacement in the title. Search strings:
  - ((Knee arthroplast*):TI OR (Knee replacement):TI) and ((Economic evaluation:ZDT and Bibliographic:ZPS) OR (Economic evaluation:ZDT and Abstract:ZPS)) IN NHSEED: 94 hits, of which 33 were 2012 onwards
  - ((Hip arthroplast*):TI OR (Hip replacement):TI) and ((Economic evaluation:ZDT and Bibliographic:ZPS) OR (Economic evaluation:ZDT and Abstract:ZPS)) IN NHSEED : 84 hits, of which 14 were 2012 onwards
- Cost-Effectiveness Analysis (CEA) Registry https://research.tufts-nemc.org/cear4/SearchingtheCEARegistry/SearchtheCEARegistry.aspx (knee OR hip OR joint) AND (arthroplast* OR replacement) – searched 11 August 2015 and only looked at the hits that were 2012 publication date or later
  - knee replacement: 27 results of which 12 were 2012 or later
  - knee arthroplasty: 23 results of which 8 were 2012 or later
  - hip replacement: 32 results of which 12 were 2012 or later
  - hip arthroplasty: 26 results of which five were 2012 or later
- Reviewed the complete publications list on the NJR website
- Reviewed the list of technology appraisals, interventional procedure guidelines and clinical guidelines related to arthritis on the NICE website and examined the full text of all relevant documents to assess whether they met inclusion criteria.

Inclusion and exclusion criteria:

- Inclusion criteria for review of models:

    - Decision-analytical model assessing the cost-effectiveness of knee or hip arthroplasty or the type of surgery performed or the type of prosthesis used, or the timing of surgery.
- Inclusion criteria for review of costing studies and wider economic evaluations:
    - Any full economic evaluation assessing costs and benefits knee or hip arthroplasty or the type of surgery performed or the type of prosthesis used, or the timing of surgery
    - Any costing study collecting patient-level data on costs or resource use for patients undergoing knee or hip arthroplasty
- Exclusion criteria:
    - Studies on interventions aimed at reducing the risks associated with joint replacement (e.g. studies on anticoagulants, anaesthesia or autologous transfusion), or those on post-surgical rehabilitation: these were excluded since they were excluded by the Daigle review and are frequently simple decision trees with a short time horizon.
    - Protocols for trials and registries that do not give any results.
    - Studies not published in either English or German.

Results

- Identified 26 decision-analytical models on hip replacement.[114, 122, 126, 129, 130, 132, 211-229]
- Identified 19 decision-analytical models on knee arthroplasty.[46, 103, 230-246]
- Identified two papers describing decision-analytical models on both knee and hip arthroplasty.[247, 248]
- Identified 13 full economic evaluations or costing studies on hip arthroplasty.[68, 105, 106, 249-258]
- Identified 16 full economic evaluations or costing studies or knee arthroplasty.[2, 45, 108, 191, 259-270]
- Identified 12 full economic evaluations or costing studies on both knee and hip arthroplasty.[43, 44, 104, 271-279]

Online Supplement 8 - Unit costs and definitions used in Chapters 5, 7 and 8

Definition of revisions

"Revision" was defined in the same way as in the NJR: namely an "operation performed to remove (and usually replace) one or more components of a total joint prosthesis for whatever reason".[96] Following correspondence with the Healthcare Quality Improvement Partnership (HQIP) and NJR, the following procedures were classed as revisions: revision [to the tibial tray, femoral component and/or acetabular component]; two-stage revision; patella revision; removal of the patella button; above knee amputation [in the case of TKA only]; knee conversion to arthrodesis; removal of a UKA prosthesis to replace it with a total or another UKA prosthesis; exchange of tibial insert; late patella resurfacing (in a patient who has not previously had patella resurfacing); removal of hip resurfacing and insertion of a THA; hip excision arthroplasty. The following procedures are not considered revisions: Removal of screws and/or plates; repair of fracture of patella (with no component added or removed); realignment of patella (with no component added or removed); insertion of polyethylene acetabular posterior lip augmentation device (PLAD) or stabiliser [in the hip].

Unit costs

The unit costs used in the economic evaluation are summarised in Table 99.

TABLE 101 Unit costs applied to all primary datasets providing resource use data

Healthcare resource	**Units**	**Unit cost**	**Reference and details**
GP surgery visit	Per visit	£46	PSSRU 2014 page 195: Cost of a surgery patient contact lasting 11.7 minutes was £46 including direct care staff costs and qualifications. A clinic patient contact lasting 17.2 minutes costs £67 including direct care staff costs and qualifications.

Healthcare resource	**Units**	**Unit cost**	**Reference and details**
GP Home visit	Per visit	£91.26	PSSRU 2014 page 195: Home visits are assumed to involve 11.4 minutes in the patient's home and an average of 12 minutes' travel time per visit (PSSRU 2014 page 194). Each minute of patient contact is valued at £3.90 including direct care staff costs and qualification costs (PSSRU 2014 page 195), giving a total cost for a home visit of £91.26.
Phoned GP for advice	Per call	£27.69	PSSRU 2014 pages 194-5: telephone consultations are assumed to last 7.1 minutes (PSSRU 2014 page 194). Each minute of patient contact is valued at £3.90 including direct care staff costs and qualification costs (PSSRU 2014 page 195), giving a total cost for a telephone call of £28.
GP Practice nurse visit	Per visit	£13.69	PSSRU 2014 page 192: £53 per hour of face-to-face contact including qualifications (£44/hour excluding qualifications). Average surgery consultation for a GP practice nurse lasts 15.5 minutes, giving a consultation cost of £14
Phoned GP practice nurse for advice	Per call	£6.27	PSSRU 2014 page 192: £53 per hour of face-to-face contact including qualifications (£44/hour excluding qualifications). Average length of a phone call was assumed to be 7.1 minutes (based on the average for GP), giving a consultation cost of £6.27

Healthcare resource	**Units**	**Unit cost**	**Reference and details**
Repeat prescription (without seeing doctor)		£0	Excluded from the analysis since medications are excluded
District nurse– Home visit	Per visit	£39	Reference costs: PSSRU 2014 (page 187) states that NHS reference costs gives mean average cost of a face-to-face contact in district nursing services for 2013/14 of £39 (IQR £31-£43).
Occupational therapist at the GP surgery/ clinic	Per visit	£77	NHS reference costs – PSSRU 2014 page 180 states that the mean cost for a one-to-one contact of occupational therapy services in 2013/2014 was £77 (IQR £61-£97).
Occupational therapist at Home	Per visit	£77	For simplicity, applied the same cost as occupational therapy at GP surgery/clinic
Community physiotherapist at clinic/GP surgery	Per visit	£51	NHS reference costs – PSSRU 2014 page 179 states that the mean cost for a one-to-one contact in physiotherapy services in 2013/2014 was £51.
Community physiotherapist – at home	Per visit	£51	For simplicity, applied the same cost as physiotherapy at GP surgery/clinic
Hospital physiotherapist	Per visit	£34	NHS reference costs – PSSRU 2014 page 235 states that the mean average cost for a non-consultant led (not admitted) follow-up physiotherapy attendance in 2013/14 was £34 (IQR £28-£38).
Physiotherapy – average	Per visit	£42.50	Following the assumption of KAT,[108] we assumed that 50% of physiotherapy visits are in hospital and 0% are in the community.

Healthcare resource	Units	Unit cost	Reference and details
Outpatient visit – orthopaedics – Follow-up visit	Per visit	£71	Payment by results tariff[280] Tariff information spreadsheet 2013-14: outpatient attendances- WF01A Follow Up Attendance - Single ProfessionalOr WF02A Follow Up Attendance - Multi-Professional (both of these codes are the same price). Follow-up attendance is used here, since patients are assumed to have already attended clinic for their joint replacement
Alternative practitioner	Per visit	£0	Assumed to not be NHS
A&E attendance – not admitted	Per visit	£81.26	National schedule of reference costs[157] weighted average of all non-admitted accident and emergency attendances , weighted by the number of attendances.
Unit costs used only in Chapter 5			
Readmission to hospital related to hip arthroplasty	Per bed-day	£642	Department of Health reference costs 2013-14.[157] This was calculated by dividing the national average unit cost by the average length of stay for all elective and non-elective long stay HRGs, to get a cost per bed day for each HRG shown on the EL and NEL worksheets. For the excess bed days, the cost per bed day was assumed to be equivalent to the national average cost shown on the EL_XS and NEL_XS worksheets. The weighted average cost per bed day was calculated across all HRGs with "knee" within the currency description across

Healthcare resource	Units	Unit cost	Reference and details
			the EL, NEL, EL_XS and NEL_XS worksheets, weighting by the number of inlier or excess bed days.
Readmission to hospital related to knee arthroplasty	Per bed-day	£942	Department of Health reference costs 2013-14.[157] This was calculated by dividing the national average unit cost by the average length of stay for all elective and non-elective long stay HRGs, to get a cost per bed day for each HRG shown on the EL and NEL worksheets. For the excess bed days, the cost per bed day was assumed to be equivalent to the national average cost shown on the EL_XS and NEL_XS worksheets. The weighted average cost per bed day was calculated across all HRGs with "hip" within the currency description across the EL, NEL, EL_XS and NEL_XS worksheets, weighting by the number of inlier or excess bed days.
Day case admission to hospital related to hip arthroplasty (day case = admission and discharge on the same day)	Per day case	£882	Department of Health reference costs 2013-14.[157] This was calculated by taking a weighted average cost of all day case HRGs with "hip" within the currency description on the DC worksheet, weighting by the number of FCEs.
Day case admission to hospital related to knee arthroplasty (day case =	Per day case	£1,328	Department of Health reference costs 2013-14.[157] This was calculated by taking a weighted average cost of all

Healthcare resource	Units	Unit cost	Reference and details
admission and discharge on the same day)			day case HRGs with "knee" within the currency description on the DC worksheet, weighting by the number of FCEs.
Admission to hospital related to hip arthroplasty (No data on length of stay)	Per admission	£2,662	Department of Health reference costs 2013-14.[157] This was calculated by taking a weighted average cost of all HRGs with "hip" within the currency description on the EL & NEL worksheets, weighting by the number of FCEs.
Admission to hospital related to knee arthroplasty (No data on length of stay)	Per admission	£3,907	Department of Health reference costs 2013-14.[157] This was calculated by taking a weighted average cost of all HRGs with "hip" within the currency description on the EL & NEL worksheets, weighting by the number of FCEs.
Unit costs used only in Chapter 7			
Readmission to hospital within 30 days of hip or knee arthroplasty	Per bed-day	£395.83	Average costs per bed-day for readmissions in PROMs/HES within 30 days of hip or knee arthroplasty
Readmission to hospital within 30 days of hip or knee arthroplasty (No data on length of stay)	Per admission	£1,255	Average costs for readmissions in PROMs/HES within 30 days of hip or knee arthroplasty
Readmission to hospital with a diagnosis of	Per bed-day	£1,107.25	Average costs per bed-day for readmissions in PROMs/HES with a

Healthcare resource	Units	Unit cost	Reference and details
hip/knee arthritis after hip/knee arthroplasty			diagnosis of hip/knee arthritis after hip/knee arthroplasty
Readmission to hospital with a diagnosis of hip/knee arthritis after hip/knee arthroplasty (No data on length of stay)	Per admission	£5,220	Average costs for readmissions in PROMs/HES with a diagnosis of hip/knee arthritis after hip/knee arthroplasty
Readmission to hospital for a hip/knee-specific procedure following hip/knee arthroplasty	Per bed-day	£551.33	Average costs per bed-day for readmissions in PROMs/HES for a hip/knee-specific procedure following hip/knee arthroplasty
Readmission to hospital for a hip/knee-specific procedure following hip/knee arthroplasty (No data on length of stay)	Per admission	£1,654	Average costs for readmissions in PROMs/HES for a hip/knee-specific procedure following hip/knee arthroplasty
Readmission to hospital with a diagnosis for infection (see *Chapter 7*) following hip/knee arthroplasty	Per bed-day	£694.8	Average costs per bed-day for readmissions in PROMs/HES with a diagnosis for infection (see *Chapter 7*) following hip/knee arthroplasty
Readmission to hospital with a diagnosis for infection (see *Chapter 7*) following hip/knee arthroplasty (No data on length of stay)	Per admission	£1,876	Average costs for readmissions in PROMs/HES diagnosis for infection (see *Chapter 7*) following hip/knee arthroplasty
Unit costs used only in Chapter 8			
Attendance at the musculoskeletal hub	Per attendance	£58	Based on 40 minutes' of patient-related activity for a grade 8a physiotherapist. Based on activity at the NOC hub, each

Healthcare resource	Units	Unit cost	Reference and details
			hub attendance lasts 30 minutes, plus an additional 10 minutes' administration per patient and will, on average, be conducted by a grade 8a physiotherapist who spends around 80% of their time on patient-related activity. The salary for a band 8a, point 36 physiotherapist was based on Agenda for Change salaries[281] and converted to an hourly rate by applying the same methodology as was applied by PSSRU for a hospital physiotherapist,[152] assuming that working hours and the percentages for salary on costs, qualifications and overheads would be the same for all hospital physiotherapists.
Outpatient consultation with an orthopaedic surgeon	Per consultation	£132	National average unit cost for first consultant-led non-admitted face-to-face attendance, WF01B, CL sheet of the National Schedule of Reference Costs Year 2013-14 NHS trusts and NHS foundation trusts[157]

Online Supplement 9 - Literature reviews of studies reporting long-term changes in clinical scores for patients without surgery and long-term changes in EQ-5D utility, clinical scores, revision rates and mortality after surgery

- Conducted PubMed search on 7th August 2015, using the two search strings:
    - For studies reporting long-term changes in clinical scores for patients without arthroplasty: (EuroQoL[Title/Abstract] OR "EQ-5D"[Title/Abstract] OR OHS[Title/Abstract] OR OKS[Title/Abstract] OR (Oxford[Title/Abstract] AND score[Title/Abstract]) OR "SF-12"[Title/Abstract] OR WOMAC[Title/Abstract] OR ("Western Ontario"[Title/Abstract] AND McMaster*[Title/Abstract])) AND ("OSTEOARTHRITIS, HIP"[MeSH Major Topic] OR "OSTEOARTHRITIS, KNEE"[MeSH Major Topic] OR (osteoarthritis AND (hip[Title/Abstract] OR hips[Title/Abstract] OR knee[Title/Abstract] OR knees[Title/Abstract]))) AND ("Regression Analysis"[MeSH Terms] OR "Models, Statistical"[MeSH Terms] OR "prognostic model" OR regression OR "proportional hazards" OR (predict* AND model))
    - For studies reporting long-term changes for patients with arthroplasty: (((hip[Title/Abstract] OR knee[Title/Abstract] OR joint[Title/Abstract]) AND (replacement[Title/Abstract] OR arthroplasty[Title/Abstract])) OR "Arthroplasty, Replacement, Knee"[MeSH Terms] OR "Arthroplasty, Replacement, Hip"[MeSH Terms]) AND ("Regression Analysis"[MeSH Terms] OR "Models, Statistical"[MeSH Terms] OR "prognostic model" OR regression OR "proportional hazards" OR (predict* AND model)) AND (WOMAC[Title/Abstract] OR "SF-12" OR (Oxford[Title/Abstract] AND score[Title/Abstract]) OR OHS[Title/Abstract] OR OKS[Title/Abstract] OR ("Western Ontario"[Title/Abstract] AND McMaster*[Title/Abstract]))

- 442 studies were screened (title and abstract) with respect to the inclusion and exclusion criteria for both reviews.
- Reviewed the complete list of publications on the websites of the Osteoarthritis Initiative (OAI) and the Multicenter Osteoarthritis Study (MOST).

- Exclusion criteria for both studies:
    - Patients with diagnoses other than osteoarthritis
    - Studies not reported in either English or German

- Exclusion criteria for studies reporting long-term changes after surgery:
    - Less than 500 patients were observed at baseline

- Inclusion criteria for studies reporting long-term change for patients without surgery:
    - Patients did not have joint replacement surgery at either baseline or follow-up

  - Studies reporting changes in WOMAC (total or any subscore), SF-12, OHS, OKS or EQ-5D

- Inclusion criteria for studies reporting long-term change for patients with surgery:
  - Studies reporting changes in EQ-5D, WOMAC (total or any subscore), SF-12, OHS, OKS, revision rates or mortality rates
  - Studies following patients for at least 2 years after surgery

Results:

Studies reporting long-term changes for patients without surgery:

- 22 studies were identified reporting long-term change in clinical scores for patients without surgery.[98-100, 123-125, 135-150]
- 21 studies reported changes in WOMAC scores,[98-100, 124, 125, 135-150] with only 1 study [98] reporting changes in WOMAC total score. Most studies reported changes in subscores, most commonly WOMAC functioning.
- Two studies reported changes in SF-12 physical scores.[123, 136]
- One study reported changes in OHS and EQ-5D alongside changes in WOMAC scores.[99]
- Follow-up duration ranged from 71 days [99]to 6 years.[123]

Studies reporting long-term changes for patients with surgery:

- 11 studies were identified reporting long-term changes in clinical scores, utility, revision rates or mortality for patients with surgery.[69, 131, 282-290]
- Six studies reported changes in clinical tool scores.
  - Three studies reported changes in OHS.[69, 288, 289]
  - Three studies reported changes in OKS.[287, 289, 290]
  - Two studies reported changes in SF-36 and WOMAC, respectively.[282, 283]
- Two studies reported changes in mortality rates.[131, 286]
- Four studies reported changes in revision rates.[131, 284, 285, 288]
- Longest follow-up period was ten years.[286-288, 290]
- Seven studies reported a predictive model.[69, 282, 283, 285-288]
- Three of these studies did not report insignificant covariates or the constant.[69, 286, 287]
- Only one of the remaining papers did not include surgical predictors in their model.[282]

Online Supplement 10 - Literature review on models predicting mortality after primary or revision knee/hip arthroplasty

Search strategy:

- Reviewed all studies listed and documents available on NJR website
- Conducted a very focused MEDLINE search, focusing on studies using NJR data (since it was already known that several recent studies had estimated mortality using NJR data and that this would be the best available data). We searched MEDLINE through PubMed on 14th July 2015 identified 20 hits, using the search string:
  (knee or hip) AND (replacement OR arthroplasty) AND (mortality OR death) AND (UK OR "United Kingdom" OR England OR Britain OR English OR British) AND ("national joint registry" OR NJR)

Inclusion criteria

- Study were only included if they presented mortality rates stratified by age and sex (plus ideally other baseline characteristics), or present coefficients for regression model(s) predicting mortality after knee and hip arthroplasty.
- We excluded any study with less than 100,000 primary operations, or 10,000 revision procedures, since studies using a similar sample of NJR data had already been identified in earlier reviews.
- We excluded any study not using UK data.

The review identified five studies.[291-295] Three further studies were identified from the review described in *Online Supplement 7*[126, 129, 131] and a more recent paper in the same series was identified from the authors.[127]

Online Supplement 11 - Literature review on mapping studies

This review aimed to identify studies mapping from SF-12, SF-36, SF-6D, WOMAC, OKS or OHS to EQ-5D, or studies mapping between any of the clinical tools under consideration.

The methods of this literature review were based on the methods to generate the HERC database of mapping studies[134] and the inclusion criteria for this review were identical to the previous review other than the source and target instruments.

Search strategy:

- Filtered the HERC database of mapping studies (version 4.0) to show studies mapping from SF-12, SF-36, SF-6D, WOMAC, OKS or OHS to EQ-5D.
- Reviewed the list of studies that had been identified in the literature searches used to generate the mapping database to look for studies mapping to SF-12.
- Searched the database search results identified in the mapping database for the terms "SF-12", "OHS", "WOMAC", and "OKS".
- Conducted the following Medline searches through PubMed:

Aim and date	**Search string**	**Number of hits**
Any mapping studies involving EQ-5D and any clinical tool 13/7/15	(mapping OR map OR mapped OR cross-walk* OR crosswalk* OR "transfer to utility" OR "indirect utility") AND (eq-5d OR euroqol) AND (SF-12 OR SF-6D OR SF-36 OR "short form" OR WOMAC OR (Oxford AND score) OR OHS OR OKS OR "Western Ontario and McMaster Universities *arthritis Index" OR "Knee injury and Osteoarthritis Outcome Score")	65 hits; 4 potentially relevant
Any mapping involving SF-12 or related and disease-specific. 13/7/15	(mapping OR map OR mapped OR cross-walk* OR crosswalk* OR "transfer to utility" OR "indirect utility") AND (SF-12 OR SF-6D OR SF-36 or "short form") AND (WOMAC OR (Oxford AND score) OR OHS OR OKS OR "Western Ontario and McMaster Universities *arthritis Index" OR KOOS OR "Knee injury and Osteoarthritis Outcome Score")	2 hits; 0 relevant

Any mapping from WOMAC to others. Searched 13/7/15	(mapping OR map OR mapped OR cross-walk* OR crosswalk* OR "transfer to utility" OR “indirect utility”) AND (WOMAC OR “Western Ontario and McMaster Universities *arthritis Index”) AND ((Oxford AND score) OR OHS OR OKS OR KOOS OR “Knee injury and Osteoarthritis Outcome Score”)	1 hit; irrelevant
Any mapping from KOOS to Oxford. Searched 13/7/15	(mapping OR map OR mapped OR cross-walk* OR crosswalk* OR "transfer to utility" OR “indirect utility”) AND (KOOS OR “Knee injury and Osteoarthritis Outcome Score”) AND ((Oxford AND score) OR OHS OR OKS)	0 hits
Repeating searches using alternative search terms for WOMAC 27/7/15	(mapping OR map OR mapped OR cross-walk* OR crosswalk* OR "transfer to utility" OR “indirect utility”) AND ("Western Ontario”[Title/Abstract] AND McMaster*[Title/Abstract]) AND (eq-5d OR euroqol OR SF-12 OR SF-6D OR SF-36 OR “short form” OR (Oxford AND score) OR OHS OR OKS OR “Knee injury and Osteoarthritis Outcome Score”) NOT (WOMAC OR “Western Ontario and McMaster Universities *arthritis Index”)	2 hits of, which Latimer 2012 was reviewed found to use published algorithm

The following studies were identified:

- Mapping from WOMAC to EQ-5D: 2 studies,[119, 296] of which was included a model mapping from WOMAC total score.[119]
- Mapping from OKS to EQ-5D: 1 study,[117] which included a model mapping from total OKS.
- Mapping from OHS to EQ-5D: 3 studies,[120, 297-299] of which one mapped from total OHS.[120]
- Mapping from SF-12 to EQ-5D: 8 studies,[118, 159, 181, 300-304] of which one mapped from SF-12 version 2 physical and mental domain scores.[118] Six studies mapped from SF-12 version 1 and were therefore considered possible candidates for predicting EQ-5D from patient-level EPOS data.[159, 181, 300-303]
- Mapping between clinical tools: 0 studies were identified that mapped from WOMAC, OKS, OHS or SF-12 onto WOMAC, OKS, OHS or SF-12.

Mapping from SF-12 to EQ-5D in EPOS

EPOS was the only dataset providing information on THA patients beyond Year 1. However, EQ-5D was not used in this study and SF-6D utilities cannot be directly compared against those measured using EQ-5D since SF-6D uses standard gamble and tends to produce non-comparable utilities (e.g. higher utilities for patients with poor health states).[158] We therefore mapped SF-12 responses from EPOS onto EQ-5D before analysis. We used the results of the literature review to identify the best available mapping model predicting EQ-5D utilities based on SF-12 or SF-36 version 1. For this purpose, we also considered response mapping models and models predicting from SF-12 or SF-36 responses as well as those mapping from domain scores. Six published mapping algorithms have been developed to map from SF-12 version 1 onto EQ-5D.[159, 181, 300-303] These were all based on general public samples (generally MEPS). We rejected Coca Perraillon et al[300] on the grounds that it used the US EQ-5D tariff and rejected Sullivan and Ghushchyan 2006[303] on the grounds that the mapping algorithm includes a large number of demographic variables that are not available in EPOS. We used KAT data to compare performance of the second-order polynomial models with and without demographics presented by Frank et al[181] and a response-mapping algorithm mapping from SF-12 version 1 item responses that was slightly modified from the one presented by Gray et al[159] and estimates predictions using expected value rather than Monte Carlo.[160] The revised Gray 2006 algorithm generated substantially lower MSE values in KAT and gave predicted values with mean and standard deviation for baseline and three-month EQ-5D that more accurately mirrored the observed EQ-5D, although all algorithms underestimated standard deviations and three-month EQ-5D and overestimated baseline EQ-5D utility. We therefore used the revised Gray 2006 algorithm to predict EQ-5D utilities for EPOS participants.

Online Supplement 12 - Regression methods and results and inputs for the economic evaluation described in Chapter 7

Distribution of patients by clinical tool score, age and sex

For the analyses presented in *Chapter 5*, we calculated the distribution of patients by age and sex using data from the Finalised PROMs Report 2013/14[165] and the ONS 2013 Mid-Year Population Estimates[166]. The Finalised PROMs Report provided the number of procedures per 100,000 population for patients aged 10 and above by age and sex. To derive absolute patient numbers from these rates, we used Mid-2013 population estimates for England, since these estimates were used to derive the rates reported in the Finalised PROMs Report. We aggregated the reported population numbers into the same categories used in the PROMs report (five-year age groups for each sex). In a final step, we multiplied the reported procedure rates with the estimated population number divided by 100,000 to obtain the absolute number of procedures conducted for each age range and sex (*Table 102*). In the results presented in *Chapter 7*, these data were superseded by values calculated using the PROMs/HES data (see *Online Supplement 15*).

TABLE 102 Age and sex distribution for patients undergoing primary arthroplasty

Age used in the model	**Age range**	**Number (percentage) of patients undergoing hip replacement**		**Number (percentage) of patients undergoing knee replacement**	
		Men	Women	Men	Women
50	Under 55	4,372 (5.7%)	4,674 (6.1%)	2,242 (2.8%)	3,289 (4.1%)
60	55 to 64	7,042 (9.2%)	8,640 (11.3%)	7,740 (9.7%)	10,088 (12.7%)
70	65 to 74	10,790 (14.1%)	16,494 (21.6%)	13,833 (17.4%)	17,704 (22.2%)
80	75 to 84	7,601 (9.9%)	13,207 (17.3%)	8,864 (11.1%)	12,750 (16.0%)
90	85+	1,093 (1.4%)	2,558 (3.3%)	1,261 (1.6%)	1,903 (2.4%)

The distribution of patients by clinical score (*Table 103* to *Table 107*) was based on the distribution of patients in the largest available dataset for that joint and score. The bands of scores used to calculate percentages were chosen to ensure that each percentage was based on at least five patients to ensure patients' anonymity. In cases where the model presents results separately for several scores in the same band, we assumed that patients were evenly distributed across the band. For example, six patients (2%) in the APEX knee cohort had WOMAC scores between 0 and 9.99 (**TABLE 104**); we therefore assumed that the costs and QALYs for a WOMAC score of 0 applied to 1% of patients in the population, while the costs and QALYs for WOMAC score of 5 also applied to 1% of the population.

TABLE 103 Distribution of patients by OKS and OHS, based on the full PROMs extract 2009-2015 (used in both Chapters 6 and 9)

Oxford score	**Percentage of patients**	
	Hip replacement	**Knee replacement**
0	0.098%	0.051%
1	0.247%	0.122%
2	0.552%	0.306%
3	1.070%	0.598%
4	1.660%	0.992%
5	2.212%	1.368%
6	2.466%	1.730%
7	2.948%	2.259%
8	3.282%	2.690%
9	3.505%	3.157%
10	3.810%	3.494%
11	4.052%	3.802%
12	4.165%	4.081%
13	4.389%	4.293%
14	4.494%	4.427%
15	4.469%	4.693%
16	4.570%	4.733%
17	4.484%	4.708%
18	4.184%	4.457%
19	4.302%	4.770%
20	4.118%	4.598%
21	3.903%	4.429%

Oxford score	**Percentage of patients**	
	Hip replacement	**Knee replacement**
22	3.736%	4.278%
23	3.410%	3.962%
24	3.263%	3.687%
25	2.966%	3.371%
26	2.697%	3.053%
27	2.393%	2.671%
28	2.113%	2.355%
29	1.845%	2.064%
30	1.530%	1.652%
31	1.461%	1.521%
32	1.214%	1.266%
33	0.980%	1.032%
34	0.771%	0.823%
35	0.666%	0.668%
36	0.514%	0.516%
37	0.411%	0.400%
38	0.305%	0.288%
39	0.216%	0.203%
40	0.188%	0.147%
41	0.120%	0.113%
42	0.082%	0.063%
43	0.056%	0.046%
44	0.036%	0.029%
45	0.024%	0.018%
46	0.014%	0.009%
47	0.007%	0.007%
48	0.006%	0.002%

TABLE 104 Distribution of knee arthroplasty patients by WOMAC score, based on the APEX knee cohort

Range of WOMAC scores	No. APEX participants in this range	WOMAC score used in the model	Proportion of patients in model assumed to be in at this score
0-9.99	6	0	1.0%
		5	1.0%
10-14.99	5	10	1.7%
15-19.99	7	15	2.4%
20-24.99	18	20	6.1%
25-29.99	14	25	4.7%
30-31.99	9	30	8.8%
32-33.99	9		
34-35.99	16	35	10.5%
36-37.99	16		
38-39.99	7		
40-41.99	18	40	16.4%
42-43.99	23		
44-45.99	15		
46-47.99	11	45	9.3%
48-49.99	9		
50-51.99	12	50	10.0%
52-53.99	11		
54-55.99	13		
56-57.99	12	55	8.6%
58-59.99	7		
60-64.99	18	60	6.1%
65-69.99	18	65	1.2%
		66	1.2%
		67	1.2%
		68	1.2%
		69	1.2%

Range of WOMAC scores	**No. APEX participants in this range**	**WOMAC score used in the model**	**Proportion of patients in model assumed to be in at this score**
70-79.99	16	70	0.5%
		71	0.5%
		72	0.5%
		73	0.5%
		74	0.5%
		75	0.5%
		76	0.5%
		77	0.5%
		78	0.5%
		79	0.5%
80-89.99	5	80	0.2%
		81	0.2%
		82	0.2%
		83	0.2%
		84	0.2%
		85	0.2%
		86	0.2%
		87	0.2%
		88	0.2%
		89	0.2%
90-100	0	90	0.0%
		91	0.0%
		92	0.0%
		93	0.0%
		94	0.0%
		95	0.0%
		96	0.0%
		97	0.0%
		98	0.0%

Range of WOMAC scores	No. APEX participants in this range	WOMAC score used in the model	Proportion of patients in model assumed to be in at this score
		99	0.0%
		100	0.0%

TABLE 105 Distribution of knee arthroplasty patients by SF-12 physical and mental scores, based on the KAT dataset

SF-12 physical score	Proportion of the total population at each physical score (rounded to the nearest whole number)	Proportion of people at this SF-12 physical score who are in each band of SF-12 mental scores		
		<35	35-64.99	≥65
12	0.72%	0%	67%	33%
13	0.29%	0%	67%	33%
14	0.38%	0%	63%	38%
15	0.62%	0%	85%	15%
16	1.10%	0%	87%	13%
17	1.20%	4%	76%	20%
18	0.96%	10%	75%	15%
19	1.49%	3%	74%	23%
20	1.87%	8%	77%	15%
21	2.20%	9%	61%	30%
22	2.73%	9%	81%	11%
23	3.31%	12%	75%	13%
24	3.64%	11%	80%	9%
25	4.31%	16%	69%	16%
26	5.17%	20%	69%	10%
27	5.03%	14%	82%	4%
28	4.65%	8%	81%	10%
29	6.23%	12%	79%	9%
30	4.31%	20%	74%	6%
31	4.94%	12%	83%	6%
32	4.79%	14%	75%	11%

SF-12 physical score	**Proportion of the total population at each physical score (rounded to the nearest whole number)**	**Proportion of people at this SF-12 physical score who are in each band of SF-12 mental scores**		
		<35	**35-64.99**	**≥65**
33	4.12%	14%	79%	7%
34	4.36%	12%	80%	8%
35	3.79%	15%	82%	3%
36	3.74%	3%	88%	9%
37	3.93%	12%	85%	2%
38	2.92%	5%	90%	5%
39	3.31%	9%	86%	6%
40	2.20%	13%	87%	0%
41	1.49%	10%	84%	6%
42	1.87%	13%	85%	3%
43	1.39%	7%	90%	3%
44	1.05%	14%	82%	5%
45	0.86%	22%	78%	0%
46	0.96%	10%	90%	0%
47	0.72%	13%	73%	13%
48	0.62%	0%	85%	15%
49	0.48%	10%	90%	0%
50	0.53%	9%	73%	18%
51	0.57%	8%	92%	0%
52	0.29%	17%	83%	0%
53	0.19%	0%	100%	0%
54	0.12%	0%	100%	0%
55	0.12%	0%	100%	0%
56	0.09%	11%	89%	0%
57	0.09%	11%	89%	0%
58	0.09%	11%	89%	0%
59	0.09%	11%	89%	0%
60	0.09%	11%	89%	0%

TABLE 106 Distribution of hip arthroplasty patients by WOMAC score, based on the APEX hip cohort

Range of WOMAC scores	**No. APEX participants in this range**	**WOMAC score used in the model**	**Proportion of patients in model assumed to be in at this score**
0-5.99	5	0	1.3%
		5	2.6%
6-9.99	7		
10-14.99	8	10	2.6%
15-19.99	15	15	4.9%
20-24.99	17	20	5.6%
25-29.99	21	25	6.9%
30-31.99	8	30	8.4%
32-33.99	11		
34-35.99	13		
		35	10.4%
36-37.99	14		
38-39.99	11		
40-41.99	14	40	11.8%
42-43.99	13		
44-45.99	18		
		45	10.9%
46-47.99	17		
48-49.99	7		
50-51.99	14	50	9.7%
52-53.99	11		
54-55.99	9		
		55	8.4%
56-57.99	12		
58-59.99	9		
60-64.99	18	60	5.9%
65-69.99	13	65	0.9%

Range of WOMAC scores	**No. APEX participants in this range**	**WOMAC score used in the model**	**Proportion of patients in model assumed to be in at this score**
		66	0.9%
		67	0.9%
		68	0.9%
		69	0.9%
70-74.99	7	70	0.5%
		71	0.5%
		72	0.5%
		73	0.5%
		74	0.5%
75-79.99	5	75	0.3%
		76	0.3%
		77	0.3%
		78	0.3%
		79	0.3%
80-84.99	7	80	0.5%
		81	0.5%
		82	0.5%
		83	0.5%
		84	0.5%
85-89.99	0	85	0.0%
		86	0.0%
		87	0.0%
		88	0.0%
		89	0.0%
90-94.99	0	90	0.0%
		91	0.0%
		92	0.0%
		93	0.0%
		94	0.0%

Range of WOMAC scores	No. APEX participants in this range	WOMAC score used in the model	Proportion of patients in model assumed to be in at this score
95-99.99	0	95	0.0%
		96	0.0%
		97	0.0%
		98	0.0%
		99	0.0%
		100	0.0%

TABLE 107 Distribution of hip arthroplasty patients by SF-12 physical and mental scores, based on the EPOS dataset

SF-12 physical score	Proportion of the total population at each physical score (rounded to the nearest whole number)	Proportion of people at this SF-12 physical score who are in each band of SF-12 mental scores		
		<35	**35-64.99**	**≥65**
12	0.1%	0%	100%	0%
13	0.1%	0%	100%	0%
14	0.1%	0%	100%	0%
15	0.1%	0%	100%	0%
16	0.4%	0%	88%	13%
17	0.4%	0%	88%	13%
18	1.2%	0%	100%	0%
19	1.4%	0%	93%	7%
20	2.5%	0%	96%	4%
21	3.9%	0%	87%	13%
22	2.5%	8%	92%	0%
23	4.8%	10%	83%	6%
24	5.7%	21%	75%	4%
25	4.2%	7%	86%	7%
26	6.4%	13%	88%	0%
27	7.9%	22%	77%	1%

SF-12 physical score	**Proportion of the total population at each physical score (rounded to the nearest whole number)**	**Proportion of people at this SF-12 physical score who are in each band of SF-12 mental scores**		
		<35	**35-64.99**	**≥65**
28	6.6%	12%	85%	3%
29	7.9%	15%	85%	0%
30	5.4%	26%	70%	4%
31	6.8%	19%	81%	0%
32	5.1%	25%	73%	2%
33	4.1%	24%	73%	2%
34	3.9%	5%	87%	8%
35	3.3%	15%	79%	6%
36	3.5%	23%	71%	6%
37	1.9%	11%	89%	0%
38	1.8%	22%	78%	0%
39	0.9%	33%	56%	11%
40	1.3%	23%	69%	8%
41	1.1%	9%	91%	0%
42	0.8%	25%	75%	0%
43	0.9%	0%	100%	0%
44	0.5%	0%	80%	20%
45	0.3%	0%	100%	0%
46	0.3%	0%	100%	0%
47	0.3%	14%	86%	0%
48	0.3%	14%	86%	0%
49	0.2%	0%	100%	0%
50	0.2%	0%	100%	0%
51	0.1%	14%	86%	0%
52	0.1%	14%	86%	0%
53	0.1%	14%	86%	0%
54	0.1%	14%	86%	0%
55	0.1%	14%	86%	0%

SF-12 physical score	Proportion of the total population at each physical score (rounded to the nearest whole number)	Proportion of people at this SF-12 physical score who are in each band of SF-12 mental scores		
		<35	**35-64.99**	**≥65**
56	0.1%	0%	100%	0%
57	0.1%	0%	100%	0%
58	0.1%	0%	100%	0%
59	0.1%	0%	100%	0%
60	0.1%	0%	100%	0%

Revision rates

Revision rates following TKA

The annual probability of revision was based on the following models reported by Pennington et al.[127] Model coefficients and Cholesky decompositions of the variance-covariance matrix were obtained from the authors.

- Cubic spline model predicting the log-cumulative hazard ($\ln(H(t|X))$) of first revisions as a function of time since primary TKA, age, sex, patella resurfacing, antibiotic cement, ASA grade, BMI, surgical position, grade of surgeon and brand of knee prosthesis. The log-cumulative hazard function was calculated at annual intervals using the methods described by Royston and Lambert (pages 109-11)[305] and converted into annual probabilities.
- Exponential regression predicting the rate of re-revisions in patients who have already had one or more revision procedure as a function of age and a dummy indicating whether the patient has had a revision in the past year.
- A year was assumed to be 365.24 days long.

In the absence of published national data, we assumed, for simplicity, when calculating revision rates that all patients had a BMI of 30. We also assumed that all TKA surgery was overseen by a consultant, and that the distribution of patients by prosthesis brand,[96] ASA grade,[161] and use of patella resurfacing and antibiotic cement[162] reflected the total population of people in the NJR database.

Revision rates following THA

We based the revision rates in our model on the regression models reported by Pennington et al.[129] Model coefficients and Cholesky decompositions of the variance-covariance matrix were obtained from the authors. We used the following regression functions in our model:

- Logistic regression model predicting risk of first revision in the first 70 days after primary THA ($prob_{70days}$) as a function of the type of THA (cemented, uncemented and hybrid), age and sex.
- Cubic spline model predicting the log-cumulative hazard ($\ln(H(t|X))$) of first revisions after the first 70 days after primary THA as a function of age, sex, time since primary THA and the type of THA (cemented, uncemented and hybrid). The log-cumulative hazard function was calculated at 0.8083 years (365.25 days minus 70 days), 1.8083 years, and annually thereafter following Royston and Lambert[305] and converted into annual probabilities. The probability of revision in the first year after THA was calculated as $prob_{Year1} = prob_{70days} + (1 - e^{-e^{\ln(H(0.8083|X))}}) * (1 - prob_{70days})$
- Exponential regression model predicting the rate of re-revisions in patients who have already been revised as a function of age, sex and whether they have had a revision in the last year.
- A year was assumed to be 365.24 days long.

In the absence of published national data, we assumed, for simplicity, when calculating revision rates that all patients had a BMI of 30. We assumed that 41.2% of people had uncemented THA and 23.1% had hybrid THA.[96]

Mortality

The probability of perioperative mortality and mortality in the year of revision surgery, and the healthy patient effect were based on models estimated by Pennington et al.[127, 129] Regression coefficients and Cholesky decompositions of the variance-covariance matrices were obtained from the authors.

All-cause mortality for the general population was based on the probability of death between age x and age x+1 (q_x) in national life tables for the UK in 2011-13.[133]

The survival advantage for joint replacement patients (healthy patient effect) was based on Tobit regression on a natural scale, with a censoring at 0 (to ensure that mortality is never negative). We calculated the healthy patient effect (i.e. the ratio of mortality risk for arthroplasty candidates divided by mortality risk for the general population) from the linear predictor of the Tobit model as:

$$E[Y|X] = P(Y > 0|X) * E[Y|Y > 0|X] = (1 - \Phi\left(-\frac{X\beta}{\sigma}\right) * \left(X\beta - \sigma * \frac{\phi\left(-\frac{X\beta}{\sigma}\right)}{1 - \Phi\left(-\frac{X\beta}{\sigma}\right)}\right)$$

where $\Phi(\cdot)$ denotes the cumulative distribution function of the standard normal distribution and $\phi(\cdot)$ denotes the probability distribution function of the standard normal distribution.

For some patients (e.g. 90-year-old men), the healthy patient effect meant that mortality eight years after arthroplasty was predicted to be higher than it would be without the health patient effect. In line with Pennington et al,[127, 129] we capped this healthy patient effect at 1 such that mortality is never higher than would be expected for members of the general public of the same age or sex. A limit was also placed on the healthy patient effect such that it is never lower than the ratio for the previous year. The healthy patient effect was assumed to not apply to revision surgery.

For the 30-day period immediately after the start of primary arthroplasty surgery, patients' mortality was based on the 30-day mortality estimated by Pennington et al.[127, 129] The total probability of dying in the year of primary arthroplasty was calculated as the probability of dying within 30 days, plus 1 minus the 30 day mortality, multiplied by the probability of dying in the remaining 335.24 days of the year (which is based on the health patient effect multiplied by 335.24 days of all-cause mortality).

Since surgical mortality is very low, there were some patient groups (e.g. women under 75) for whom the above function predicts mortality to be lower with TJA than without TJA. In these situations, total mortality in the year of surgery was set to be equal to the total mortality without surgery.

Mortality associated with revision surgery was excluded from the analyses described in *Chapter 5*, unless the models developed by Pennington et al[127, 129] predicted that mortality would be more than 10% higher than would be expected in the absence of revision surgery. (in which case mortality was assumed to be 10% higher than without revision surgery). If the mortality was predicted to be 10% higher, we followed Pennington et al in setting mortality in the year of revision at a maximum of 10% above all-cause mortality to avoid extrapolating very high mortality rates to very old patients who were generally outside the sample used to estimate mortality rates. Furthermore, no excess mortality was applied to revisions occurring within 12 months of primary arthroplasty in the analyses described in *Chapter 5*. For THA, the probability of death in the year of revision surgery was calculated using the logistic regression model predicting death in the year of revision in 65-95-year-olds undergoing hip revision surgery;[129] if this model predicted mortality to be >10% higher than without revision surgery, the mortality in the year of revision were set to 10% above the mortality without revision surgery. For TKA, we followed Pennington et al[127] in using the model that they estimated for 30-day mortality associated with primary arthroplasty for both primary and revision surgery; mortality in the year of revision surgery was calculated from the 30-day mortality and the annual mortality that would have applied in the absence of revision surgery in the same way as for primary arthroplasty; if this model predicted mortality to be >10% higher than without revision surgery, the mortality in the year of revision were set to 10% above the mortality without revision surgery. In models predicting mortality for revision surgery, we used age at the time of revision, rather than age at primary surgery. However, the published models of mortality associated with revision surgery[127, 129] were applied to all revision procedures in *Chapter 7*.

Mapping baseline clinical tool scores onto EQ-5D utility

Methods

Models mapping from OKS, OHS, WOMAC and SF-12 onto EQ-5D utility were required to estimate pre-operative EQ-5D utility for each hypothetical individual considered in the model. Only models mapping from total OKS, total OHS, total WOMAC or both SF-12 physical and mental scores were considered due to the way in which clinical tool scores were considered in the model structure.

We first reviewed the results of literature review on mapping studies (see *Online Supplement 11)* to identify whether there were any suitable published studies that could be used to predict pre-operative EQ-5D utility based on total pre-operative clinical scores. We compared the sample sizes and evaluated the methods. In cases where the published mapping algorithm(s) were inadequate, the analysis was conducted as follows:

- Models were estimated based on joint-specific data where available (APEX knee data for WOMAC knees, APEX hip data for WOMAC hips). However, since KAT comprised the only dataset reporting SF-12 and EQ-5D, we estimated only one mapping algorithm for SF-12 and applied it to hips as well as knees.
- We initially combined data from all available time points in order to maximise sample size.
- In general, EQ-5D utility comprised the dependent variable; however GLM models predicted EQ-5D disutility (1-utility).
- Step 0 comprised estimation of an OLS model predicting EQ-5D as a function of:
    - WOMAC/SF-12 scores measured at the same time as the EQ-5D measurement (“score”)
    - age at the time of EQ-5D measurement (“score”)
    - sex
    - dummy for whether the measurement is pre-operative (“baseline”)
    - baseline*score interaction
    - baseline*age interaction
    - baseline*sex interaction
        - Unlike for post-operative utility, treatment was not considered as a variable for APEX since we were primarily interested in baseline data.
    - If ALL of the three interaction terms were statistically significant, we estimated models just on baseline data, excluding post-operative measurements
- Exploratory data analysis was then conducted on the relevant data set (either just baseline, or all available measurements).
- The “simple model” used in step 1 comprised all of the above variables if baseline and post-operative data are pooled, and will just comprise score, age and sex.
- Steps 1, 2 and 3 selected the functional form for the model, score and age/sex variables as usual.
- If baseline and post-operative data were pooled, Step 3b comprised dropping each of the interactions and the baseline dummy one at a time to assess whether this decreases MSE. After that, the model including all interactions that contribute to prediction accuracy was estimated to identify and drop any interaction terms or the baseline dummy that are not statistically significant.

For the results presented in *Chapter 7*, the mapping models from OHS and OKS onto EQ-5D were replaced by models estimated on PROMs/HES data.

Mapping OKS on to EQ-5D utility in TKA

We used the only published mapping study on OKS to predict EQ-5D utility, since it used a large UK sample and published the variance-covariance matrix.[117] We used the simple model mapping from total OKS to EQ-5D utility presented in the “Calculator for secondary data” worksheet of the supplementary material for this paper, available at http://www.herc.ox.ac.uk/downloads/downloads-supporting-material-1/mapping-analyses-to-estimate-eq-5d-utilities-and-responses-based-on-oxford-knee-score. A new mapping algorithm was developed as part of the work described in *Chapter 7*.

Mapping WOMAC onto EQ-5D utility in TKA

The APEX study was used to estimate the mapping model from WOMAC total score onto EQ-5D utility, since it was the only study containing both WOMAC and EQ-5D scores for TKA patients. We therefore did no external validation. The model selection procedure, measures of model performance (MSE) and 10-fold cross-validation are described, *see Chapter 5, Regression Analyses*.

APEX contained data on up to four measurements (at baseline, three months, six months and 12 months after the operation) for up to 339 patients undergoing TKA. We conducted a complete-case analysis using 978 observations with complete data on WOMAC, EQ-5D, age and sex, 270 of which were baseline observations.

We pooled all available observations, since step 0 found that not all interactions between baseline measurement and other variables were significant. No variables indicating treatment allocation were included in the mapping model, since there was no reason to expect treatment allocation to affect the relationship between WOMAC and EQ-5D at any given point in time: particularly since step 0 demonstrated that this relationship was not affected by whether or not patients had undergone arthroplasty.

The exploratory data analysis showed that the distribution of EQ-5D showed three peaks – two larger spikes at 1 and between 0.5 and 0.8, and a smaller peak around zero. Based on this graph, we decided to evaluate Tobit, two-part and OLS models. We plotted mean EQ-5D utility against WOMAC score and visually compared the fit of different functional forms for the trend. We decided to evaluate linear, quadratic and cubic trends for WOMAC score. Similarly, we plotted mean EQ-5D utility against age, and on the basis of the graph we decided to evaluate a linear age trend as well as 20-year age bands, i.e. grouping individuals aged below 60, aged 60 to 80, and 80 and above. Finally, we considered a full set of interaction terms between covariates and baseline measurement. However, these interaction terms were excluded from the model if they did not improve prediction accuracy (as measured by MSE).

The final model was chosen as a Tobit model with a lower limit at -0.594 and an upper limit of 1. The model was estimated on 978 observations from 289 patients, and it included a cubic trend for total WOMAC score, interaction terms between baseline measurement and WOMAC score as well as baseline measurement and sex (*Table 108*). Within 10-fold cross-validation, the MSE for this model was 0.0322368. The variance-covariance matrix is available at http://www.herc.ox.ac.uk/downloads/downloads-supporting-material-1/ACHE.

TABLE 108 Tobit regression model estimated to map from WOMAC to EQ-5D in TKA patients, censoring values at 1 and -0.594[b]

Variable	**Mean (SE)**
Total WOMAC	-0.018950 (0.003034)*
Total WOMAC-squared	0.000231 (0.000087)*
Total WOMAC-cubed	-0.000002 (0.000001)*
Baseline * WOMAC interaction (=WOMAC if the observation is pre-operative)	0.000781 (0.000489)
Baseline*female (=1 if female AND pre-operative)	0.053860 (0.027257)*
Constant term	1.111017 (0.030188)*
Sigma term for Tobit (σ)	0.203282 (0.007201)*

* p<0.05

[a] To calculate predicted EQ-5D utility for the Tobit model, it is necessary to first calculate the linear predictor (XB) by multiplying the values for the individual patient by the coefficients shown and summing over all coefficients. The predicted utility can then be calculated as

$$\widehat{eq5d} = -0.594 * \Phi\left(\frac{-0.594 - XB}{\sigma}\right) + 1 * \Phi\left(-\frac{1 - XB}{\sigma}\right)$$

$$+ \left(\Phi\left(\frac{1-XB}{\sigma}\right) - \Phi\left(\frac{-0.594-XB}{\sigma}\right)\right) * \left(Xb - \sigma * \frac{\phi\left(\frac{1-Xb}{\sigma}\right)-\phi\left(\frac{-0.594-Xb}{\sigma}\right)}{\Phi\left(\frac{1-Xb}{\sigma}\right)-\Phi\left(\frac{-0.594-Xb}{\sigma}\right)}\right).$$

Mapping baseline SF-12 onto EQ-5D utility in TKA

The KAT trial[108] was used to estimate this parameter since it was the only available dataset with both EQ-5D and SF-12. We therefore did no external validation. The model selection procedure, measures of model performance (MSE) and 10-fold cross-validation are described *see Chapter 5, Regression Analyses*.

KAT provided data on up to 14 measurements for 2217 patients, although many patients had fewer than 14 measurements due to administrative censoring, death, early withdrawal from the trial, not returning questionnaires or item non-response. We conducted a complete case analysis on 19,410 observations with complete data on both SF-12 and EQ-5D, of which 2055 were pre-operative measurements. Since step 0 found that not all interactions between baseline measurements and other variables were significant, baseline and post-operative data were pooled together.

Exploratory data analysis demonstrated that the distribution of EQ-5D utilities had three peaks at 1, between 0.5 and 0.8 and below 0.4. We therefore explored OLS, Tobit, two-part, three-part[117] and GLM models using either log or identity link and either Gaussian or gamma family. We plotted the mean EQ-5D utility at each SF-12 physical and mental score (rounded to the nearest whole number) and compared it against different fitted functions. The plots for baseline and post-operative scores appeared to be parallel, suggesting that it was reasonable to have one model covering both baseline and post-operative scores. On the basis of such graphs, we evaluated linear, quadratic and cubic functions for the relationship between EQ-5D utility and either SF-12 physical/mental scores or age at the time of EQ-5D measurement, rejected log-linear functions and did not identify any spline points. A full set of interactions between baseline and other variables were considered for inclusion in the final model, but dropped if they were not statistically significant, or if dropping them improved prediction accuracy.

A Tobit model estimated on 19,410 observations from 2201 individuals gave best predictions (*Table 109*). Within 10-fold cross validation, the MSE for this model was 0.0327. The variance-covariance matrix is available at http://www.herc.ox.ac.uk/downloads/downloads-supporting-material-1/ACHE.

TABLE 109 Tobit model mapping from SF-12 onto EQ-5D in TKA patients, censoring values at -0.594 and 1 (used for both knee and hip arthroplasty models)

Variable	**Mean coefficient (SE)**
SF-12 physical score	0.055248 (0.004927)*
SF-12 physical score squared	-0.001080 (0.000132)*
SF-12 physical score cubed	0.000011 (0.000001)*
SF-12 mental score	0.022604 (0.001651)*
SF-12 mental score squared	-0.000107 (0.000015)*
Physical*mental interaction	-0.000062 (0.000021)*
Age at the time of EQ-5D measurement	-0.063368 (0.017593)*
Age squared	0.001015 (0.000257)*
Age cubed	-0.000005 (0.000001)*
Male sex	-0.005060 (0.005944)
Dummy indicating whether this is a pre-operative measurement (1=baseline)	-0.223447 (0.008195)*
Interaction between male sex and baseline (=1 if Male AND pre-operative)	0.064526 (0.011750)*
Constant term	0.050268 (0.406268)
Sigma term for Tobit (σ)[a]	0.210880 (0.002038)*

* p<0.05

[a] To calculate predicted EQ-5D utility for the Tobit models, it is necessary to first calculate the linear predictor (XB) by multiplying the values for the individual patient by the coefficients shown and summing over all coefficients. The predicted utility can then be calculated as

$$\widehat{eq5d} = -0.594 * \Phi\left(\frac{-0.594 - XB}{\sigma}\right) + 1 * \Phi\left(-\frac{1 - XB}{\sigma}\right)$$

$$+ \left(\Phi\left(\frac{1-XB}{\sigma}\right) - \Phi\left(\frac{-0.594-XB}{\sigma}\right)\right) * (Xb - \sigma * \frac{\phi\left(\frac{1-Xb}{\sigma}\right) - \phi\left(\frac{-0.594-Xb}{\sigma}\right)}{\Phi\left(\frac{1-Xb}{\sigma}\right) - \Phi\left(\frac{-0.594-Xb}{\sigma}\right)}).$$

Although this model was estimated on patients before and after TKA, we applied the results of this mapping model to both knee and hip patients. Model performance has not been assessed in patients with hip arthritis due to a shortage of data, although it comprises the best available mapping algorithm for SF-12 and our preliminary analyses suggested that published algorithms estimated on general public samples[118, 159, 181] performed poorly in patients with arthritis.

Mapping OHS on to EQ-5D in THA

Of the three studies mapping from OHS to EQ-5D utility, one used a small sample[297] and another did not report a model mapping from total OHS.[306] We therefore used a study using a large sample of THA patients.[120] We used the "OLS continuous model" shown in Table 2 of the paper and obtained the exact coefficient values and variance-covariance matrix from the authors. A new mapping algorithm was developed as part of the work described in *Chapter 7*.

Mapping WOMAC onto EQ-5D in THA

The model was estimated based on data from the APEX trial. The only other dataset containing both WOMAC scores and EQ-5D utility for THA patients was EuroHip. However, EuroHip contained only data on 139 patients from the UK. Moreover, since the EuroHip study was considerably older than the APEX trial, we decided to not conduct external validation. The model selection procedure, measures of model performance (MSE) and 10-fold cross-validation are described, see *Chapter 5, Regression Analyses.*

APEX contained data on up to four measurements (at baseline, three months, six months and 12 months after the operation) for up to 343 patients undergoing THA. We conducted a complete-case analysis using 1,049 observations with complete data on WOMAC, EQ-5D, age and sex, 343 of which were baseline observations.

We pooled all available observations, since step 0 found that not all interactions between baseline measurement and other variables were significant.

The exploratory data analysis showed that the distribution of EQ-5D showed three peaks – two larger spikes at 1 and between 0.5 and 0.8, and a smaller peak around zero. Based on this graph, we decided to evaluate Tobit, two-part and OLS models. We plotted mean EQ-5D utility against WOMAC score and visually compared the fit of different functional forms for the trend. On this basis, we decided to evaluate linear, quadratic and cubic trends for WOMAC score. Similarly, we plotted mean EQ-5D utility against age, and on the basis of the graph we decided to evaluate a linear age trend as well as 20-year age bands, i.e. grouping individuals aged below 60, aged 60 to 80, and 80 and above. Finally, we considered a full set of interaction terms between covariates and baseline measurement. However, these interaction terms were excluded from the model if they did not improve prediction accuracy (as measured by MSE).

The final model was a linear regression model estimated on 1,067 observations from 318 patients, and it included a cubic trend for total WOMAC score as well as an interaction term between baseline measurement and WOMAC score (*Table 110*). Within 10-fold cross-validation, the MSE for this model was 0.0322093. The variance-covariance matrix is available at http://www.herc.ox.ac.uk/downloads/downloads-supporting-material-1/ACHE.

TABLE 110 OLS linear regression model mapping from WOMAC to EQ-5D in THA patients from APEX[a]

Variable	**Mean (SE)**
Current WOMAC	-0.011079 (0.001530)*
WOMAC squared	0.000048 (0.000053)
WOMAC cubed	-0.000001 (0.0)*
Baseline * WOMAC interaction (=WOMAC if the observation is pre-operative)	0.001963 (0.000624)*
Constant	0.958478 (0.010765)*

* p<0.05

[a] Predicted EQ-5D utility can be calculated for the linear model simply by multiplying the values for the individual patient by the coefficients shown and summing over all coefficients.

Mapping SF-12 onto EQ-5D in THA

In the absence of any hip dataset providing directly measured EQ-5D utility and SF-12 responses, the SF-12 hip model used the mapping model developed for TKA (*Table 109*).

Post-operative EQ-5D utility 3-12 months after arthroplasty

Analysis plan

- The primary analysis focused on EQ-5D utility six months after primary arthroplasty unless the only available dataset for the clinical tool in question measure post-operative quality of life at a different time point.

- This analysis excluded patients who died before six months, since they have no utility data.
- Since it is difficult to identify which PROMs respondents had revisions within 12 months of TJA and we have a shortage of data to assess how revision rates vary with clinical tool, we combined together patients who had a revision before 12 months and patients who have not been revised in this period.
- All models described in this section were re-estimated using the PROMs/HES extract as part of the analyses described in *Chapter 7* (*Online Supplement 15, post-operative EQ-5D utility six months after arthroplasty*).

Post-operative EQ-5D utility six months after TKA: OKS

Post-operative EQ-5D utility after TKA for OKS was estimated on 96,893 patient records from the NHS PROMs data. Based on the exploratory data analysis, we considered OLS models, two-part models and Tobit models censored from below at -0.594 and from above at 1. For OKS, we considered cubic trends, linear and quadratic splines with spline points at 10 and 35 as well as logarithmic OKS. Finally, since age was only available in 10-year age bands, we considered whether to drop age, gender or both from the final model. The final model was a Tobit model, censoring values at -0.594 and 1, which includes a cubic trend for OKS as well as agebands. Gender was dropped from the model. The results in the below table (see **TABLE 111**) were used in the analyses presented in *Chapter 5*. They were superseded by the results in *Online Supplement 15, Post-Operative EQ-5D Utility Six Months After Arthroplasty* in the analyses described in *Chapter 7*.

TABLE 111 Tobit model predicting EQ-5D utility six month after knee arthroplasty as a function of OKS

Variable	**Mean (SE)**
Age 50-59 years	0.059293 (0.022349)*
Age 60-69 years	0.128623 (0.022182)*
Age 70-79 years	0.142143 (0.022178)*
Age 80-89 years	0.134714 (0.022311)*
Age ≥90 years	0.139572 (0.127209)
Baseline OKS	0.045136 (0.001534)*
OKS Squared	-0.001252 (0.000080)*
OKS cubed	0.000015 (0.000001)*
Constant term	0.173052 (0.023767)*

Sigma term for Tobit (σ)[a]	0.300878 (0.000851)*

* p<0.05

[a] The Tobit model censored values at -0.594 and 1. To calculate predicted EQ-5D utility for the Tobit models, it is necessary to first calculate the linear predictor (XB) by multiplying the values for the individual patient by the coefficients shown and summing over all coefficients. The predicted utility can then be calculated as

$$\widehat{eq5d} = -0.594 * \Phi\left(\frac{-0.594 - XB}{\sigma}\right) + 1 * \Phi\left(-\frac{1 - XB}{\sigma}\right)$$

$$+\left(\Phi\left(\frac{1-XB}{\sigma}\right) - \Phi\left(\frac{-0.594-XB}{\sigma}\right)\right) * (Xb - \sigma * \frac{\phi\left(\frac{1-Xb}{\sigma}\right)-\phi\left(\frac{-0.594-Xb}{\sigma}\right)}{\Phi\left(\frac{1-Xb}{\sigma}\right)-\Phi\left(\frac{-0.594-Xb}{\sigma}\right)}).$$

Post-operative EQ-5D utility six months after TKA: WOMAC

Post-operative EQ-5D utility after TKA for WOMAC was estimated on 221 patient records from the APEX trial. Based on the exploratory data analysis, we considered OLS models, two-part models and Tobit models censored from below at -0.594 and from above at 1. For total WOMAC score, we considered linear, quadratic and cubic trends, a log-linear trend as well as a linear spline with spline points at scores of 20, 40, 60, and 80. For age, we considered a linear trend, binary indicators for patients under 50 and over 80 as well as excluding age from the model. We also considered whether to include indicators for sex of the patient and an indicator for the treatment arm of the trial. The final model was a linear regression model, which includes a linear trend for total WOMAC score and an indicator for patients in the treatment arm of the trial (*Table 112*). Sex and age were dropped from the model.

TABLE 112 Linear regression model predicting EQ-5D utility six month after knee arthroplasty as a function of total WOMAC score

Variable	**Mean (SE)**
WOMAC (On a scale where 0 is no problems and 100 is extreme problems)	-0.0061 (0.0009)*
Treatment allocation	-0.0379 (0.0307)
Constant term	1.1056 (0.0687)*

* p<0.05

Post-operative EQ-5D utility six months after TKA: SF-12

Post-operative EQ-5D was estimated using data from 1884 KAT participants, using utilities measured three months after knee arthroplasty. Based on the exploratory data analysis, we considered OLS models, two-part models and Tobit models and considered linear and quadratic functions for SF-12 physical and mental scores. The final model was a Tobit model, censoring values at -0.594 and 1 (*Table 113*).

TABLE 113 Tobit model predicting EQ-5D utility three months after knee arthroplasty as a function of SF-12

Variable	**Mean coefficient (SE)**
Age at the time of knee arthroplasty (years)	-0.134396 (0.046955)*
Age squared	0.002335 (0.000716)*
Age cubed	-0.000013 (0.000004)*
Baseline SF-12 physical score	0.032858 (0.005911)*
SF-12 physical squared	-0.000177 (0.000062)*
Baseline SF-12 mental score	0.014391 (0.002158)*
Physical*mental interaction	-0.000274 (0.000069)*
Constant term	1.908156 (1.024908)
Sigma term for Tobit (σ)†	0.254626 (0.004657)*

* $p<0.05$

† The Tobit model censored values at -0.594 and 1.

To calculate predicted EQ-5D utility for the Tobit models, it is necessary to first calculate the linear predictor (XB) by multiplying the values for the individual patient by the coefficients shown and summing over all coefficients. The predicted utility ($\hat{U}$) can then be calculated as

$$\widehat{eq5d} = -0.594 * \Phi\left(\frac{-0.594-XB}{\sigma}\right) + 1 * \Phi\left(-\frac{1-XB}{\sigma}\right)$$

$$+\left(\Phi\left(\frac{1-XB}{\sigma}\right) - \Phi\left(\frac{-0.594-XB}{\sigma}\right)\right) * (Xb - \sigma * \frac{\phi\left(\frac{1-Xb}{\sigma}\right)-\phi\left(\frac{-0.594-Xb}{\sigma}\right)}{\Phi\left(\frac{1-Xb}{\sigma}\right)-\Phi\left(\frac{-0.594-Xb}{\sigma}\right)}).$$

Post-operative EQ-5D utility six months after THA: OHS

This was estimated on 90,023 observations from the NHS PROMs data. Based on the exploratory data analysis, we considered OLS, Tobit and two-part models. We considered cubic trends, linear and quadratic splines with spline points at 10 and 35 as well as logarithmic functional forms for OHS. Finally, we considered whether to drop age, gender or both from the model. The final model was a two-part model with a logistic first stage and a logarithmic trend for OHS. Both age and gender were included. The results in the below tables (*Table 114* and *Table 115*) were used in the analyses presented in *Chapter 5*. They were superseded by the results in *Online Supplement 15, Post-operative EQ-5D utility six months after arthroplasty* in the analyses described in *Chapter 7*.

TABLE 114 Logistic model predicting the probability of EQ-5D utility of 1 six months after hip arthroplasty as a function of OHS

Variable	**Mean (SE)**
Age 50-59 years	-0.033353 (0.053898)
Age 60-69 years	0.030069 (0.051415)
Age 70-79 years	-0.252957 (0.051358)*
Age 80-89 years	-0.656784 (0.054533)*
Age ≥90 years	-1.126616 (0.423692)*
Female sex	-0.264657 (0.014390)*
Natural logarithm of OHS†	0.933211 (0.014859)*
Constant term	-2.663896 (0.066392)*

* p<0.05

† For patients with OHS of 0, we set ln(OHS) to 0.

TABLE 115 OLS model predicting EQ-5D utility for patients with values <1 six months after hip arthroplasty as a function of OHS

Variable	**Mean (SE)**
Age 50-59 years	-0.033353 (0.053898)
Age 60-69 years	0.030069 (0.051415)
Age 70-79 years	-0.252957 (0.051358)*
Age 80-89 years	-0.656784 (0.054533)*
Age ≥90 years	-1.126616 (0.423692)*
Female sex	-0.264657 (0.014390)*
Natural logarithm of OHS	0.933211 (0.014859)*
Constant term	-2.663896 (0.066392)*

* p<0.05

† For patients with OHS of 0, we set ln(OHS) to 0.

Post-operative EQ-5D utility six months after THA: WOMAC

Post-operative EQ-5D utility after TKA for WOMAC was estimated on 244 patient records from the APEX trial. Based on the exploratory data analysis, we considered OLS models, two-part models and Tobit models censored from below at -0.594 and from above at 1. For total WOMAC score, we considered linear, quadratic and cubic trends, a log-linear trend as well as a linear spline with spline points at scores of 20, 40, 60, and 80. For age, we considered a linear trend, binary indicators for patients under 50 and over 80 as well as excluding age from the model. We also considered whether to include indicators for sex of the patient and an indicator for the treatment arm of the trial. The final model was a linear regression model, which includes a linear trend for total WOMAC score and an indicator for patients in the treatment arm of the trial (*Table 116*). Sex and age were dropped from the model.

TABLE 116 Linear regression model predicting EQ-5D utility six month after hip arthroplasty as a function of total WOMAC score

Variable	**Mean (SE)**
WOMAC	-0.0041 (0.0008)*
Treatment dummy	-0.0468 (0.0291)
Constant term	1.1223 (0.0630)*

* $p<0.05$

Post-operative EQ-5D utility 12 months after THA: SF-12

This was estimated on 798 EPOS participants, using utilities measured 12 months after hip arthroplasty (the first available post-operative data). EQ-5D utility for each EPOS participant was mapped from SF-12 responses using a modified version of the algorithm by Gray et al;[159] subsequent regression analyses used the mapped utilities as the dependent variable.

Based on exploratory data analysis, we evaluated OLS models and GLM models predicting EQ-5D disutility (disutility =1-utility) with log or identity link and Gaussian or gamma family. We explored linear, quadratic and log-linear functions for SF-12 physical and mental scores, as well as linear, quadratic, cubic and linear spline functions for age. The final model comprised GLM with log-link and gamma family, predicting EQ-5D disutility (*Table 117*).

TABLE 117 GLM model predicting EQ-5D utility 12 months after hip arthroplasty as a function of SF-12

Variable	**Mean (SE)**
Age at the time of operation	0.170533 (0.080323)*
Age squared	-0.003299 (0.001388)*
Age cubed	0.000020 (0.000008)*
Natural log of baseline physical SF-12 score	-1.109035 (0.138579)*
Baseline mental SF-12 score	-0.030385 (0.002609)*
Constant term	1.130907 (1.612182)

* p<0.05

To calculate predicted EQ-5D utility for the GLM model, it is necessary to first calculate the linear predictor (XB) by multiplying the values for the individual patient by the coefficients shown and summing over all coefficients. The predicted utility ($\hat{U}$) can then be calculated as $\hat{U} = 1 - e^{XB}$.

Long-term annual change in EQ-5D utility beyond six months – Without surgery

As described in the text, we used Ara and Brazier's Model 1[121] to predict the rate at which EQ-5D utility decreases with age. The variance-covariance matrix was obtained from the authors. We used only the age (β1) and age-squared β2) coefficients from this model and calculated utility in year t as:

$$utility_t = utility_{t-1} + (\beta 1 \cdot age_t + \beta 2 \cdot age_t^2) - (\beta 1 \cdot age_{t-1} + \beta 2 \cdot age_{t-1}^2)$$

Long-term annual change in EQ-5D utility beyond six months after surgery

Methods

- Data were analysed in long format (one row per EQ-5D measurement per patient), omitting observations <6 months after primary arthroplasty.
- We included observations that were >12 months after a revision and observations that were made any time before the revision (including measurements <12 months before a revision) observations after revisions and observations before 6 months.
- A dummy variable indicating whether the observation is after a revision was included in all regression models.
- Both mixed models with random effects on patient ID and standard OLS or GLM with clustered standard errors were used to allow for repeated measures.
- These models predicted EQ-5D utility or disutility as a function of time since primary TKA, clinical score, age and sex.
- We included a variable indicating the time since primary arthroplasty and the coefficients on this variable were used to extrapolate the utility predicted at 6 months to a lifetime.
- An additional step was added into the estimation pathway after Step 1 in which we investigated alternative functional forms (e.g. polynomials) for time since primary surgery. We selected the functional form with lowest MSE for use in Step 2.
- In Step 3a, we considered different specifications of two different age variables: age at the time of primary arthroplasty and age at the time of EQ-5D measurement. All of the specifications identified in exploratory data analysis were tested with each of these age variables, in addition to an analysis dropping the age term. The specification with lowest MSE was used in Step 3b.
- A second additional step was added into the estimation pathway after Step 3b, in which we explored interactions between time since primary arthroplasty and other covariates. We included interactions in the final model only if they are statistically significant AND reduce MSE.
- Resulting coefficients were compared against estimates of age-related changes in EQ-5D from the literature. We also assessed whether the resulting model is more or less accurate for observations after revisions than for observations on patients who don’t have revisions.
- The same models were used in both *Chapter 5* and *Chapter 7.*

Long-term annual change in EQ-5D utility more than three months after TKA: OKS

We analysed 15,414 EQ-5D measurements from 2004 KAT participants in long format. Mixed models with random constant and fixed slopes (estimated using xtmixed) were compared against OLS models allowing for repeated measures using clustering. Linear and quadratic functions of time since primary arthroplasty were evaluated, as were linear, quadratic, cubic and log-linear functions for OKS. Linear, quadratic, cubic and linear spline functions were evaluated for both age at operation and age at time of EQ-5D measurement and compared against a model dropping age. The final model used OLS regression with clustering (*Table 118*).

TABLE 118 OLS model predicting change in EQ-5D utility >12 months after TKA as a function of OKS

Variable	**Mean (SE)†**
Natural log of OKS. Equals 0 if OKS = 0‡	*0.177637 (0.011105)**
Agenow: i.e. age in years at time of EQ-5D measurement (i.e. if the patient had TKA aged 70, in year 5 agenow = 75)	0.007168 (0.001541)*
Age70now: Equals agenow minus 70 if the patient is aged 70 years or over at the time of EQ-5D measurement	-0.008851 (0.002551)*
Years since TKA	-0.006154 (0.001417)*
Revised: Equals 1 if the patient has previously been revised‡	*-0.159778 (0.032394)**
Age*year interaction: Equals age70now multiplied by year	-0.000373 (0.000167)*
Constant term‡	*-0.237247 (0.103126)**

* $p<0.05$

† Standard errors were adjusted for clustering

‡ Coefficients shown in italics were not used in the model

The coefficients for age and time were used to predict how much lower (or higher) utility *t* years after primary arthroplasty is compared with utility at time t-1: both for patients who have undergone revision surgery, and those who have not been revised.

$$\begin{aligned} utility_t &= utility_{t-1} + (0.0072 agenow_t - 0.0089 age70now_t - 0.0062t - 0.00037 agenow_t \cdot t) \\ &- (0.0072 agenow_{t-1} - 0.0089 age70now_{t-1} - 0.0062(t-1) - 0.00037 agenow_{t-1} \cdot (t-1)) \end{aligned}$$

Long-term annual change in EQ-5D utility more than three months after TKA: WOMAC

In the absence of any datasets with pre-operative WOMAC and >12 months' follow-up, we estimated the relationship between pre-operative EQ-5D and the rate of change in EQ-5D using KAT. This was estimated on 15,468 observations on 2010 patients. We compared mixed models with random constant and fixed slopes (estimated using xtmixed) against OLS models allowing for repeated measures using clustering. Linear and quadratic functions were evaluated for time since primary arthroplasty were evaluated, while linear, quadratic, cubic and log-linear functions were evaluated for OKS. Linear, quadratic, cubic and linear spline functions for both age at operation and age at time of EQ-5D measurement and compared against a model dropping age. The final model used OLS regression with clustering (*Table 119*).

TABLE 119 OLS model predicting change in EQ-5D utility >12 months after TKA as a function of pre-operative EQ-5D utility

Variable	**Mean (SE)**
Pre-operative EQ-5D utility‡	*0.2156246 (0.0167463)**
Age at the current time	-0.0945247 (0.0345562)*
Age squared	0.0016453 (0.0005015)*
Age cubed	-0.0000090 (0.0000024)*
Male sex‡	*0.0249543 (0.0099297)**
Years since primary TKA	-0.0081117 (0.0009752)*
Dummy indicating whether the patient has previously had revision surgery‡	*-0.1546991 (0.0340697)**
Constant term‡	*2.2962380 (0.7889336)**

* p<0.05

† Standard errors were adjusted for clustering

‡ Coefficients shown in italics were not used in the model

The coefficients for age and time were used to predict how much lower (or higher) utility *t* years after primary arthroplasty is compared with utility at time t-1: both for patients who have undergone revision surgery, and those who have not been revised.

$$utility_t = utility_{t-1} + (-0.095age_t + 0.0016age_t^2 - 0.0000090age_t^3 - 0.0081t)$$
$$-(-0.095age_{t-1} + 0.0016age_{t-1}^2 - 0.0000090age_{t-1}^3 - 0.0081(t-1))$$

Long-term annual change in EQ-5D utility more than three months after TKA: SF-12

Data on 15,312 observations on 1982 patients in the KAT study[108] were used to predict how EQ-5D utility changes over time since TKA. We explored linear models with mixed effects (using a random constant and fixed slope) or clustering, and modelled time since primary knee arthroplasty using both linear and quadratic functions. We focused on linear functions for SF-12 score, but explored linear, quadratic, cubic and linear spline models for either age at the time of primary arthroplasty, or age at the time of EQ-5D measurement (*Table 120*).

TABLE 120 OLS model predicting annual change in EQ-5D utility over time and with age, estimated on KAT data

Variable	**Mean coefficient (SE)†**
Pre-operative SF-12 physical score‡	*0.007045 (0.000578)**
Pre-operative SF-12 mental score‡	*0.006750 (0.000447)**
Age at the time of EQ-5D measurement	-0.097470 (0.030789)*
Age squared	0.001688 (0.000454)*
Age cubed	-0.0000092 (0.0000022)*
Time since primary knee arthroplasty (years)	-0.008916 (0.000962)*
Dummy equal to 1 if the patient has had revision surgery before the EQ-5D measurement‡	*-0.149460 (0.032117)**
Constant term‡	*1.901595 (0.688863)**

* $p<0.05$

† Standard errors were adjusted for clustering

‡ Coefficients shown in italics were not used in the model

The coefficients for age and time were used to predict how much lower (or higher) utility *t* years after primary arthroplasty is compared with utility at time t-1: both for patients who have undergone revision surgery, and those who have not been revised.

$$utility_t = utility_{t-1} + (-0.097age_t + 0.0017age_t^2 - 0.0000092age_t^3 - 0.0089t)$$
$$-(-0.097age_{t-1} + 0.0017age_{t-1}^2 - 0.0000092age_{t-1}^3 - 0.0089(t-1))$$

Hip arthroplasty

"Long format" data on 3230 observations from 985 patients in the EPOS study were used to predict how EQ-5D utility changes over time since THA. EQ-5D for each EPOS participant was mapped from SF-12 responses using a modified version of the algorithm by Gray et al.[159] These models predicted EQ-5D utility or disutility as a function of time since primary THA, clinical score, age and sex. For THA, we explored a range of linear and GLM specifications with either mixed effects or clustering, and modelled time since hip arthroplasty as a linear variable and as the natural logarithm of time since joint replacement. After the functional form had been selected for the type of model, time since arthroplasty, clinical tool, age and sex, we explored interactions between time since joint replacement and the other variables. An OLS model with clustering gave the best predictions. However, this model found no evidence of any decrease or increase in utility with either age or time since primary hip arthroplasty. We therefore used the model developed by Ara and Brazier[121] to estimate the annual change in EQ-5D utility for patients with and without THA.

EQ-5D utility <12 months before or after revision

Methods

- The following methods were used for OKS and SF-12 in TKA using KAT data:
- These models were estimated after models for post-operative EQ-5D and long-term change in EQ-5D had been finalised.
- All revisions that occurred >1 year after primary arthroplasty were included, regardless of whether they were first, second or third revisions.
- Models were estimated on long-format data (one row per patient per year), excluding observations <1 year after primary arthroplasty.
- Patients who have died were by default excluded because they did not complete EQ-5D, although patients who died soon after revision were included in the analysis of utilities before revision.
- Separate models were estimated for EQ-5D before revision and EQ-5D after revision, although these two estimates were combined within the Markov model to estimate QALYs in the year of revision.
- EQ-5D up to 12 months *before* revision was estimated on patients who had a revision between 0 and 12 months after this EQ-5D measurement.
- EQ-5D up to 12 months *after* revision was estimated on patients who had a revision between 0 and 12 months before this EQ-5D measurement.
- Models allowed for repeated observations (i.e. patients with more than one revision) using clustered standard errors.
- We first went through Step 1 outlined in *Chapter 5, Regression Analyses* to select the appropriate functional form, using clinical tool score measured before primary arthroplasty, age, sex and time since primary arthroplasty as covariates.
- The sample of EQ-5D observations before or after revision was relatively small compared with the number of covariates. Step 1a therefore comprised estimation on the entire dataset of a model with the following explanatory variables: baseline score; age at the time of revision surgery; sex; and time elapsed between primary and revision surgery. Any variables that were not statistically significant at the 0.05 level were dropped from subsequent analyses.
- If pre-operative clinical tool score was not statistically significant in this analysis, we estimated models based on freely-available PROMs data as described below.

No available datasets provided data on both pre-operative WOMAC and utility before or after revision. Unless clinical tool score was non-significant in step 1a, we therefore estimated the following three models on KAT after conducting the above steps for OKS and SF-12, and chose the model with lowest MSE for use in the Markov model for WOMAC in TKA:

a) A model omitting all clinical tool variables. This model assumed that EQ-5D before (or after) revisions is *independent* of clinical tool scores measured before primary arthroplasty. If this model had lower MSE than models including OKS and/or SF-12, freely-available PROMs data were used to calculate utility before/after revision for OKS and/or SF-12 as well as WOMAC (see below).
b) A model using the utility that would be predicted at the time of the utility measurement taken before/after revision in place of the clinical tool. We used the final models for post-operative EQ-5D and long-term change in EQ-5D to predict each patient's EQ-5D at the time point when EQ-5D was measured before or after revision. This predicted value was used as an independent variable in the model predicting EQ-5D before (or after) revisions; predicted EQ-5D was entered in the model in the same functional form as was used for the clinical tool score. This model assumed that EQ-5D before (or after) revisions is predicted by what we would expect the EQ-5D utility to be at that time point based on the patient's pre-operative characteristics and the time since primary joint replacement. If this model had lowest MSE in step 3c, we used this model estimated on KAT to estimate how much lower EQ-5D was than predicted for WOMAC.
c) Unless either OKS or both of the SF-12 domain scores are dropped from their respective models (model a), we also went through the model selection process a third time, using observed baseline EQ-5D as the dependent variable. If the final model selected in this process has lower MSE than models (a) or (b), we assumed that EQ-5D before (or after) revisions is predicted by baseline EQ-5D in the WOMAC model.

We estimated simpler models using freely available PROMs data in the following three scenarios:

- THA;
- WOMAC, if model (a) was selected;
- OKS or SF-12 in TKA, if clinical tool was not statistically significant in step 1a.

In these situations, separate regression analyses were conducted on freely available PROMs data to predict utility before or after revision, using age dummies and sex as explanatory variables. The regression on EQ-5D utility before revision used baseline EQ-5D measurements as the dependent variable; the regression on EQ-5D after revision used six month EQ-5D as the dependent variable. Both analyses were done only on patients having revisions.

The models described in this section were re-estimated using PROMs/HES data as part of the analyses described in *Chapter 7* (see *Online Supplement 15, EQ-5D Utility Before Or After Revision Surgery).*

EQ-5D utility <12 months before knee revision

Two OLS models were estimated on all EQ-5D measurements in KAT that were <12 months before revision surgery to identify whether either pre-operative SF-12 or pre-operative OKS had any impact on utility before revision arthroplasty. In both models, gender was the only statistically significant variable.

We therefore used PROMs data and model (a) to estimate the utility before knee revision as a function of just age and gender in the analyses presented in *Chapter 5* and at the second user group meeting. Based on exploratory data analyses, we considered OLS, Tobit and two-part models. We also considered excluding age, gender or both from the model. The final model was estimated as a two-part model with age categories for individuals aged 60-69, 70-79 and 80 and above. The other age categories were collapsed due to small cell counts. Furthermore, gender was only included in the second-stage to improve model performance. The estimates are based on 4,559 observations. The results are shown in Table 121 below. These results were superseded by those in *Online Supplement 15, EQ-5D Utility Before Or After Revision Surgery* in the analyses presented in *Chapter 7*.

TABLE 121 Two-part model predicting utility before revision surgery

Variable	**Mean (SE)** Part 1: Logit model predicting the probability of being in perfect health	**Mean (SE)** Part 2: OLS model predicting utility for patients in less than perfect health
Age 60-69	-0.273536 (1.225649)	0.037863 (0.015266)*
Age 70-79	1.404703 (1.045518)	0.041215 (0.015240)*
Age ≥80	1.652067 (1.096941)	0.042653 (0.018564)*
Female	-	-0.053738 (0.009651)*
Constant term	-6.434547 (1.000802)*	0.312471 (0.014240)*

* p<0.05

EQ-5D utility <12 months after knee revision: OKS

Models were estimated on 86 revisions in 79 KAT participants[108] for which EQ-5D utility <12 months after revision surgery was available. Based on the EDA and the small sample size, we considered only OLS models and only considered linear functions for OKS and age.

Models allowed for repeated observations using clustered standard errors. The initial model (Step 1a) indicated that age and OKS were the only statistically significant predictors of utility after revisions. We therefore did not consider the time interval between primary TKA and revision or gender in subsequent models.

The results in the table below were used in the analyses presented in *Chapter 5*. They were superseded by the results in *Online Supplement 15, EQ-5D utility before or after revision surgery* in the analyses described in *Chapter 7*.

TABLE 122 OLS model predicting utility after knee revision surgery as a function of OKS

Variable	**Mean (SE†)**
Pre-operative OKS	0.011825 (0.005271)*
Age at the time of the EQ-5D measurement taken <12 months after revision	0.009646 (0.004115)*
Constant term	-0.436961 (0.289162)

* p<0.05

† Standard errors were adjusted for clustering

EQ-5D utility <12 months after knee revision: WOMAC

No available datasets collecting baseline WOMAC included >12 months' follow-up and analyses on KAT demonstrated that dropping either OKS or SF-12 from the model worsened predictions of utility after revisions. For both OKS and SF-12, we therefore estimated models predicting EQ-5D utility after revision surgery as a function of either pre-operative EQ-5D utility, or predicted EQ-5D utility likely to have arisen if the patient had not needed a revision. These models were estimated on data from the KAT trial[108] for the 86 revisions that had utility measurements <12 months afterwards; these revisions involved 79 different patients.

Pre-operative EQ-5D had no statistically significant effect on EQ-5D utility after revision in this small sample. However, a model including the predicted utility that patients would be expected to have if they hadn't required revision surgery gave better predictions than a model with no clinical tool variables or a model predicting utility as a function of pre-operative EQ-

5D. Predicted utility was estimated by first predicting each patient's utility six months after TKA as a function of pre-operative OKS using the Tobit model estimated on freely available PROMs data (see **TABLE 111**); we then adjusted this figure to allow for the time that had elapsed between six months after TKA and the time of the post-revision utility measurement using the OLS model shown in *Table 118*. This predicted utility was inserted directly into the model specification selected in the previous section: i.e. an OLS regression with clustering predicting EQ-5D utility after revision as a function of age and predicted utility (*Table 123*).

TABLE 123 OLS model predicting utility after knee revision surgery as a function of predicted EQ-5D utility

Variable	**Mean (SE†)**
EQ-5D utility that the model predicts at the end of the year in which revision occurred (see text for more details)	1.08357 (0.32783)*
Age in years at the end of the year in which revision occurs	0.00932 (0.00398)*
Constant term	-0.95426 (0.32883)*

* p<0.05

† Standard errors were adjusted for clustering

Within the model, the coefficients were used to predict utility after a revision in year t as a function of age in year t+1 and the utility accrued in the >1 year after primary TKA in the same year.

$$utility\mathrm{AfterRevision}_t = -0.95 + 1.08\mathrm{Utility} > 1\mathrm{yrAfterPrimaryTKA}_t + 0.0093(age_t + 1)$$

EQ-5D utility <12 months after knee revision: SF-12

We used data on 84 revisions in 77 KAT participants[108] to estimate models predicting EQ-5D utility <12 months after revision surgery. We considered only OLS models based on EDA and the small sample size and only considered linear functions for SF-12 and age. Models allowed for repeated observations using clustered standard errors. The initial model (Step 1a) indicated that age and SF-12 mental score were the only statistically significant predictors of utility after revisions. We therefore did not consider the time interval between primary TKA and revision or gender in subsequent models. Both SF-12 physical and mental scores were retained in the model in line with the analysis plan (*Table 124*).

TABLE 124 OLS model predicting EQ-5D <12 months after knee revision as a function of SF-12

Variable	**Mean coefficient (SE†)**
Baseline SF-12 physical score	0.0035 (0.0036)
Baseline SF-12 mental score	0.0070 (0.0031)*
Age at the time of the post-revision utility measurement (years)	0.0106 (0.0042)*
Constant term	-0.7336 (0.3328)*

* p<0.05

† Standard errors were adjusted for clustering

EQ-5D utility <12 months before hip revision

The only study that followed patients' utility for more than 12 months after primary hip arthroplasty (EPOS) provided only seven observations of utility before revision. In the analyses conducted before the second user group meeting, we therefore estimated utility after revision as a function of just age and sex, using PROMs data.

Based on exploratory data analyses, we considered OLS, Tobit and two-part models. We considered excluding age, gender or both from the model. All age categories above 80 were collapsed due to small cell counts. The final model was estimated as a two-part model including both age and gender on 7,163 observations. The results are shown in *Table 125* below.

TABLE 125 Two-part model predicting utility before revision surgery

Variable	**Mean (SE)** Part 1: Logit model predicting the probability of being in perfect health	**Mean (SE)** Part 2: OLS model predicting utility for patients in less than perfect health
Age 50-59 years	0.159629 (0.422338)	0.012363 (0.026949)
Age 60-69 years	0.155521 (0.399817)	0.044180 (0.025291)
Age 70-79 years	-0.457898 (0.404344)	0.035740 (0.025008)

Age ≥80	-1.108853 (0.464742)*	0.001334 (0.026033)
Female sex	-0.278001 (0.137824)*	-0.018640 (0.007977)*
Constant term	-3.093858 (0.393987)*	0.362187 (0.024769)*

* p<0.05

The results in the above table were used in the analyses presented in *Chapter 5*. They were superseded by the results in *Online Supplement 15, EQ-5D Utility Before Or After Revision Surgery* in the analyses described in *Chapter 7*.

EQ-5D utility <12 months after hip revision

Since the patients in the EPOS study were generally not followed up after revision surgery, we used PROMs data to estimate utility after revision as a function of just age and sex, in the analyses conducted before the second user group meeting.

Based on exploratory data analyses, we considered OLS, Tobit and two-part models. We considered excluding age, sex or both. All age categories above 80 were collapsed due to small cell counts. The final model was estimated as an OLS regression on both age and sex using 7,191 observations. Results are shown in Table 126.

TABLE 126 OLS model predicting utility after hip revision surgery

Variable	**Mean (SE)**
Age 50-59 years	0.045 (0.023)
Age 60-69 years	0.101 (0.022)*
Age 70-79 years	0.10 (0.022)*
Age ≥80	0.068 (0.023)*
Female sex	-0.018 (0.007)*
Constant term	0.591 (0.022)*

* p<0.05

The results in the above table were used in the analyses presented in *Chapter 5*. They were superseded by the results in *Online Supplement 15, EQ-5D utility before or after revision surgery* in the analyses described in *Chapter 7*.

Cost of the primary arthroplasty procedure and hospital stay

Methods

We used the Healthcare Resource Groups (HRG v4) from the National Tariff Payment system 2014/15 to assign costs for the primary operation. There are three relevant HRGs for each joint – HB12A, HB12B and HB12C for THA and HB21A, HB21B and HB21C for TKA. The exact HRG for a case depends on the patient's comorbidity and complications score. Since reliable and comparable data on patient's comorbidities and complications across datasets were missing, we derived a weighted average cost of the three relevant HRGs. We derived the frequency of each HRG from the reported activity in the National Schedule of Reference Costs 2013/14.[157] Then, we used these frequencies to derive the average costs of a THA/TKA procedure using the prices reported in the National Tariff 2014/15 (£5,977.98 for TKA and £5,563.24 for THA).[154] Next, we calculated the weighted average costs of excess bed days. While the price for an excess bed day does not differ across the three relevant HRGs, the trimpoint at which an additional bed day is considered excess does. Consequently, the costs of each potential excess bed day had to be adjusted for the probability that this day is considered "excess". Again, we used the reported frequencies of the relevant HRGs to calculate the probability that a particular day would be considered "excess", and then we multiplied the price for this excess bed day with the calculated probability. For example, a patient with a length of stay of 14 days would have five excess bed days under HB12C (without complications and comorbidities), but zero under HB12B and HB12A (minor and major complications, respectively). Since HB12C accounts for 70% of all recorded activity, we would assign a price of £165 (0.7*£235) to each of these five additional days. Finally, the total cost of the primary operation was derived as the sum of the base HRG (i.e. the weighted average across HRGs) plus the costs of the excess bed days (weighted by their probability of being above the trim point).

Changes in guidelines and waiting time targets resulted in considerable changes in the average length of stay for a joint replacement in the last decade. Consequently, data from studies (e.g. KAT and EPOS) conducted in the early 2000s do not accurately reflect current practice today. However, since KAT and EPOS are the only datasets containing the SF-12 instrument, we relied on these two datasets to estimate how the costs of the primary arthroplasty differ by pre-operative SF-12 scores. Applying the current national tariff to these older datasets would have resulted in a systematic overestimation of the costs, since the share of patients with excess bed days would be considerably higher than the share for more recent studies. We addressed this problem by adjusting the length-of-stay for primary TJA using data from the COASt study conducted in 2011. This adjustment mechanism relies on the assumption that while the distribution of length of stay has shifted, the ranking of patients has remained consistent over the past decade. For example, under this assumption a patient from the KAT trial with a median length of stay would be assumed to still be at the median under current practice, although the duration of the median length of stay has changed. Similarly, a patient with a length of stay at the 90th percentile would be assumed to still be at the 90th percentile under current practice. We took the length-of-stay data from COASt data (n=460 for knees and n=703 for hips). We then ranked patients in the KAT and EPOS datasets on their original length of stay and divided them into 460 and 703 groups of equal size, respectively. In a final step, we then applied the length-of-stay data from COASt to these groups, i.e. the group of patients with the shortest length of stay in KAT would be assigned the shortest length of stay in the COASt knee sample, the group with the second shortest stay would be assigned the second shortest observed stay etc. This “adjusted length-of-stay” variable closely resembles the distribution of length of stay in the COASt data while preserving the ranking of patients from the original data.

The dependent variable comprised the payment by results tariff. In the analyses conducted before the user group meeting, PbR tariffs were estimated based on patients’ length of stay (see above). For the post-user group analysis, we identified HRGs and calculated PbR tariffs directly by putting HES data through the grouper (see *Chapter 7, Methods For Manipulating And Analysing NHS Proms/HES Linked Data*).

This analysis included all patients who underwent arthroplasty, regardless of whether they died or were revised soon afterwards or even in the same hospital stay, since it was not possible to disaggregate the cost of the two procedures conducted in the same hospital episode. Including the cost of revisions conducted in the primary hospital stay as well as applying the cost of a separate hospital stay to all revisions may slightly overestimate total costs, although the effect of this on total costs is likely to be minimal and will be the same for all clinical tool scores in the preliminary analyses, where clinical tool scores do not affect revision rates.

Cost of primary TKA: OKS

The cost of primary TKA was estimated based on data from the COASt study. We considered OLS models, Tobit models censored from below at £5976.976 (the costs of the base HRG), gamma-GLM models using both a log-link and the canonical link function, Gaussian-GLM models with a log-link function,, and two-part models predicting the probability of no costs for excess bed days (i.e., the costs equal £5976.976, see above). For the two-part models, we used a logistic first-stage for all models, but considered OLS models, Gaussian-GLM models with a log-link function as well as gamma-GLM models with a canonical link function or a log-link function. We considered linear and cubic trends, linear splines with a spline point at 15 for OKS as well as excluding it from the model. For age, we considered linear trends, 20-year age bands, a simple binary indicator for patients over 80, a linear spline with a spline point at 80 as well as excluding age from the model. Finally, we considered whether to exclude sex from the model. The final model was estimated as a two-part model with a gamma-GLM second-stage using a log-link function. The model used linear trends for OKS and age and was estimated on 409 observations. The results are shown in *Table 127* below. The model shown below was superseded by a model estimated on PROMs/HES data in the analyses described in *Chapter 7* (see *Online Supplement 15, Cost of the primary arthroplasty procedure and hospital stay*).

TABLE 127 Two-part model with a gamma-GLM using a log-link function as a second-stage predicting the costs of primary TKA

Variable	**Mean (SE)** Part 1: Logit model predicting the probability of costs being £5,976.976	**Mean (SE)** Part 2: Gamma-GLM predicting the costs for patients with excess bed days
Age at operation	-0.0979 (0.0239)*	0.0108 (0.0052)*
Pre-op OKS	0.0482 (0.0229)*	0.0016 (0.0048)
Constant term	8.4123 (1.8354)*	8.0163 (0.3938)*

* p<0.05

Cost of primary TKA: WOMAC

The cost of primary TKA for WOMAC was estimated based on data from the APEX trial. We considered OLS models, Tobit models censored from below at £5976.976 (the costs of the base HRG), gamma-GLM models using both a log-link and the canonical link function, Gaussian-GLM models with a log-link function,, and two-part models predicting the probability of no costs for excess bed days (i.e., the costs equal £5976.976, see above). For the two-part models, we used a logistic first-stage for all models, but considered OLS models, Gaussian-GLM models with a log-link function as well as gamma-GLM models with a canonical link function or a log-link function. We considered linear, quadratic and cubic trends for WOMAC. For age, we considered linear, quadratic, and cubic trends, a simple binary indicator for patients over 75, a linear spline with a spline point at 75 as well as excluding age from the model. Finally, we considered whether to exclude sex as well as an indicator for the treatment arm of the trial from the model. The final model was estimated as a gamma-GLM model using a log-link function. The model used a cubic trend for WOMAC, an indicator for patients over 75 as well as an indicator for sex of the patient. The model was estimated on 272 patient records. The results are shown in Table 128 below.

TABLE 128 Gamma-GLM using a log-link function predicting the costs of primary TKA

Variable	**Mean (SE)**
Dummy indicating whether the patient is aged > 75	0.0247283 (0.0083560)*
Female sex	-0.0140192 (0.0079851)
Total baseline WOMAC score (On a scale where 0 = no problems and 100 = severe problems)	-0.0055054 (0.0042946)
WOMAC squared	0.0001249 (0.0000814)
WOMAC cubed	-0.0000008 (0.0000005)
Constant term	8.7634840 (0.0705678)*

* p<0.05

Cost of primary TKA: SF-12

This was estimated using data from KAT. We considered OLS models, Tobit models censored from below at £5,976.976 (the costs of the base HRG), gamma-GLM models using both a log-link and the canonical link function, Gaussian-GLM models with a log-link function, and two-part models predicting the probability of no costs for excess bed days (i.e., the costs equal £5,976.976, see above). For the two-part models, we used a logistic first-stage for all models, but considered OLS models, Gaussian-GLM models with a log-link function as well as gamma-GLM models with a canonical link function or a log-link function. We considered linear, quadratic, cubic as well as logarithmic trends for both SF-12 physical and mental. We considered the inclusion of a linear interaction term between both components. We considered linear, quadratic and cubic age trends as well as 10-year age bands and excluding age. Finally, we considered the impact of excluding sex.

The final model was estimated as a two-part model with a gamma-GLM with a log-link for the second-stage. The model included linear trends for SF-12 physical and mental health and was estimated on 2,104 observations (*Table 129*).

TABLE 129 Two-part model with a gamma-GLM using a log-link function as a second-stage predicting the costs of primary TKA

Variable	**Mean (SE)** Part 1: Logit model predicting the probability of costs equal to £5,976.976	**Mean (SE)** Part 2: Gamma-GLM with a log-link function predicting the costs for patients with excess bed days
SF-12 physical	0.0186 (0.0094)*	-0.00362 (0.00230)
SF-12 mental	0.0128 (0.0063)*	0.00033 (0.00162)
Constant term	1.0382 (0.4442)*	8.93166 (0.11132)*

* p<0.05

Cost of primary THA: OHS

This was estimated on 596 observations from the COASt study. We considered OLS models, Tobit models censored from below at £5,563.236 (the costs of the base HRG), gamma-GLM models using both a log-link and the canonical link function, Gaussian-GLM models with a log-link function, and two-part models predicting the probability of no costs for excess bed days (i.e., the costs equal £5,563.236, see above). For the two-part models, we used a logistic first-stage for all models, but considered OLS models, Gaussian-GLM models with a log-link function as well as gamma-GLM models with a canonical link function or a log-link function. We considered linear and cubic trends as well as a linear spline with a spline point at 10 for OHS. We also considered excluding OHS from the model. For age, we considered a linear trend, a linear spline with a spline point at 70, a simple binary indicator for patients aged over 70, 20-year age bands as well as excluding age. We also considered whether to exclude sex or not. The final model was estimated as a two-part model with a gamma-GLM using a log-link function for the second-stage. The model included a linear trend for OHS and an indicator for patients aged over 70. The results are shown in Table 130. The model shown below was superseded by a model estimated on PROMs/HES data in the analyses described in *Chapter 7* (see *Online Supplement 15, Cost Of The Primary Arthroplasty Procedure And Hospital Stay).*

TABLE 130 Two-part model with a gamma-GLM using a log-link function as a second-stage predicting the costs of primary THA

Variable	**Mean (SE)** Part 1: Logit model predicting the probability of costs equal to £5,563.236	**Mean (SE)** Part 2: Gamma-GLM with a log-link function predicting the costs for patients with excess bed days
Age ≥70 years	-0.9718 (0.3188)*	0.1540 (0.2105)
Pre-operative OHS	0.0728 (0.0199)*	-0.0214 (0.0125)
Constant term	1.6678 (0.4096)*	9.0683 (0.2710)*

* p<0.05

Cost of primary THA: WOMAC

The cost of primary THA for WOMAC was estimated based on data from the APEX trial. We considered OLS models, Tobit models censored from below at £5,563.236 (the costs of the base HRG), gamma-GLM models using both a log-link and the canonical link function, Gaussian-GLM models with a log-link function,, and two-part models predicting the probability of no costs for excess bed days (i.e., the costs equal £5,563.236, see above). For the two-part models, we used a logistic first-stage for all models, but considered OLS models, Gaussian-GLM models with a log-link function as well as gamma-GLM models with a canonical link function or a log-link function. We considered linear, quadratic and cubic trends for WOMAC. For age, we considered linear, quadratic, and cubic trends, a simple binary indicator for patients over 70, a linear spline with a spline point at 70 as well as excluding age from the model. Finally, we considered whether to exclude sex as well as an indicator for the treatment arm of the trial from the model. The final model was estimated as a gamma-GLM model using a log-link function. The model used a linear trend for WOMAC, a quadratic trend for age as well as an indicator for sex of the patient. The model was estimated on 288 patient records. The results are shown in *Table 131* below.

TABLE 131 Gamma-GLM using a log-link function predicting the costs of primary THA

Variable	**Mean (SE)**
Age at operation in years	-0.002864 (0.002576)
Age squared	0.000030 (0.000020)
Female sex	-0.012109 (0.007639)
Total baseline WOMAC score (On a scale where 0 = no problems and 100 = severe problems)	0.000228 (0.000211)
Constant term	8.682774 (0.083508)*

* $p<0.05$

Cost of primary THA: SF-12

This model was estimated on 993 observations from EPOS. We considered OLS models, Tobit models censored from below at £5,563.236 (the costs of the base HRG), gamma-GLM models using both a log-link and the canonical link function, Gaussian-GLM models with a log-link function, and two-part models predicting the probability of no costs for excess bed days (i.e., the costs equal £5,563.236, see above). For the two-part models, we used a logistic first-stage for all models, but considered OLS models, Gaussian-GLM models with a log-link function as well as gamma-GLM models with a canonical link function or a log-link function. For both SF-12 physical and mental, we considered linear, quadratic and cubic trends as well as logarithmic functional forms. We also considered linear interactions between both as well as an interaction term between logarithmic SF-12 physical and linear SF-12 mental. For age, we considered linear and quadratic trends, a linear spline with a spline point at age 70, a binary indicator for patients aged 70 and above as well as 10-year age bands. We also considered the impact of excluding age from the model. Finally, we considered whether to exclude gender. The final model was estimated as a two-part model with a gamma-GLM second-stage using a log-link function. We included linear trends for age and SF-12 physical, a quadratic trend for SF-12 mental as well as gender into the model. The results are shown in Table 132.

TABLE 132 Two-part model with a gamma-GLM using a log-link function as a second-stage predicting the costs of primary THA

Variable	**Mean (SE)** Part 1: Logit model predicting the probability of costs equal to £5,563.236	**Mean (SE)** Part 2: Gamma-GLM with a log-link function predicting the costs for patients with excess bed days
Age	-0.046829 (0.010804)*	0.000955 (0.005079)
SF-12 physical	0.037035 (0.018306)*	0.014077 (0.008004)
SF-12 mental	-0.193642 (0.083838)*	0.047761 (0.051961)
SF-12 mental squared	0.002253 (0.000904)*	-0.000529 (0.000571)
Female	0.038135 (0.221556)	-0.259654 (0.130432)*
Constant term	8.169817 (2.144950)*	7.542399 (1.224455)*

* $p<0.05$

Community, outpatient and readmission costs beyond the initial hospital stay for arthroplasty: Year 1

Methods

- Includes all readmissions and ambulatory consultations within 12 months of primary arthroplasty
- This will be estimated on all patients regardless of whether they have had a revision to their joint within 12 months of the primary surgery
- Patients who died will by default be excluded because they won't have returned resource use questionnaires

Costs Year 1 after primary knee arthroplasty: OKS

Costs in the first year after primary knee arthroplasty were estimated based on 1,841 patients in the KAT trial. We considered OLS models, Tobit models censored at zero, gamma-GLM models with log-link functions as well as two-part models with second-stage models using OLS, gamma-GLM with canonical link or a gamma-GLM with a log-link. We considered linear, quadratic and cubic trends for OKS, and linear, quadratic and cubic trends for age as well as 20-year age bands or omission of age controls. Finally, we considered whether to include sex into the model. The final model was estimated as a two-part model with a gamma-GLM with a log-link for the second stage. We included sex and a linear trend for baseline OKS into the model. The results in the below table (*Table 133*) were used in the analyses presented in *Chapter 5*. They were superseded by the results in *Online Supplement 15* in the analyses described in *Chapter 7*.

TABLE 133 Two-part model with a gamma-GLM using a log-link function for the second-stage predicting costs in year 1 after primary knee arthroplasty as a function of OKS

Variable	**Mean (SE):** Part 1: Logit model predicting the probability of zero costs	**Mean (SE):** Part 2: Gamma-GLM with log-link function predicting the costs for patient with non-zero costs
Female	0.138440 (0.188766)	-0.300281 (0.188127)
Pre-op OKS	0.026725 (0.012217)*	-0.036629 (0.011479)*
Constant term	-3.103224 (0.302614)*	7.726214 (0.276265)*

* p<0.05

Costs Year 1 after primary knee arthroplasty: WOMAC

Costs in the first year after primary knee arthroplasty were estimated based on 272 patients in the APEX trial. We considered OLS models, Tobit models censored at zero, gamma-GLM models with a log-link function or canonical link function, Gaussian-GLM models with a log-link function as well as two-part models with second-stage models using OLS, gamma-GLM with canonical link or a log-link as well as Gaussian-GLM models with a log-link function. We considered linear, quadratic and cubic trends for WOMAC, and linear, quadratic and cubic trends for age as well omission of age controls. Finally, we considered whether to include sex or an indicator for the treatment arm of the trial into the model. The final model was estimated as a two-part model with a gamma-GLM with a log-link for the second stage. We included a cubic trend for total WOMAC score as well as an indicator for the treatment arm into the model (*Table 134*).

TABLE 134 Two-part model predicting costs in year 1 after primary knee arthroplasty as a function of WOMAC

Variable	**Mean (SE):** Part 1: Logit model predicting the probability of zero costs	**Mean (SE):** Part 2: Gamma-GLM with log-link function predicting the costs for patient with non-zero costs
WOMAC score	-0.280526 (0.272874)	-0.057542 (0.116681)
WOMAC squared	0.006885 (0.005307)	0.001919 (0.002247)
WOMAC cubic	-0.000046 (0.000033)	-0.000015 (0.000014)
Treatment dummy	0.541328 (0.424427)	-0.468044 (0.229540)*
Constant term	-0.208930 (4.464382)	6.531847 (1.898884)*

* $p<0.05$

Costs Year 1 after primary knee arthroplasty: SF-12

This was estimated based on 1,817 patients in the KAT trial. For the functional form of the model, we considered OLS models, Tobit models censored at zero, gamma-GLM models with a log-link functions as well as two-part models with second-stage models using OLS, gamma-GLM with canonical link or a gamma-GLM with a log-link. We considered linear, quadratic and cubic trends for SF-12 physical as well as linear and quadratic splines with a spline point at 40. For SF-12 mental, we considered linear, quadratic and cubic trends. A linear interaction between SF-12 physical and mental was considered. For age, we estimated models using linear, quadratic and cubic age as well as 20-year age bands and models without age controls. We also considered whether to exclude gender from the model. The final model was estimated as an OLS model including linear trends for SF-12 physical and mental (*Table 135*).

TABLE 135 OLS model predicting costs in year 1 after primary knee arthroplasty as a function of SF-12

Variable	Mean (SE)
SF-12 physical	-18.77 (12.64)
SF-12 mental	-20.37 (9.01)*
Constant-term	2554.88 (636.27)*

* p<0.05

Costs Year 1 after primary hip arthroplasty: OHS

This model was estimated based on 542 patients from the COASt study. For the functional form of the model, we considered OLS models, Tobit models censored at zero, gamma-GLM models with a log-link functions as well as two-part models with second-stage models using OLS, gamma-GLM with canonical link or a gamma-GLM with a log-link. We considered linear, quadratic and cubic trends for OHS as well as a linear spline with a spline point at 25. For age, we considered linear and quadratic age trends, 20-year age bands as well as omitting age from the model. Finally, we considered whether to include sex into the model. The final model was estimated as an OLS model with a linear trend for baseline OHS. The results in the below table *(Table 136*) were used in the analyses presented in *Chapter 5*. They were superseded by the results in *Online Supplement 15* in the analyses described in *Chapter 7*.

TABLE 136 OLS model predicting costs in year 1 after primary hip arthroplasty as a function of OHS

Variable	Mean (SE)
Pre-operative OHS	-5.88 (5.25)
Constant term	320.63 (105.59)*

* p<0.05

Costs Year 1 after primary hip arthroplasty: WOMAC

Costs in the first year after primary knee arthroplasty were estimated based on 291 patients in the APEX trial. We considered OLS models, Tobit models censored at zero, gamma-GLM models with a log-link function or canonical link function, Gaussian-GLM models with a log-link function as well as two-part models with second-stage models using OLS, gamma-GLM with canonical link or a log-link as well as Gaussian-GLM models with a log-link function. We considered linear, quadratic and cubic trends for WOMAC, and linear, quadratic and cubic trends for age as well omission of age controls. Finally, we considered whether to include sex or an indicator for the treatment arm of the trial into the model. The final model was estimated as a two-part model with a gamma-GLM with a log-link for the second stage. We included a linear trend for total WOMAC score as well as an indicator for the treatment arm and an indicator for sex of the patient into the model (*Table 137*).

TABLE 137 Two-part model predicting costs in year 1 after primary knee arthroplasty as a function of WOMAC

Variable	**Mean (SE):** Part 1: Logit model predicting the probability of zero costs	**Mean (SE):** Part 2: Gamma-GLM with a log-link function predicting the costs for patients with non-zero costs
Female sex	0.819283 (0.495251)	0.548768 (0.286040)
WOMAC score	-0.024494 (0.013126)	-0.006326 (0.006562)
Treatment dummy	0.095587 (0.446545)	0.499724 (0.260435)
Constant term	-1.693265 (0.781776)*	6.004175 (0.404803)*

* $p<0.05$

Costs Year 1 after primary hip arthroplasty: SF-12

Since there was no dataset available containing both costs in year 1 after primary hip arthroplasty as well as SF-12, we estimated a model predicting costs in year 1 based on baseline EQ-5D. The model was estimated based on 651 patients in the COASt study. For the functional form of the model, we considered OLS models, Tobit models censored at zero, gamma-GLM models with a log-link functions as well as two-part models with second-stage models using OLS, gamma-GLM with canonical link or a gamma-GLM with a log-link. We considered linear, quadratic and cubic trends for EQ-5D as well as omitting EQ-5D from the model. We considered linear and quadratic age trends, 20-year age bands as well as omitting age from the model. Finally, we considered whether to include sex into the model. The final model was estimated as a two-part model using an OLS second-stage. We included no covariates, i.e. costs in year 1 were predicted based on a constant term (*Table 138*).

TABLE 138 Two-part model with an OLS second-stage predicting costs in year 1 after primary hip arthroplasty for the SF-12 Markov model

Variable	**Mean (SE)**	
	Logistic regression predicting whether patients have perfect health	**OLS predicting utility for patients without perfect health**
Constant term	0.52 (0.08)*	601.49 (109.67)*

* p<0.05

Community, outpatient and readmission costs beyond the initial hospital stay for arthroplasty: Year 2 onwards

Methods for TKA

- This will include readmissions and ambulatory consultations
- This will be estimated on long-format data (one row per patient per year), excluding data on the first year after joint replacement
- This will be estimated on patients who have not yet had a revision and don't have revision surgery in the year in question
- Patients who died will by default be excluded because they won't have returned resource use questionnaires
- Indicators of time since primary surgery will be included if they are statistically significant and improve MSE

Costs >1 year after primary knee arthroplasty: OKS

The model was estimated based on 13,271 observations from the KAT trial. For the functional form of the model we considered OLS models, gamma-GLMs with log-link function, linear mixed models (or multilevel models) as well as two-part models with an OLS or gamma-GLM with log-link-function for the second-stage. We considered linear, quadratic and cubic trends for OKS. We considered whether to include current age or age at primary operation and time since primary operation. Then, we considered linear, quadratic and cubic functional forms as well as omitting the variable for both age at operation and time since primary operation. Finally, we considered whether to include sex into the model. The final model was estimated as a two-part model with an OLS second-stage. We included linear trends for age at primary operation and years since primary operation as well as a cubic trend for baseline OKS. We clustered standard errors on the patient-level. The results in the below table (*Table 139*) were used in the analyses presented in *Chapter 5*. They were superseded by the results in *Online Supplement 15* in the analyses described in *Chapter 7*.

TABLE 139 Two-part model predicting costs in year 2 onwards after primary knee arthroplasty based on OKS

Variable	**Mean (SE):** Part 1: Logit model predicting the probability of zero costs	**Mean (SE):** Part 2: OLS model predicting the costs for patients with non-zero costs
Age at operation	0.029725 (0.004888)*	-1.976697 (2.980840)
Pre-operative OKS	0.125865 (0.059970)*	-63.044690 (41.991040)
Squared OKS	-0.005089 (0.003353)	3.401745 (2.100949)
Cubic OKS	0.000075 (0.000057)	-0.053517 (0.030774)
Years since primary arthroplasty operation	0.175079 (0.010551)*	-2.555611 (11.315120)
Constant term	-2.483726 (0.441981)*	738.25150 (364.8210)*

* $p<0.05$

Costs >1 year after primary knee arthroplasty: WOMAC

Since there was no dataset available containing both costs from year 2 onwards as well as WOMAC, we estimated a model predicting costs from year 2 onwards based on EQ-5D. This model was estimated using 13,303 observations from the KAT trial. For the functional form of the model, we considered OLS models, gamma-GLMs with log-link function, linear mixed models (or multilevel models) as well as two-part models with an OLS or gamma-GLM with log-link function for the second-stage. We considered linear, quadratic and cubic trends for EQ-5D as well as whether to exclude EQ-5D from the model. We considered whether to include current age or age at primary operation and time since primary operation. Then, we considered linear, quadratic and cubic functional forms as well as omitting the variable for both age at operation and time since primary operation. Finally, we considered whether to include sex into the model. The final model was estimated as a two-part model with an OLS second-stage and included linear trends for age at primary operation and years since primary operation as well as a cubic trend for baseline EQ-5D (*Table 140*). All standard errors were clustered at the patient-level.

TABLE 140 Two-part model predicting costs in year 2 onwards after primary knee arthroplasty based on EQ-5D

Variable	**Mean (SE)** Part 1: Logit model predicting the probability of zero costs	**Mean (SE)** Part 2: OLS model predicting the costs for patients with non-zero costs
Age at operation	0.028 (0.005)*	-1.870 (2.812)
Baseline EQ-5D	1.992 (0.488)*	-374.275 (332.272)
EQ-5D squared	-5.579 (1.547)*	1420.198 (911.096)
EQ-5D cubic	4.977 (1.686)*	-1129.015 (1174.478)
Years since primary arthroplasty operation	0.177 (0.011)*	-9.052 (10.162)
Constant term	-1.539 (0.336)*	416.834 (218.726)

* $p<0.05$

Costs >1 year after primary knee arthroplasty: SF-12

This was estimated using 13,187 observations from the KAT trial. For the functional form of the model, we considered OLS models, gamma-GLMs with log-link function, linear mixed models (or multilevel models) as well as two-part models with an OLS or gamma-GLM with log-link function for the second-stage. We considered linear, quadratic as well as cubic trends for SF-12 physical and mental. In addition, we considered whether to include a linear interaction term between both components. We considered whether to include current age or age at primary operation and time since primary operation. Then, we considered linear, quadratic and cubic functional forms as well as omitting the variable for both age at operation and time since primary operation. Finally, we considered whether to include sex into the model. The final model was estimated as a two-part model with a gamma-GLM and a log-link function for the second-stage. We included quadratic trends for age at primary operation and years since primary operation as well as a cubic trend for SF-12 physical, a linear trend for SF-12 mental and a linear interaction term between SF-12 physical and mental. The model also controlled for sex (*Table 141*). Standard errors were clustered at the patient level.

TABLE 141 Two-part model predicting costs in year 2 onwards after primary knee arthroplasty based on SF-12

Variable	**Mean (SE)** Part 1: Logit model predicting the probability of zero costs	**Mean (SE)** Part 2: Gamma-GLM with a log-link function predicting the costs for patients with non-zero costs
Age at operation	0.101449 (0.048256)*	0.077429 (0.072859)
Age squared	-0.000555 (0.000360)	-0.000617 (0.000540)
Female	0.089250 (0.077670)	-0.278921 (0.155024)
SF-12 physical	0.062390 (0.087104)	-0.368058 (0.183006)*
SF-12 physical squared	-0.001490 (0.002509)	0.005664 (0.004613)
Cubic SF-12 physical	0.000015 (0.000024)	-0.000038 (0.000044)
SF-12 mental	0.021125 (0.013249)	-0.081486 (0.039303)*
SF-12 Interaction	-0.000051 (0.000422)	0.002348 (0.001303)
Years since primary TKA	0.453551 (0.042738)*	0.047273 (0.171111)
Years squared	-0.024156 (0.003562)*	-0.004041 (0.015524)
Constant term	-6.346083 (1.948817)*	10.653810 (3.537165)*

* $p<0.05$

Costs >1 year after primary hip arthroplasty

The cost of consultations in years 2 to 10 after THA were based on the values presented in Appendices 40 and 41 of Pinedo Villanueva 2013.[114]. The analyses conducted for COASt included the cost of medication; we therefore took the mean cost of different types of ambulatory consultations from Pinedo Villanueva 2013 (Appendices 40, 41, 46 and 49).[114] These tables provide the absolute difference in the cost of different community/outpatient consultations between men and women of different ages who have had arthroplasty and have either good or poor outcomes, relative to matched controls without arthritis. When applying these we used the published model mapping from total OHS to EQ-5D[120] in reverse, to identify a cut-off on the EQ-5D scale that indicates good or poor outcomes. The mapping model suggested that an OHS of 33 would equal a utility of 0.6624. Using this method, we therefore counted any hypothetical individuals having EQ-5D <0.6624 (i.e. OHS <33) as having poor outcomes. In line with the assumption made in the original thesis,[114] patients are generally assigned the community cost for good outcomes if their EQ-5D utility at the start of that particular year was ≥0.6624. In PSA, the costs of each type of consultation were varied independently for each patient subgroup, with no allowance for correlations between different types of consultation. The parameters used in the mapping algorithm (and therefore the cut-off value) were also varied in PSA. Although this constitutes an arbitrary cut-off between good and poor outcomes, this distinction only affects community costs and is the only way to make use of this secondary data, which comprises the best available. These figures were superseded by those shown in *Online Supplement 15* in the analyses described in *Chapter 7*.

Cost of revision arthroplasty procedure and hospital stay

Methods used for TKA

- The cost of the admission in which revision surgery takes place was estimated separately from other costs in order to separate between one and two stage revisions and so that we could apply the entire cost of surgery to patients who died.
- Although we assessed whether costs vary with time since primary surgery, this analysis included all revisions no matter how soon they occurred after the patient was discharged from hospital following primary arthroplasty. However, revisions that occurred within the same hospital stay as primary arthroplasty were excluded as they were counted in the cost of primary arthroplasty.
- The dependent variable will comprise the payment by results tariff for the admission in which revision surgery occurs. For two-stage revisions done in two separate admissions, we added together the cost of both admissions. PbR tariffs were estimated based on patients' length of stay.
- Step 1a comprised estimation on the entire dataset of a model with the following explanatory variables: baseline score; age at the time of revision surgery; sex; time elapsed between primary and revision surgery. Any variables that were not statistically significant at the 0.05 level were dropped from subsequent analyses since the available sample (~84) is relatively small for a model with six covariates.
- If no covariates were statistically significant and/or dropping all covariates improved MSE, this collapsed to estimation of sample means.

Cost of knee revision surgery: OKS

The model was estimated based on 127 observations from the KAT trial. During the model selection process, we considered OLS models as well as gamma-GLM models with a log-link function. We considered linear, quadratic as well as cubic trends for OKS. Then, we considered whether to include age at primary operation and years since primary operation or current age (in the year of revision). For both age and years since primary arthroplasty we considered linear, quadratic and cubic functional forms as well as omitting the variable from the model. Finally, we considered whether to include sex into the model. The final model was estimated as a gamma-GLM with a log-link function. We included a linear trend for baseline OKS as well as a cubic trend for years since primary arthroplasty (*Table 142*). Standard errors were clustered at the patient level. The results in the below table were used in the analyses presented in *Chapter 5*. They were superseded by the results in *Online Supplement 15, Cost of revision arthroplasty procedure and hospital stay* in the analyses described in *Chapter 7*.

TABLE 142 Gamma-GLM with log-link function predicting costs of knee revision surgery based on OKS

Variable	**Mean (SE)**
Pre-operative OKS	-0.0051 (0.0107)
years since primary	0.1157 (0.2925)
years squared	-0.0577 (0.0575)
years cubed	0.0042 (0.0032)
Constant term	9.9465 (0.3972)*

* p<0.05

Cost of knee revision surgery: WOMAC

Since there was no dataset available containing data on revision surgery and WOMAC, we estimated a model predicting the costs of knee revision surgery based on baseline EQ-5D. This model was estimated using 126 observations from the KAT trial. For the functional form of the model, we considered OLS models as well as gamma-GLM models with a log-link function. We considered linear, quadratic and cubic trends for EQ-5D as well as omitting EQ-5D from the model. Then, we considered whether to include age at primary operation and years since primary operation or current age (in the year of revision). For both age and years since primary arthroplasty we considered linear, quadratic and cubic functional forms as well as omitting the variable from the model. Finally, we considered whether to include sex into the model. The final model was estimated as a gamma-GLM with a log-link function. We included a linear trend for baseline EQ-5D as well as a linear trend for years since primary arthroplasty (*Table 143*). All standard errors were clustered at the patient-level.

TABLE 143 Gamma-GLM with log-link function predicting costs of knee revision surgery based on EQ-5D

Variable	**Mean (SE)**
EQ-5D	-0.298 (0.292)
Years since primary	-0.049 (0.037)
Constant term	10.009 (0.20)*

* p<0.05

Cost of knee revision surgery: SF-12

This model was estimated using 122 observations from the KAT trial. For the functional form of the model, we considered OLS models as well as gamma-GLM models with a log-link function. We considered linear, quadratic as well as cubic trends for both SF-12 physical and mental. In addition, we considered whether including a linear interaction term between both SF-12 components would improve model performance. Then, we considered whether to include age at primary operation and years since primary operation or current age (in the year of revision). For current age we considered linear, quadratic and cubic functional forms as well as omitting the variable from the model. Finally, we considered whether to include sex into the model. The final model was estimated as a gamma-GLM model with a log-link function. We included linear trends for baseline SF-12 physical and SF-12 mental (*Table 144*). All standard errors were clustered at the patient-level.

TABLE 144 Gamma-GLM with log-link function predicting costs of knee revision surgery based on SF-12

Variable	Mean (SE)
SF-12 physical	-0.0014 (0.0099)
SF-12 mental	-0.0158 (0.0070)*
Constant term	10.4872 (0.4953)*

* p<0.05

Cost of hip revision surgery

The cost of hospital admissions for revision surgery were obtained from Table 44 of the COASt monograph.[151] Values were inflated from 2011-12 values up to 2013-14 values using HCHS pay and prices index.[152] Since the costs for men and women in different ages were estimated in independent samples, they were assumed to be uncorrelated and are assumed to follow a gamma distribution. These costs were superseded by the results in *Online Supplement 15, Cost Of Revision Arthroplasty Procedure And Hospital Stay* in the analyses described in *Chapter 7*.

Community, outpatient and readmission costs during the year of revision: analyses presented in Chapter 5

Methods for TKA

Revision arthroplasty: Costs in the year of revision surgery that was performed

- This was estimated on all patients who had a revision in the year leading up to the relevant resource use questionnaire (regardless of how many revisions they have in that year, how many previous revisions they have had or how long ago the revision occurred).
- This was estimated on long-format data (one row per patient per year), with clustering.
- Patients who died were by default be excluded because they did not return resource use questionnaires.
- The dependent variable excluded the cost of revision surgery and primary arthroplasty (if the revision occurred within 12 months of primary arthroplasty but included outpatient care and other readmissions.
- We included indicators of time since primary surgery in steps 1-3. At the end of step 3, we removed time since primary surgery from the final model if it was not statistically significant, or if omitting it reduces MSE. If time since primary surgery was retained in the model, we then assessed whether adding in polynomials or interactions for this term reduces MSE; interactions were only be included if they were statistically significant.

Costs in the year of knee revision surgery: OKS (analyses presented in Chapter 5)

The model was estimated based on 88 observations from the KAT trial. For the functional form of the model, we considered OLS models as well as gamma-GLM models with a log-link function. We considered linear, quadratic as well as cubic trends for OKS. Then, we considered whether to include age at primary operation and years since primary operation or current age (in the year of revision). For age we considered linear, quadratic and cubic functional forms as well as omitting age from the model. For years since primary arthroplasty, we considered linear, quadratic and cubic trends as well as a linear spline with a spline point at 5. We also considered whether to exclude the variable from the model. Finally, we considered whether to include sex into the model. The final model was estimated as an OLS model including a linear trend for baseline OKS, a quadratic trend for years since primary arthroplasty as well as a dummy for female patients. All standard errors were clustered at the patient-level. The results in the below table (*Table 145*) were used in the analyses presented in *Chapter 5*. They were superseded by the results in *Online Supplement 15* in the analyses described in *Chapter 7*.

TABLE 145 OLS model with clustered standard errors predicting costs in the year of revision surgery (excluding the cost of revision arthroplasty) based on OKS

Variable	**Mean (SE)**
Female	-1149.35 (1082.38)
Pre-operative OKS	-4.14 (51.25)
Years since primary	-2165.57 (1062.49)*
Years since primary squared	158.29 (80.30)
Constant term	7832.70 (2791.29)*

* p<0.05

Costs in the year of knee revision surgery: WOMAC

Since there was no dataset available containing data on revisions as well as WOMAC scores, we estimated a model predicting the costs in the year of revision arthroplasty based on EQ-5D. This model was estimated based on 92 observations from the KAT trial. For the functional form of the model, we considered OLS models, gamma-GLM models with a log-link function as well as two-part models with an OLS or gamma-GLM with log-link function second-stage. We considered linear, quadratic and cubic trends as well as a linear spline with a spline point at zero for EQ-5D. We also considered whether excluding EQ-5D from the model would improve model performance. Then, we considered whether to include age at primary operation and years since primary operation or current age (in the year of revision). For current age we considered linear, quadratic and cubic functional forms as well as omitting age from the model. Finally, we considered whether to include sex into the model. The final model was estimated as an OLS model including a linear trend for current age (*Table 146*). Standard errors were clustered at the patient-level.

TABLE 146 OLS model with clustered standard errors predicting costs in the year of revision surgery (excluding the cost of revision arthroplasty) for the WOMAC model

Variable	Mean (SE)
Current age	-103.89 (50.75)*
Constant term	9611.20 (3803.92)*

* p<0.05

Costs in the year of knee revision surgery: SF-12

This model was estimated using 88 observations from the KAT trial. For the functional form of the model, we considered OLS models as well as gamma-GLM models with a log-link function. We considered linear, quadratic and cubic trends for both SF-12 physical and SF-12 mental as well as including a linear interaction term between both SF-12 components. Then, we considered whether to include age at primary operation and years since primary operation or current age (in the year of revision). For age at primary operation we considered linear, quadratic and cubic functional forms as well as omitting age from the model. For years since primary arthroplasty we considered linear, quadratic and cubic trends as well as a linear spline with a spline point at 5. Finally, we considered whether to include sex into the model. The final model was estimated as an OLS model including a linear trend for age at primary operation, a quadratic trend for years since primary operation as well as linear trends for baseline SF-12 physical and SF-12 mental (*Table 147*). Standard errors were clustered at the patient-level.

TABLE 147 OLS model with clustered standard errors predicting costs in the year of revision surgery (excluding the cost of revision arthroplasty) based on SF-12

Variable	Mean (SE)
Age at operation	-56.81 (53.97)
SF-12 physical	-3.10 (36.84)
SF-12 mental	-62.56 (32.51)
Year since primary TKA	-1949.64 (956.38)*
Year squared	139.74 (71.84)
Constant term	13918.04 (4202.22)*

* p<0.05

Costs in the year of hip revision surgery

For *Chapter 5*, the cost of consultations in the year of hip revision surgery were based on the values presented by Pinedo Villanueva 2013,[114] using the methods described in *Online Supplement 12, Costs >1 year after primary hip arthroplasty*. However, for community costs in the year of revision surgery, patients were assigned costs for good (or poor) outcomes based on their utility after the revision (again, in line with the assumption made in the original thesis). These figures were superseded by the results in *Online Supplement 15* in the analyses described in *Chapter 7*.

Community, outpatient and readmission costs >1 year after revision

Methods for TKA

- This was estimated on long-format data (one row per patient per year).
- This was estimated on patients who have had at least one revision and did not have revision surgery in the year in question.
- No distinction was made between one and two-stage revisions, how many revisions the patient has had or how long has elapsed since the last revision due to the Markovian assumption implicit within the model.
- Patients who died were excluded.
- Step 1a comprised estimation on the entire dataset of a model with the following explanatory variables: baseline score; age at the time of costing questionnaire; sex. Any variables that were not statistically significant at the 0.05 level were dropped from subsequent analyses since the available sample (~84) is relatively small for a model with six covariates.

Costs >1 year after knee revision surgery: OKS

This model was estimated using 329 observations from the KAT trial. For the functional form of the model, we considered OLS models, linear mixed models, gamma-GLM models with a log-link function as well as two-part models with an OLS or gamma-GLM with log-link function for the second-stage. We considered linear, quadratic and cubic trends for OKS. Then, we considered whether to include current age or age at primary operation and years since primary operation. For both age at primary operation and years since primary operation we considered linear, quadratic and cubic trends as well as excluding the variables from the model. Finally, we considered whether to include sex into the model. The final model was estimated as a two-part model with a gamma-GLM with log-link function for the second-stage. The model included a linear trend for age at primary arthroplasty and a cubic trend for baseline OKS. Standard errors were clustered at the patient-level. The results in the below table (*Table 148*) were used in the analyses presented in *Chapter 5*. They were superseded by the results in *Online Supplement 15* in the analyses described in *Chapter 7*.

TABLE 148 Two-part model predicting the costs from year 2 onwards after knee revision surgery based on OKS

Variable	**Mean (SE)** Part 1: Logit model predicting the probability of zero costs	**Mean (SE)** Part 2: Gamma-GLM with a log-link function predicting the costs for patients with non-zero costs
Age at operation	-0.017083 (0.020055)	0.009360 (0.022027)
Pre-operative OKS	0.024672 (0.250819)	-0.183504 (0.146119)
Pre-operative OKS squared	0.001333 (0.011461)	0.012512 (0.008120)
Cubic OKS	-0.000011 (0.000153)	-0.000224 (0.000122)
Constant term	0.398229 (2.005773)	6.139289 (1.538455)*

* $p<0.05$

Costs >1 year after knee revision surgery: WOMAC

Since there was no dataset available containing both data on revisions and WOMAC scores, we estimated a model predicting the costs from year 2 onwards after knee revision surgery based on EQ-5D. The model was estimated using 340 observations from the KAT trial. For the functional form of the model, we considered OLS models, linear mixed models, gamma-GLM models with a log-link function as well as two-part models with an OLS or gamma-GLM with log-link function for the second-stage. We considered linear, quadratic and cubic trends for baseline EQ-5D as well as omitting the variable from the model. Then, we considered whether to include current age or age at primary operation and years since primary operation. For current age, we considered linear, quadratic and cubic trends as well as omitting age from the model. Finally, we considered whether to include sex into the model. The final model was estimated as an OLS model including only a constant term (*Table 149*). Standard errors were clustered on the patient-level.

TABLE 149 OLS model with clustered standard errors predicting the costs from year 2 onwards after knee revision surgery for the WOMAC Markov model

Variable	Mean (SE)
Constant term	226.14 (53.97)*

* $p<0.05$

Costs >1 year after knee revision surgery: SF-12

This model was estimated using 326 observations from the KAT trial. For the functional form of the model, we considered OLS models, linear mixed models, gamma-GLM models with a log-link function as well as two-part models with an OLS or gamma-GLM with log-link function for the second-stage. We considered linear, quadratic and cubic trends for both SF-12 physical and mental. In addition, we considered whether to include a linear interaction term between both SF-12 components. Then, we considered whether to include current age or age at primary operation and years since primary operation. For both age at primary arthroplasty and years since primary arthroplasty we considered linear, quadratic and cubic trends as well as omitting the variable from the model. Finally, we considered whether to include sex into the model. The final model was estimated as a two-part model using a gamma-GLM with log-link function for the second-stage. The model included a linear trend for age at primary operation, a quadratic trend for SF-12 physical as well as a linear trend for SF-12 mental (*Table 150*). Standard errors were clustered at the patient-level.

TABLE 150 Two-part model predicting the costs from year 2 onwards after knee revision surgery based on SF-12

Variable	**Mean (SE)** Part 1: Logit model predicting the probability of zero costs	**Mean (SE)** Part 2: Gamma-GLM with a log-link function predicting the costs for patients with non-zero costs
Age at operation	-0.00060 (0.02037)	-0.0055 (0.0182)
SF-12 physical	-0.14860 (0.13289)	0.1641 (0.0686)*
SF-12 physical squared	0.00273 (0.00188)	-0.0030 (0.0012)*
SF-12 mental	0.01805 (0.01558)	0.020 (0.0122)
Constant term	1.14385 (2.98179)	3.3838 (1.1404)*

* $p<0.05$

Costs >1 year after hip revision surgery

For *Chapter 5*, the cost of consultations >1 year after hip revision surgery were based on the values presented in Appendix 49 of Pinedo Villanueva 2013,[114] using the methods described in *Online Supplement 12, Costs >1 year after primary hip arthroplasty*.

Community, outpatient and inpatient costs without joint replacement

Methods

- We assumed that the costs incurred without joint replacement (e.g. GP visits, hospital admissions, physiotherapy etc.) remain constant over the time horizon of the model (i.e., in the absence of joint replacement surgery patients will incur the same costs in every year), other than age-related trends. This is in line with the assumption that clinical score will remain constant without joint replacement. However, we used the cross-sectional COASt data to assess how costs vary with age and applied these coefficients to each patient's age in each year of the model.
- We estimate the costs without joint replacement using data on the costs incurred in the year before joint replacement surgery from the COASt study.
- Included are consultations with a GP, nurse, hospital doctor, physiotherapy, visits to A&E as well as admissions to a hospital.

Costs without TKA: OKS

This is estimated using 278 observations from the COASt study. In the model selection process, we considered OLS models, Tobit models censored at zero, gamma-GLM models with a log-link function as well as two-part models using an OLS model or gamma-GLMs with canonical link function or log-link function for the second-stage. We considered linear, quadratic and cubic trends for OKS. For age, we considered linear, quadratic and cubic trends as well as 20-year age bands. We also considered dropping age from the model. Finally, we considered whether to include sex into the model. The final model was estimated as a gamma-GLM with a log-link function, and it included a quadratic trend for OKS as well as a linear trend for age. The results in the below table (*Table 151*) were used in the analyses presented in both *Chapter 5* and *Chapter 7*.

TABLE 151 Gamma-GLM with log-link function predicting the costs in the year before joint replacement based on OKS

Variable	**Mean (SE)**
Age	-0.021 (0.0143)
Baseline OKS	0.0431 (0.07467)
Squared OKS	-0.0016 (0.0017)
Constant term	8.0268 (1.3024)*

* p<0.05

Costs without TKA: WOMAC and SF-12

Since no dataset was available containing both pre-operative costs and WOMAC or SF-12 scores, we estimated a model predicting pre-operative costs based on baseline EQ-5D. This was estimated using 277 observations from the COASt study. During the model selection process, we considered OLS models, Tobit models censored at zero, gamma-GLM models with a log-link function as well as two-part models using an OLS model or gamma-GLMs with canonical link function or log-link function for the second-stage. For baseline EQ-5D, we considered linear, quadratic and cubic trends. We also considered whether dropping baseline EQ-5D from the model would improve model fit. We considered linear, quadratic and cubic trends for age as well as 20-year age bands and omitting age. Finally, we considered whether to include sex into the model. The final model was estimated as a two-part model with a gamma-GLM with log-link function for the second-stage. The model included linear trends for age and baseline EQ-5D (*Table 152*).

TABLE 152 Two-part model with a gamma-GLM with log-link function for the second-stage predicting the costs in the year before joint replacement based on EQ-5D

Variable	**Mean (SE)** Part 1: Logit model predicting the probability of zero costs	**Mean (SE)** Part 2: Gamma-GLM with a log-link function predicting the costs for patients with non-zero costs
Age at operation	0.028 (0.024)	-0.019 (0.018)
Baseline EQ-5D	-0.307 (0.869)	-0.582 (0.398)
Constant term	-4.633 (1.619)*	8.353 (1.292)*

* p<0.05

Costs without THA: OHS

This was estimated using 441 observations from the COASt study. We considered OLS models, Tobit models censored at zero, gamma-GLM models with a log-link function as well as two-part models using an OLS model or gamma-GLMs with canonical link function or log-link function for the second-stage during the model selection process. For OHS, we considered linear, quadratic and cubic trends as well as logarithmic functional form (for observations with an OHS of zero, we set ln(OHS)=0). We considered linear, quadratic and cubic trends for age as well as 20-year age bands and omitting age from the model. Finally, we considered whether to include sex into the model. The final model was estimated as a gamma-GLM with log-link function and included a quadratic age trend and logarithmic OHS. The results in the below table (*Table 153*) were used in the analyses presented in both *Chapter 5* and *Chapter 7*.

TABLE 153 Gamma-GLM with log-link function predicting the costs in the year before joint replacement based on OHS

Variable	**Mean (SE)**
Linear age	-0.086989 (0.044409)

Quadratic age	0.000548 (0.000349)
Natural Log of OHS (set to 0 for patients with OHS = 0)	-0.348454 (0.117729)*
Constant term	10.33050 (1.429089)*

* p<0.05

Costs without THA: WOMAC and SF-12

Since no dataset was available containing both pre-operative costs and WOMAC or SF-12 scores, we estimated a model predicting pre-operative costs based on baseline EQ-5D. This was estimated using 277 observations from the COASt study. During the model selection process, we considered OLS models, Tobit models censored at zero, gamma-GLM models with a log-link function as well as two-part models using an OLS model or gamma-GLMs with canonical link function or log-link function for the second-stage. For baseline EQ-5D, we considered linear, quadratic and cubic trends. We also considered whether dropping baseline EQ-5D from the model would improve model fit. We considered linear, quadratic and cubic trends for age as well as 20-year age bands and omitting age. Finally, we considered whether to include sex into the model. The final model was estimated as a gamma-GLM model with log-link function. The model included a quadratic trend for age and a binary indicator for sex. Baseline EQ-5D was excluded from the model (*Table 154*).

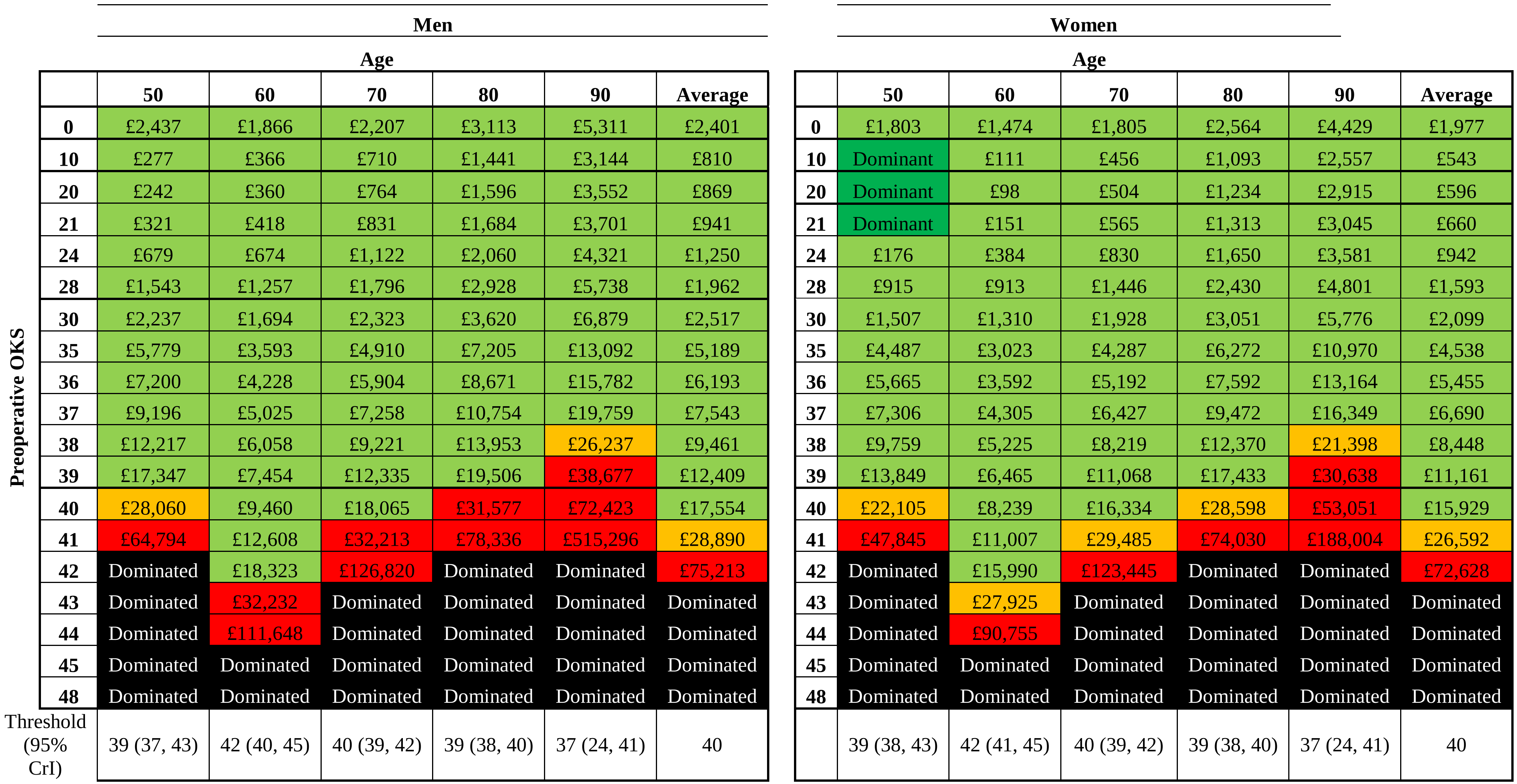
TABLE 154 Gamma-GLM with log-link function predicting the costs in the year before joint replacement based on age and sex for the WOMAC and SF-12 models

Variable	**Mean (SE)**
Age	-0.05991 (0.07176)
Age squared	0.00035 (0.00056)
Female	-0.16441 (0.23797)
Constant term	8.70451 (2.29294)*

* p<0.05

Online Supplement 13 - Additional results of the economic evaluations presented in Chapter 7

Additional decision grids separated by gender



	Men					
	Age					
Preoperative OKS	50	60	70	80	90	Average
0	£2,437	£1,866	£2,207	£3,113	£5,311	£2,401
10	£277	£366	£710	£1,441	£3,144	£810
20	£242	£360	£764	£1,596	£3,552	£869
21	£321	£418	£831	£1,684	£3,701	£941
24	£679	£674	£1,122	£2,060	£4,321	£1,250
28	£1,543	£1,257	£1,796	£2,928	£5,738	£1,962
30	£2,237	£1,694	£2,323	£3,620	£6,879	£2,517
35	£5,779	£3,593	£4,910	£7,205	£13,092	£5,189
36	£7,200	£4,228	£5,904	£8,671	£15,782	£6,193
37	£9,196	£5,025	£7,258	£10,754	£19,759	£7,543
38	£12,217	£6,058	£9,221	£13,953	£26,237	£9,461
39	£17,347	£7,454	£12,335	£19,506	£38,677	£12,409
40	£28,060	£9,460	£18,065	£31,577	£72,423	£17,554
41	£64,794	£12,608	£32,213	£78,336	£515,296	£28,890
42	Dominated	£18,323	£126,820	Dominated	Dominated	£75,213
43	Dominated	£32,232	Dominated	Dominated	Dominated	Dominated
44	Dominated	£111,648	Dominated	Dominated	Dominated	Dominated
45	Dominated	Dominated	Dominated	Dominated	Dominated	Dominated
48	Dominated	Dominated	Dominated	Dominated	Dominated	Dominated
Threshold (95% CrI)	39 (37, 43)	42 (40, 45)	40 (39, 42)	39 (38, 40)	37 (24, 41)	40

	Women					
	Age					
Preoperative OKS	50	60	70	80	90	Average
0	£1,803	£1,474	£1,805	£2,564	£4,429	£1,977
10	Dominant	£111	£456	£1,093	£2,557	£543
20	Dominant	£98	£504	£1,234	£2,915	£596
21	Dominant	£151	£565	£1,313	£3,045	£660
24	£176	£384	£830	£1,650	£3,581	£942
28	£915	£913	£1,446	£2,430	£4,801	£1,593
30	£1,507	£1,310	£1,928	£3,051	£5,776	£2,099
35	£4,487	£3,023	£4,287	£6,272	£10,970	£4,538
36	£5,665	£3,592	£5,192	£7,592	£13,164	£5,455
37	£7,306	£4,305	£6,427	£9,472	£16,349	£6,690
38	£9,759	£5,225	£8,219	£12,370	£21,398	£8,448
39	£13,849	£6,465	£11,068	£17,433	£30,638	£11,161
40	£22,105	£8,239	£16,334	£28,598	£53,051	£15,929
41	£47,845	£11,007	£29,485	£74,030	£188,004	£26,592
42	Dominated	£15,990	£123,445	Dominated	Dominated	£72,628
43	Dominated	£27,925	Dominated	Dominated	Dominated	Dominated
44	Dominated	£90,755	Dominated	Dominated	Dominated	Dominated
45	Dominated	Dominated	Dominated	Dominated	Dominated	Dominated
48	Dominated	Dominated	Dominated	Dominated	Dominated	Dominated
	39 (38, 43)	42 (41, 45)	40 (39, 42)	39 (38, 40)	37 (24, 41)	40

FIGURE 71 Cost-effectiveness of TKA in patients of different age and baseline OKS for men and women separately

Cost/QALY for TJA vs no arthroplasty

Men

Age

	50	60	70	80	90	Average
0	Dominant	Dominant	£133	£447	£1,061	£165
10	Dominant	Dominant	£62	£516	£1,421	£119
20	£33	£87	£347	£974	£2,300	£437
30	£392	£409	£723	£1,570	£3,466	£856
40	£769	£731	£1,101	£2,198	£4,789	£1,283
50	£1,084	£985	£1,401	£2,733	£6,045	£1,630
60	£1,335	£1,178	£1,628	£3,149	£7,135	£1,894
70	£1,589	£1,376	£1,863	£3,572	£8,315	£2,164
80	£1,914	£1,634	£2,180	£4,228	£10,192	£2,541
85	£2,403	£2,020	£2,686	£5,327	£13,798	£3,142
86	£2,588	£2,163	£2,880	£5,779	£15,478	£3,375
87	£2,800	£2,323	£3,099	£6,306	£17,588	£3,639
88	£3,042	£2,503	£3,347	£6,926	£20,310	£3,942
89	£3,320	£2,708	£3,631	£7,662	£23,940	£4,289
90	£3,641	£2,939	£3,956	£8,547	£28,998	£4,690
91	£4,015	£3,203	£4,331	£9,625	£36,492	£5,156
92	£4,453	£3,504	£4,764	£10,960	£48,667	£5,702
93	£4,970	£3,849	£5,269	£12,645	£71,722	£6,345
94	£5,584	£4,244	£5,859	£14,824	£131,430	£7,108
95	£6,321	£4,699	£6,554	£17,730	£639,477	£8,022
96	£7,214	£5,223	£7,376	£21,766	Dominated	£9,127
97	£8,306	£5,826	£8,355	£27,696	Dominated	£10,478
98	£9,662	£6,523	£9,529	£37,174	Dominated	£12,152

-

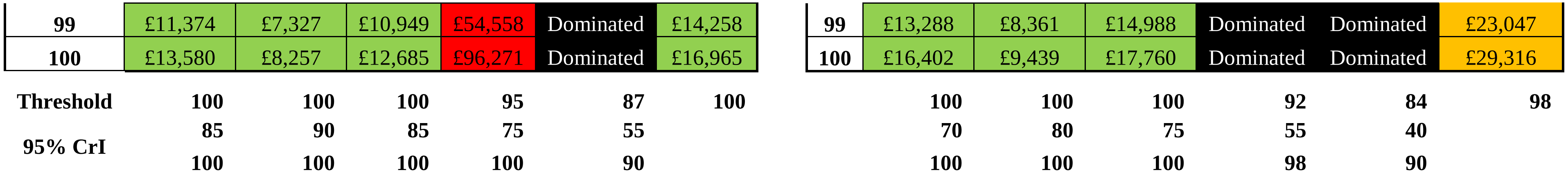
WOMAC score (rescaled to 0-100; 0 indicates poor function)

Cost/QALY for TJA vs no arthroplasty

Women

Age

	50	60	70	80	90	Average
0	Dominant	Dominant	Dominant	£291	£878	£21
10	Dominant	Dominant	Dominant	£420	£1,302	£27
20	Dominant	Dominant	£284	£915	£2,260	£372
30	£159	£320	£704	£1,601	£3,654	£846
40	£546	£684	£1,160	£2,407	£5,469	£1,370
50	£906	£1,007	£1,575	£3,174	£7,480	£1,849
60	£1,203	£1,261	£1,907	£3,801	£9,411	£2,229
70	£1,462	£1,477	£2,191	£4,385	£11,411	£2,563
80	£1,749	£1,719	£2,511	£5,151	£14,125	£2,961
85	£2,186	£2,089	£3,061	£6,699	£21,042	£3,668
86	£2,368	£2,239	£3,293	£7,415	£25,090	£3,971
87	£2,588	£2,418	£3,569	£8,279	£30,892	£4,328
88	£2,851	£2,629	£3,895	£9,335	£39,859	£4,750
89	£3,158	£2,868	£4,271	£10,648	£55,457	£5,242
90	£3,518	£3,141	£4,706	£12,317	£89,097	£5,822
91	£3,944	£3,454	£5,214	£14,496	£213,457	£6,509
92	£4,450	£3,812	£5,809	£17,436	Dominated	£7,333
93	£5,057	£4,224	£6,512	£21,591	Dominated	£8,329
94	£5,791	£4,697	£7,345	£27,853	Dominated	£9,548
95	£6,689	£5,242	£8,342	£38,263	Dominated	£11,060
96	£7,800	£5,869	£9,541	£58,736	Dominated	£12,967
97	£9,193	£6,590	£10,997	£116,605	Dominated	£15,417
98	£10,970	£7,416	£12,779	£1,281,502	Dominated	£18,647



99	£11,374	£7,327	£10,949	£54,558	Dominated	£14,258
100	£13,580	£8,257	£12,685	£96,271	Dominated	£16,965
Threshold	**100**	**100**	**100**	**95**	**87**	**100**
95% CrI	**85**	**90**	**85**	**75**	**55**	
	100	**100**	**100**	**100**	**90**	

99	£13,288	£8,361	£14,988	Dominated	Dominated	£23,047
100	£16,402	£9,439	£17,760	Dominated	Dominated	£29,316
	100	**100**	**100**	**92**	**84**	**98**
	70	**80**	**75**	**55**	**40**	
	100	**100**	**100**	**98**	**90**	

FIGURE 72 Cost-effectiveness of TKA in patients of different age and baseline WOMAC for men and women separately

Men: Mental score 30

Age

SF-12 physical score	50	60	70	80	90	Average
18	£877	£762	£953	£1,646	£4,561	£1,105
20	£768	£666	£882	£1,607	£4,666	£1,033
30	£728	£589	£837	£1,651	£5,302	£1,004
40	£1,042	£779	£1,028	£1,998	£7,007	£1,244
45	£1,456	£1,027	£1,287	£2,497	£10,348	£1,571
48	£1,969	£1,310	£1,581	£3,115	£17,205	£1,956
49	£2,240	£1,448	£1,725	£3,433	£23,109	£2,148
50	£2,600	£1,623	£1,903	£3,848	£36,505	£2,392
51	£3,104	£1,848	£2,132	£4,408	£95,345	£2,711
52	£3,853	£2,149	£2,432	£5,198	Dominated	£3,144
53	£5,081	£2,570	£2,841	£6,386	Dominated	£3,760
54	£7,448	£3,198	£3,427	£8,359	Dominated	£4,699
55	£13,875	£4,225	£4,333	£12,233	Dominated	£6,294
56	£95,026	£6,202	£5,899	£23,126	Dominated	£9,566
57	Dominated	£11,509	£9,219	£222,707	Dominated	£19,913
58	Dominated	£70,560	£20,726	Dominated	Dominated	Dominated
59	Dominated	Dominated	Dominated	Dominated	Dominated	Dominated
60	Dominated	Dominated	Dominated	Dominated	Dominated	Dominated
Threshold	52	57	57	52	47	57
95% CrI	50	54	54	52	40	
	58	60	60	58	54	

Women: Mental score 30

Age

SF-12 physical score	50	60	70	80	90	Average
18	£68	£225	£500	£1,060	£3,098	£589
20	£6	£173	£463	£1,042	£3,158	£552
30	£23	£167	£470	£1,099	£3,509	£572
40	£215	£305	£610	£1,325	£4,346	£741
45	£406	£448	£770	£1,616	£5,710	£937
48	£608	£594	£938	£1,946	£7,743	£1,150
49	£704	£662	£1,016	£2,107	£8,977	£1,250
50	£823	£743	£1,110	£2,306	£10,824	£1,373
51	£975	£843	£1,226	£2,561	£13,870	£1,526
52	£1,176	£968	£1,371	£2,893	£19,787	£1,721
53	£1,453	£1,131	£1,556	£3,344	£36,053	£1,978
54	£1,862	£1,349	£1,802	£3,985	£267,489	£2,330
55	£2,522	£1,656	£2,141	£4,963	Dominated	£2,837
56	£3,768	£2,118	£2,636	£6,621	Dominated	£3,628
57	£6,993	£2,891	£3,418	£10,005	Dominated	£5,021
58	£34,844	£4,436	£4,828	£20,535	Dominated	£8,091
59	Dominated	£9,004	£8,078	Dominated	Dominated	£20,163
60	Dominated	£322,904	£23,089	Dominated	Dominated	Dominated
Threshold	57	59	59	57	52	58
95% CrI	54	56	56	54	46	
	60	60	60	60	56	

FIGURE 73 Cost-effectiveness of TKA in patients of different age and baseline SF-12 physical score at SF-12 mental score of 30 for men and women separately

Men: Mental score 50

Age

SF-12 physical score	50	60	70	80	90	Average
12	£336	£436	£719	£1,415	£4,118	£825
30	£817	£763	£1,172	£2,513	£12,451	£1,418
33	£1,031	£901	£1,330	£2,867	£17,369	£1,623
34	£1,120	£957	£1,394	£3,015	£20,187	£1,707
35	£1,222	£1,019	£1,465	£3,184	£24,279	£1,801
36	£1,341	£1,091	£1,546	£3,379	£30,795	£1,909
39	£1,864	£1,379	£1,872	£4,219	£271,968	£2,355
40	£2,134	£1,514	£2,021	£4,634	Dominated	£2,566
41	£2,490	£1,679	£2,202	£5,165	Dominated	£2,828
42	£2,984	£1,886	£2,425	£5,864	Dominated	£3,160
43	£3,713	£2,153	£2,707	£6,826	Dominated	£3,595
44	£4,900	£2,510	£3,074	£8,229	Dominated	£4,187
46	£13,200	£3,764	£4,272	£14,547	Dominated	£6,367
47	£78,346	£5,018	£5,344	£24,366	Dominated	£8,710
48	Dominated	£7,518	£7,174	£79,637	Dominated	£13,927
49	Dominated	£14,906	£10,977	Dominated	Dominated	£35,494
50	Dominated	£589,337	£23,563	Dominated	Dominated	Dominated
51	Dominated	Dominated	Dominated	Dominated	Dominated	Dominated
52	Dominated	Dominated	Dominated	Dominated	Dominated	Dominated
53	Dominated	Dominated	Dominated	Dominated	Dominated	Dominated
54	Dominated	Dominated	Dominated	Dominated	Dominated	Dominated
Threshold	46	49	49	46	33	48
95% CrI	42	46	48	44	20	

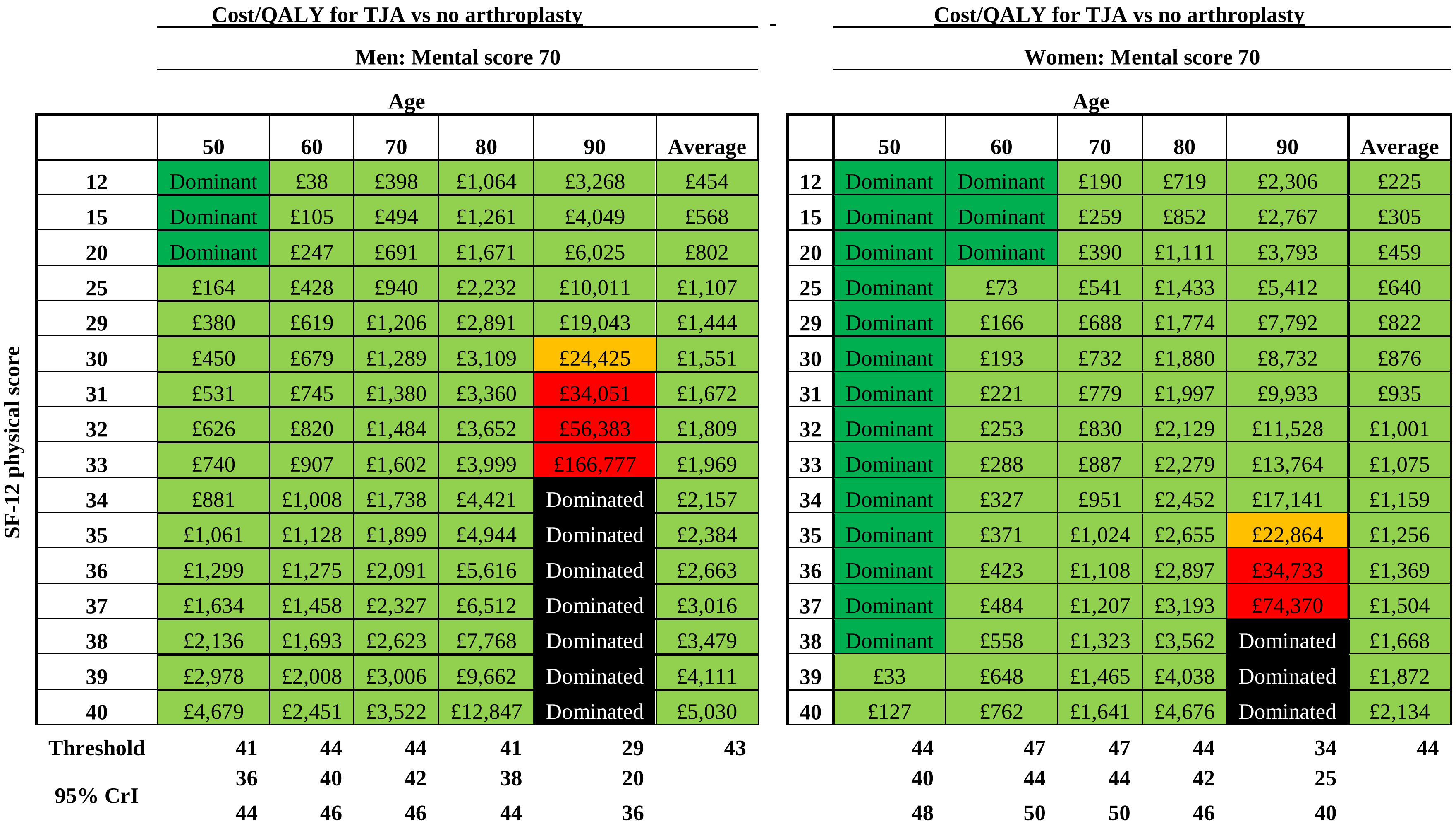
Women: Mental score 50

Age

SF-12 physical score	50	60	70	80	90	Average
12	Dominant	£39	£363	£921	£2,821	£425
30	Dominant	£253	£676	£1,596	£6,343	£817
33	£57	£325	£766	£1,783	£7,646	£930
34	£88	£353	£801	£1,857	£8,245	£974
35	£122	£383	£840	£1,941	£8,977	£1,023
36	£159	£417	£883	£2,035	£9,895	£1,078
39	£305	£543	£1,046	£2,413	£14,972	£1,291
40	£371	£598	£1,117	£2,586	£18,488	£1,386
41	£451	£662	£1,201	£2,794	£24,593	£1,498
42	£549	£739	£1,299	£3,051	£37,783	£1,634
43	£673	£831	£1,418	£3,373	£87,246	£1,800
44	£838	£946	£1,564	£3,790	Dominated	£2,008
46	£1,401	£1,282	£1,981	£5,131	Dominated	£2,638
47	£1,946	£1,542	£2,294	£6,308	Dominated	£3,144
48	£2,992	£1,918	£2,729	£8,262	Dominated	£3,902
49	£5,810	£2,508	£3,373	£12,125	Dominated	£5,159
50	£40,205	£3,567	£4,421	£23,252	Dominated	£7,636
51	Dominated	£6,009	£6,415	£357,756	Dominated	£14,735
52	Dominated	£17,597	£11,649	Dominated	Dominated	£206,583
53	Dominated	Dominated	£60,819	Dominated	Dominated	Dominated
54	Dominated	Dominated	Dominated	Dominated	Dominated	Dominated
Threshold	49	52	52	49	40	51
95% CrI	46	50	50	46	32	

50	**50**	**50**	**48**	**40**	**52**	**54**	**54**	**52**	**46**

FIGURE 74 Cost-effectiveness of TKA in patients of different age and baseline SF-12 physical score at SF-12 mental score of 50 for men and women separately



Cost/QALY for TJA vs no arthroplasty

Men: Mental score 70

Age

SF-12 physical score

	50	60	70	80	90	Average
12	Dominant	£38	£398	£1,064	£3,268	£454
15	Dominant	£105	£494	£1,261	£4,049	£568
20	Dominant	£247	£691	£1,671	£6,025	£802
25	£164	£428	£940	£2,232	£10,011	£1,107
29	£380	£619	£1,206	£2,891	£19,043	£1,444
30	£450	£679	£1,289	£3,109	£24,425	£1,551
31	£531	£745	£1,380	£3,360	£34,051	£1,672
32	£626	£820	£1,484	£3,652	£56,383	£1,809
33	£740	£907	£1,602	£3,999	£166,777	£1,969
34	£881	£1,008	£1,738	£4,421	Dominated	£2,157
35	£1,061	£1,128	£1,899	£4,944	Dominated	£2,384
36	£1,299	£1,275	£2,091	£5,616	Dominated	£2,663
37	£1,634	£1,458	£2,327	£6,512	Dominated	£3,016
38	£2,136	£1,693	£2,623	£7,768	Dominated	£3,479
39	£2,978	£2,008	£3,006	£9,662	Dominated	£4,111
40	£4,679	£2,451	£3,522	£12,847	Dominated	£5,030
Threshold	41	44	44	41	29	43
95% CrI	36	40	42	38	20	
	44	46	46	44	36	

Cost/QALY for TJA vs no arthroplasty

Women: Mental score 70

Age

	50	60	70	80	90	Average
12	Dominant	Dominant	£190	£719	£2,306	£225
15	Dominant	Dominant	£259	£852	£2,767	£305
20	Dominant	Dominant	£390	£1,111	£3,793	£459
25	Dominant	£73	£541	£1,433	£5,412	£640
29	Dominant	£166	£688	£1,774	£7,792	£822
30	Dominant	£193	£732	£1,880	£8,732	£876
31	Dominant	£221	£779	£1,997	£9,933	£935
32	Dominant	£253	£830	£2,129	£11,528	£1,001
33	Dominant	£288	£887	£2,279	£13,764	£1,075
34	Dominant	£327	£951	£2,452	£17,141	£1,159
35	Dominant	£371	£1,024	£2,655	£22,864	£1,256
36	Dominant	£423	£1,108	£2,897	£34,733	£1,369
37	Dominant	£484	£1,207	£3,193	£74,370	£1,504
38	Dominant	£558	£1,323	£3,562	Dominated	£1,668
39	£33	£648	£1,465	£4,038	Dominated	£1,872
40	£127	£762	£1,641	£4,676	Dominated	£2,134
	44	47	47	44	34	44
	40	44	44	42	25	
	48	50	50	46	40	

FIGURE 75 Cost-effectiveness of TKA in patients of different age and baseline SF-12 physical score at SF-12 mental score of 70 for men and women separately

	Men					
	Age					
OHS	50	60	70	80	90	Average
0	Dominant	Dominant	£371	£703	£1,445	£226
10	£656	£644	£766	£1,037	£2,049	£798
20	£1,080	£995	£1,057	£1,383	£2,375	£1,136
30	£1,958	£1,732	£1,789	£2,368	£4,412	£1,959
35	£3,073	£2,623	£2,743	£3,744	£8,087	£3,031
36	£3,457	£2,918	£3,066	£4,234	£9,711	£3,397
37	£3,946	£3,285	£3,472	£4,870	£12,156	£3,861
38	£4,591	£3,755	£4,002	£5,729	£16,257	£4,470
39	£5,481	£4,378	£4,719	£6,956	£24,554	£5,305
40	£6,791	£5,245	£5,745	£8,851	£50,231	£6,517
41	£8,907	£6,534	£7,338	£12,160	Dominated	£8,442
42	£12,911	£8,653	£10,145	£19,417	Dominated	£11,968
43	£23,365	£12,786	£16,409	£48,140	Dominated	£20,521
44	£120,605	£24,408	£42,768	Dominated	Dominated	£71,559
45	Dominated	£260,792	Dominated	Dominated	Dominated	Dominated
46	Dominated	Dominated	Dominated	Dominated	Dominated	Dominated
47	Dominated	Dominated	Dominated	Dominated	Dominated	Dominated
48	Dominated	Dominated	Dominated	Dominated	Dominated	Dominated
Threshold (95% CrI)	42 (42, 43)	43 (43, 44)	43 (42, 43)	42 (41, 42)	38 (34, 41)	42

	Women					
	Age					
OHS	50	60	70	80	90	Average
0	Dominant	Dominant	£297	£500	£1,115	£202
10	£604	£593	£719	£914	£1,820	£766
20	£1,030	£941	£1,011	£1,212	£2,088	£1,084
30	£1,915	£1,671	£1,745	£2,128	£3,973	£1,907
35	£3,087	£2,581	£2,732	£3,448	£7,511	£3,025
36	£3,503	£2,888	£3,075	£3,931	£9,139	£3,419
37	£4,044	£3,276	£3,514	£4,569	£11,667	£3,930
38	£4,777	£3,782	£4,097	£5,452	£16,133	£4,617
39	£5,825	£4,468	£4,908	£6,756	£26,151	£5,591
40	£7,451	£5,453	£6,115	£8,874	£69,072	£7,079
41	£10,311	£6,987	£8,103	£12,918	Dominated	£9,638
42	£16,681	£9,707	£11,990	£23,709	Dominated	£15,073
43	£43,304	£15,858	£22,999	£143,232	Dominated	£34,459
44	Dominated	£43,046	£274,891	Dominated	Dominated	Dominated
45	Dominated	Dominated	Dominated	Dominated	Dominated	Dominated
46	Dominated	Dominated	Dominated	Dominated	Dominated	Dominated
47	Dominated	Dominated	Dominated	Dominated	Dominated	Dominated
48	Dominated	Dominated	Dominated	Dominated	Dominated	Dominated
Threshold (95% CrI)	42 (41, 42)	43 (42, 43)	42 (42, 43)	41 (41, 42)	38 (34, 41)	42

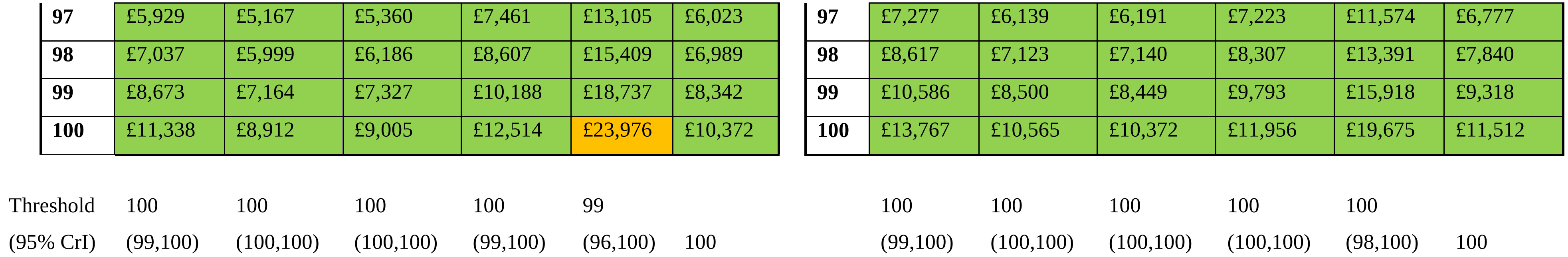
FIGURE 76 Cost-effectiveness of THA in patients of different age and baseline OHS for men and women separately

Cost/QALY for TJA vs no arthroplasty

WOMAC score	Men					
	Age					
	50	60	70	80	90	Average
0	£339	£335	£372	£504	£760	£395
5	£360	£356	£394	£540	£826	£420
10	£385	£382	£420	£581	£901	£450
15	£417	£414	£453	£632	£989	£488
20	£456	£453	£494	£692	£1,090	£534
25	£503	£498	£543	£762	£1,204	£588
30	£556	£550	£598	£840	£1,330	£648
35	£615	£607	£659	£926	£1,468	£715
40	£678	£667	£725	£1,017	£1,616	£786
45	£746	£732	£794	£1,115	£1,773	£862
50	£819	£802	£869	£1,219	£1,941	£944
55	£899	£877	£949	£1,331	£2,124	£1,032
60	£990	£962	£1,039	£1,457	£2,329	£1,132
65	£1,098	£1,064	£1,146	£1,606	£2,574	£1,250
70	£1,238	£1,195	£1,283	£1,797	£2,889	£1,402
75	£1,429	£1,371	£1,469	£2,056	£3,317	£1,607
80	£1,702	£1,622	£1,732	£2,422	£3,929	£1,899
85	£2,127	£2,008	£2,135	£2,983	£4,881	£2,348
90	£2,874	£2,670	£2,822	£3,937	£6,537	£3,118
95	£4,525	£4,058	£4,244	£5,912	£10,127	£4,733
96	£5,129	£4,544	£4,735	£6,593	£11,417	£5,298

Cost/QALY for TJA vs no arthroplasty

	Women					
	Age					
	50	60	70	80	90	Average
0	£403	£390	£416	£496	£736	£443
5	£433	£416	£444	£531	£798	£473
10	£467	£447	£476	£570	£869	£509
15	£509	£484	£515	£619	£952	£552
20	£561	£531	£564	£678	£1,048	£605
25	£620	£586	£621	£747	£1,158	£667
30	£687	£648	£685	£824	£1,279	£737
35	£760	£716	£756	£908	£1,411	£814
40	£840	£789	£832	£999	£1,552	£896
45	£925	£868	£913	£1,095	£1,703	£984
50	£1,017	£952	£999	£1,198	£1,863	£1,077
55	£1,118	£1,044	£1,093	£1,309	£2,036	£1,179
60	£1,231	£1,147	£1,198	£1,432	£2,229	£1,293
65	£1,367	£1,269	£1,324	£1,579	£2,459	£1,429
70	£1,540	£1,425	£1,484	£1,766	£2,753	£1,602
75	£1,776	£1,636	£1,700	£2,019	£3,150	£1,836
80	£2,112	£1,935	£2,005	£2,377	£3,714	£2,167
85	£2,636	£2,394	£2,473	£2,923	£4,579	£2,676
90	£3,554	£3,179	£3,266	£3,848	£6,056	£3,542
95	£5,571	£4,825	£4,907	£5,747	£9,136	£5,349
96	£6,307	£5,400	£5,471	£6,397	£10,205	£5,975



97	£5,929	£5,167	£5,360	£7,461	£13,105	£6,023
98	£7,037	£5,999	£6,186	£8,607	£15,409	£6,989
99	£8,673	£7,164	£7,327	£10,188	£18,737	£8,342
100	£11,338	£8,912	£9,005	£12,514	£23,976	£10,372
Threshold	100	100	100	100	99	
(95% CrI)	(99,100)	(100,100)	(100,100)	(99,100)	(96,100)	100

97	£7,277	£6,139	£6,191	£7,223	£11,574	£6,777
98	£8,617	£7,123	£7,140	£8,307	£13,391	£7,840
99	£10,586	£8,500	£8,449	£9,793	£15,918	£9,318
100	£13,767	£10,565	£10,372	£11,956	£19,675	£11,512
	100	100	100	100	100	
	(99,100)	(100,100)	(100,100)	(100,100)	(98,100)	100

FIGURE 77 Cost-effectiveness of THA in patients of different age and baseline WOMAC for men and women separately

	Men, mental score = 30					
	Age					
SF-12 physical score	**50**	**60**	**70**	**80**	**90**	**Average**
18	£1,287	£1,109	£1,276	£2,453	Dominated	£1,499
19	£1,220	£1,068	£1,234	£2,295	Dominated	£1,432
20	£1,172	£1,038	£1,203	£2,182	Dominated	£1,383
21	£1,135	£1,016	£1,181	£2,100	Dominated	£1,347
22	£1,108	£1,000	£1,166	£2,039	£40,657	£1,320
23	£1,087	£989	£1,155	£1,995	£21,280	£1,301
24	£1,072	£981	£1,148	£1,962	£15,107	£1,287
30	£1,050	£985	£1,167	£1,924	£7,457	£1,283
40	£1,107	£853	£996	£1,969	£7,185	£1,208
49	£1,249	£1,241	£1,513	£2,878	£17,964	£1,707
50	£1,342	£1,333	£1,640	£3,193	£24,436	£1,852
51	£1,457	£1,447	£1,799	£3,612	£39,906	£2,035
52	£1,604	£1,591	£2,005	£4,189	£123,475	£2,271
53	£1,794	£1,776	£2,278	£5,034	Dominated	£2,588
54	£2,051	£2,023	£2,657	£6,372	Dominated	£3,030
55	£2,413	£2,368	£3,210	£8,792	Dominated	£3,678
56	£2,957	£2,878	£4,089	£14,404	Dominated	£4,731
57	£3,858	£3,700	£5,678	£40,967	Dominated	£6,707
58	£5,618	£5,224	£9,357	Dominated	Dominated	£11,675
59	£10,480	£8,952	£26,478	Dominated	Dominated	£45,620
60	£79,891	£31,012	Dominated	Dominated	Dominated	Dominated

	Women, mental score = 30					
	Age					
SF-12 physical score	**50**	**60**	**70**	**80**	**90**	**Average**
18	£1,253	£1,086	£1,165	£1,872	Dominated	£1,403
19	£1,193	£1,048	£1,128	£1,766	Dominated	£1,342
20	£1,149	£1,021	£1,101	£1,688	£35,057	£1,297
21	£1,115	£1,000	£1,081	£1,630	£15,635	£1,263
22	£1,090	£984	£1,066	£1,587	£10,620	£1,237
23	£1,070	£973	£1,057	£1,559	£8,341	£1,220
24	£1,056	£965	£1,052	£1,539	£7,049	£1,209
30	£1,036	£971	£1,072	£1,523	£4,577	£1,208
40	£1,083	£809	£903	£1,519	£4,501	£1,117
49	£1,184	£1,119	£1,291	£1,986	£7,867	£1,496
50	£1,257	£1,188	£1,380	£2,151	£9,056	£1,602
51	£1,344	£1,270	£1,487	£2,358	£10,818	£1,731
52	£1,451	£1,371	£1,620	£2,626	£13,670	£1,891
53	£1,585	£1,497	£1,788	£2,982	£19,016	£2,097
54	£1,757	£1,657	£2,007	£3,475	£32,486	£2,367
55	£1,982	£1,866	£2,301	£4,199	£123,546	£2,728
56	£2,291	£2,150	£2,715	£5,354	Dominated	£3,247
57	£2,735	£2,554	£3,334	£7,468	Dominated	£4,051
58	£3,426	£3,169	£4,351	£12,489	Dominated	£5,443
59	£4,630	£4,208	£6,299	£38,568	Dominated	£8,382
60	£7,215	£6,305	£11,419	Dominated	Dominated	£18,387

Threshold (95% CrI)	59 (57, 60)	59 (57, 60)	58 (56, 60)	56 (53, 58)	48 (-1, 56)	58	60 (58, 60)	60 (59, 60)	60 (58, 60)	58 (56, 60)	53 (-1, 58)	60

FIGURE 78 Cost-effectiveness of THA in patients of different age and baseline SF-12 physical score at SF-12 mental score of 30 for men and women separately

Men, mental score = 50

Age

SF-12 physical score	50	60	70	80	90	Average
12	£1,254	£1,119	£1,313	£2,421	Dominated	£1,507
15	£1,097	£1,020	£1,209	£2,057	£12,303	£1,344
20	£1,061	£1,016	£1,130	£1,991	£6,282	£1,294
30	£872	£890	£1,066	£1,835	£5,854	£1,183
40	£1,142	£1,179	£1,463	£2,615	£7,402	£1,596
47	£1,691	£1,755	£2,296	£4,536	£18,423	£2,492
48	£1,844	£1,914	£2,537	£5,166	£24,935	£2,753
49	£2,036	£2,114	£2,847	£6,030	£39,421	£3,087
50	£2,283	£2,369	£3,255	£7,275	£98,560	£3,530
51	£2,610	£2,705	£3,814	£9,208	Dominated	£4,138
52	£3,063	£3,167	£4,621	£12,581	Dominated	£5,020
53	£3,723	£3,831	£5,872	£19,842	Dominated	£6,399
54	£4,764	£4,861	£8,042	£46,139	Dominated	£8,825
55	£6,627	£6,643	£12,647	Dominated	Dominated	£14,129
56	£10,830	£10,402	£28,495	Dominated	Dominated	£34,199
57	£28,559	£23,091	Dominated	Dominated	Dominated	Dominated
58	Dominated	Dominated	Dominated	Dominated	Dominated	Dominated
59	Dominated	Dominated	Dominated	Dominated	Dominated	Dominated
60	Dominated	Dominated	Dominated	Dominated	Dominated	Dominated
Threshold (95% CrI)	59 (57, 60)	59 (57, 60)	58 (56, 60)	56 (53, 58)	48 (-1, 56)	58

Women, mental score = 50

Age

SF-12 physical score	50	60	70	80	90	Average
12	£1,204	£1,071	£1,160	£1,792	£48,889	£1,367
15	£1,064	£979	£1,070	£1,551	£6,101	£1,222
20	£1,031	£977	£1,004	£1,520	£3,919	£1,179
30	£857	£820	£928	£1,330	£3,780	£1,056
40	£1,086	£1,055	£1,230	£1,811	£4,242	£1,375
47	£1,506	£1,474	£1,789	£2,800	£7,439	£2,005
48	£1,614	£1,581	£1,937	£3,082	£8,582	£2,174
49	£1,745	£1,711	£2,119	£3,441	£10,225	£2,382
50	£1,908	£1,872	£2,348	£3,911	£12,768	£2,645
51	£2,113	£2,074	£2,641	£4,549	£17,193	£2,985
52	£2,378	£2,335	£3,031	£5,457	£26,701	£3,440
53	£2,732	£2,681	£3,566	£6,839	£61,181	£4,074
54	£3,225	£3,160	£4,342	£9,171	Dominated	£5,009
55	£3,952	£3,859	£5,552	£13,862	Dominated	£6,509
56	£5,117	£4,958	£7,667	£27,774	Dominated	£9,260
57	£7,248	£6,909	£12,209	£857,920	Dominated	£15,801
58	£12,289	£11,220	£28,315	Dominated	Dominated	£49,440
59	£37,623	£27,962	Dominated	Dominated	Dominated	Dominated
60	Dominated	Dominated	Dominated	Dominated	Dominated	Dominated
	60 (58, 60)	60 (59, 60)	60 (58, 60)	58 (56, 60)	53 (-1, 58)	60

FIGURE 79 Cost-effectiveness of THA in patients of different age and baseline SF-12 physical score at SF-12 mental score of 50 for men and women separately

SF-12 physical score	Men, mental score = 70 Age					
	50	**60**	**70**	**80**	**90**	**Average**
12	£932	£843	£825	£1,571	£4,135	£1,023
15	£673	£659	£736	£1,190	£3,595	£827
20	£734	£727	£824	£1,326	£3,144	£910
25	£826	£827	£952	£1,543	£3,411	£1,042
30	£946	£954	£1,118	£1,836	£4,018	£1,216
35	£1,110	£1,127	£1,348	£2,261	£5,013	£1,457
40	£1,372	£1,402	£1,722	£2,994	£6,997	£1,851
41	£1,447	£1,480	£1,830	£3,214	£7,661	£1,965
42	£1,532	£1,569	£1,956	£3,475	£8,492	£2,096
Threshold (95% CrI)	59 (57, 60)	59 (57, 60)	58 (56, 60)	56 (53, 58)	48 (-1, 56)	58

SF-12 physical score	Women, mental score = 70 Age					
	50	**60**	**70**	**80**	**90**	**Average**
12	£946	£864	£813	£1,347	£3,114	£1,018
15	£707	£664	£726	£1,000	£2,779	£825
20	£762	£724	£801	£1,095	£2,390	£891
25	£843	£808	£904	£1,238	£2,490	£998
30	£947	£912	£1,033	£1,427	£2,817	£1,137
35	£1,084	£1,051	£1,208	£1,691	£3,325	£1,325
40	£1,295	£1,263	£1,483	£2,124	£4,253	£1,624
41	£1,353	£1,321	£1,559	£2,249	£4,535	£1,708
42	£1,419	£1,387	£1,647	£2,393	£4,869	£1,803
	60 (58, 60)	60 (59, 60)	60 (58, 60)	58 (56, 60)	53 (-1, 58)	60

FIGURE 80 Cost-effectiveness of THA in patients of different age and baseline SF-12 physical score at SF-12 mental score of 70 for men and women separately

Results of sensitivity analysis

OKS in TKA

Age

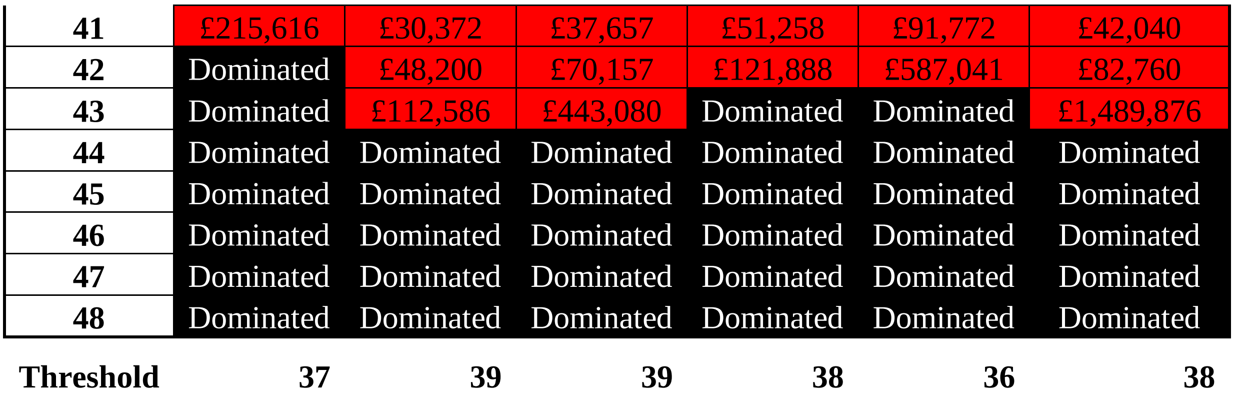
Oxford score

	50	60	70	80	90	Average
0	£5,066	£4,019	£4,186	£4,875	£6,406	£4,452
10	£1,964	£1,851	£2,145	£2,728	£3,981	£2,278
20	£2,212	£2,078	£2,430	£3,080	£4,506	£2,571
21	£2,371	£2,199	£2,554	£3,217	£4,683	£2,701
24	£3,055	£2,704	£3,067	£3,783	£5,404	£3,242
30	£5,948	£4,660	£5,068	£6,005	£8,257	£5,364
35	£12,784	£8,469	£9,123	£10,691	£14,562	£9,717
36	£15,644	£9,803	£10,600	£12,459	£17,050	£11,318
37	£19,773	£11,520	£12,544	£14,835	£20,492	£13,436
38	£26,266	£13,815	£15,222	£18,202	£25,568	£16,377
39	£38,005	£17,048	£19,157	£23,351	£33,810	£20,743
40	£65,799	£21,962	£25,526	£32,228	£49,555	£27,931
41	£215,616	£30,372	£37,657	£51,258	£91,772	£42,040
42	Dominated	£48,200	£70,157	£121,888	£587,041	£82,760
43	Dominated	£112,586	£443,080	Dominated	Dominated	£1,489,876
44	Dominated	Dominated	Dominated	Dominated	Dominated	Dominated
45	Dominated	Dominated	Dominated	Dominated	Dominated	Dominated
46	Dominated	Dominated	Dominated	Dominated	Dominated	Dominated
47	Dominated	Dominated	Dominated	Dominated	Dominated	Dominated
48	Dominated	Dominated	Dominated	Dominated	Dominated	Dominated
Threshold	**37**	**39**	**39**	**38**	**36**	**38**

Age

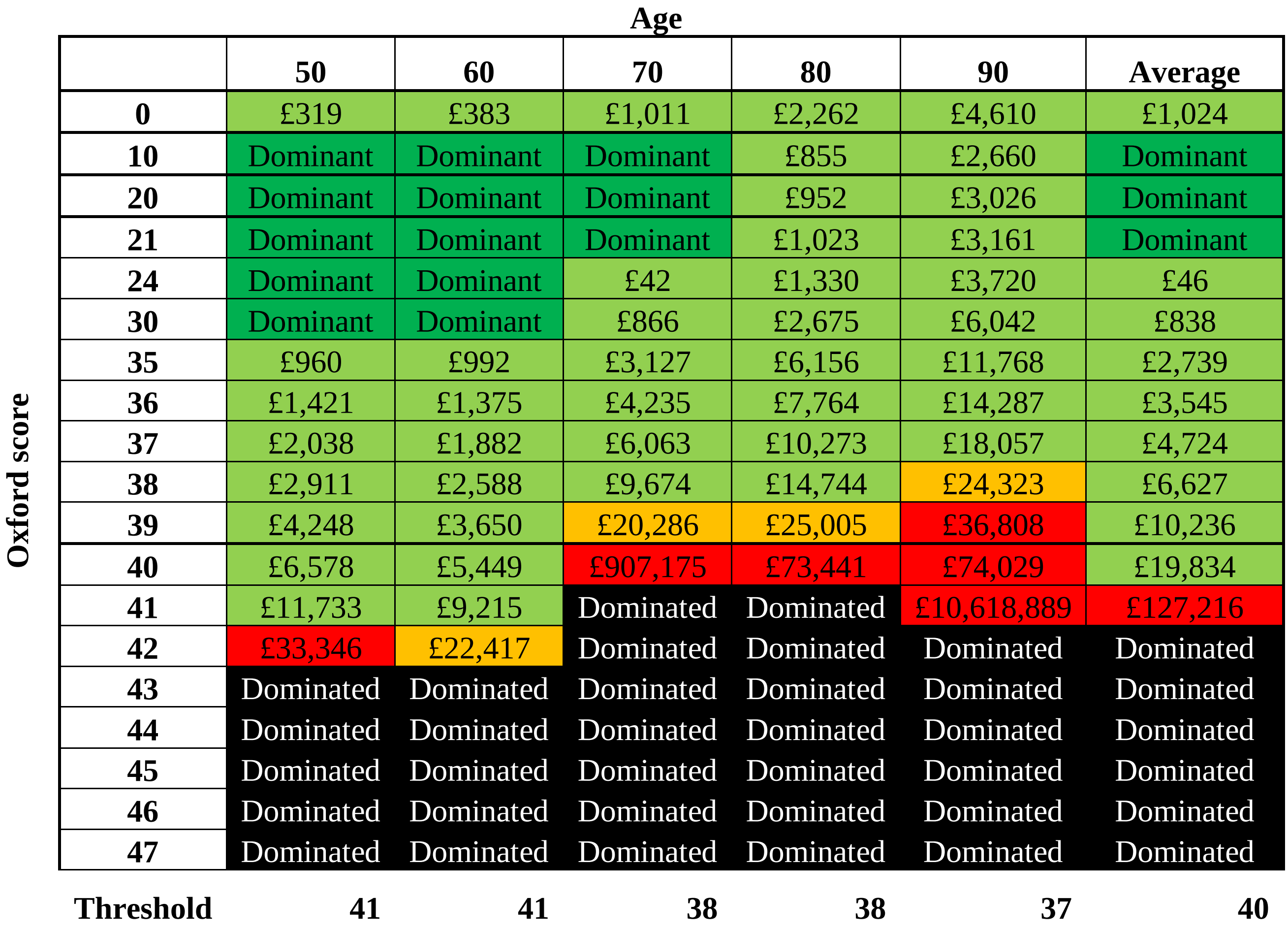
Oxford score

	50	60	70	80	90	Average
0	£5,066	£4,019	£4,186	£4,875	£6,406	£4,452
10	£1,964	£1,851	£2,145	£2,728	£3,981	£2,278
20	£2,212	£2,078	£2,430	£3,080	£4,506	£2,571
21	£2,371	£2,199	£2,554	£3,217	£4,683	£2,701
24	£3,055	£2,704	£3,067	£3,783	£5,404	£3,242
30	£5,948	£4,660	£5,068	£6,005	£8,257	£5,364
35	£12,784	£8,469	£9,123	£10,691	£14,562	£9,717
36	£15,644	£9,803	£10,600	£12,459	£17,050	£11,318
37	£19,773	£11,520	£12,544	£14,835	£20,492	£13,436
38	£26,266	£13,815	£15,222	£18,202	£25,568	£16,377
39	£38,005	£17,048	£19,157	£23,351	£33,810	£20,743
40	£65,799	£21,962	£25,526	£32,228	£49,555	£27,931



41	£215,616	£30,372	£37,657	£51,258	£91,772	£42,040
42	Dominated	£48,200	£70,157	£121,888	£587,041	£82,760
43	Dominated	£112,586	£443,080	Dominated	Dominated	£1,489,876
44	Dominated	Dominated	Dominated	Dominated	Dominated	Dominated
45	Dominated	Dominated	Dominated	Dominated	Dominated	Dominated
46	Dominated	Dominated	Dominated	Dominated	Dominated	Dominated
47	Dominated	Dominated	Dominated	Dominated	Dominated	Dominated
48	Dominated	Dominated	Dominated	Dominated	Dominated	Dominated
Threshold	**37**	**39**	**39**	**38**	**36**	**38**

FIGURE 81 Cost-effectiveness of TKA in patients of different age and baseline OKS (averaged over men and women): 5 year time horizon



Age

Oxford score	**50**	**60**	**70**	**80**	**90**	**Average**
0	£319	£383	£1,011	£2,262	£4,610	£1,024
10	Dominant	Dominant	Dominant	£855	£2,660	Dominant
20	Dominant	Dominant	Dominant	£952	£3,026	Dominant
21	Dominant	Dominant	Dominant	£1,023	£3,161	Dominant
24	Dominant	Dominant	£42	£1,330	£3,720	£46
30	Dominant	Dominant	£866	£2,675	£6,042	£838
35	£960	£992	£3,127	£6,156	£11,768	£2,739
36	£1,421	£1,375	£4,235	£7,764	£14,287	£3,545
37	£2,038	£1,882	£6,063	£10,273	£18,057	£4,724
38	£2,911	£2,588	£9,674	£14,744	£24,323	£6,627
39	£4,248	£3,650	£20,286	£25,005	£36,808	£10,236
40	£6,578	£5,449	£907,175	£73,441	£74,029	£19,834
41	£11,733	£9,215	Dominated	Dominated	£10,618,889	£127,216
42	£33,346	£22,417	Dominated	Dominated	Dominated	Dominated
43	Dominated	Dominated	Dominated	Dominated	Dominated	Dominated
44	Dominated	Dominated	Dominated	Dominated	Dominated	Dominated
45	Dominated	Dominated	Dominated	Dominated	Dominated	Dominated
46	Dominated	Dominated	Dominated	Dominated	Dominated	Dominated
47	Dominated	Dominated	Dominated	Dominated	Dominated	Dominated
Threshold	**41**	**41**	**38**	**38**	**37**	**40**

FIGURE 82 Cost-effectiveness of TKA in patients of different age and baseline OKS (averaged over men and women): 60 year time horizon

Age

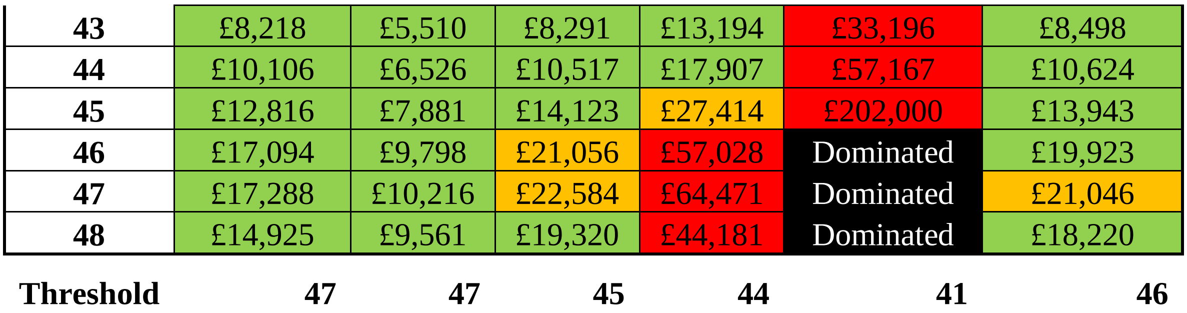
Oxford score

	50	60	70	80	90	Average
0	£1,531	£1,298	£1,558	£2,221	£3,982	£1,700
10	£26	£182	£467	£1,030	£2,412	£542
20	Dominant	£168	£489	£1,111	£2,653	£566
21	£40	£210	£535	£1,168	£2,750	£615
24	£274	£391	£730	£1,407	£3,143	£821
30	£1,140	£1,035	£1,437	£2,280	£4,589	£1,568
31	£1,350	£1,186	£1,610	£2,499	£4,963	£1,750
35	£2,466	£1,966	£2,551	£3,737	£7,191	£2,735
36	£2,838	£2,218	£2,874	£4,181	£8,041	£3,071
37	£3,261	£2,500	£3,249	£4,709	£9,087	£3,459
38	£3,749	£2,819	£3,690	£5,348	£10,410	£3,914
39	£4,318	£3,184	£4,219	£6,139	£12,135	£4,456
40	£4,994	£3,608	£4,868	£7,146	£14,484	£5,115
41	£5,814	£4,108	£5,684	£8,478	£17,884	£5,937
42	£6,835	£4,715	£6,771	£10,364	£23,304	£7,013
43	£8,218	£5,510	£8,291	£13,194	£33,196	£8,498
44	£10,106	£6,526	£10,517	£17,907	£57,167	£10,624
45	£12,816	£7,881	£14,123	£27,414	£202,000	£13,943
46	£17,094	£9,798	£21,056	£57,028	Dominated	£19,923
47	£17,288	£10,216	£22,584	£64,471	Dominated	£21,046
48	£14,925	£9,561	£19,320	£44,181	Dominated	£18,220
Threshold	**47**	**47**	**45**	**44**	**41**	**46**

Age

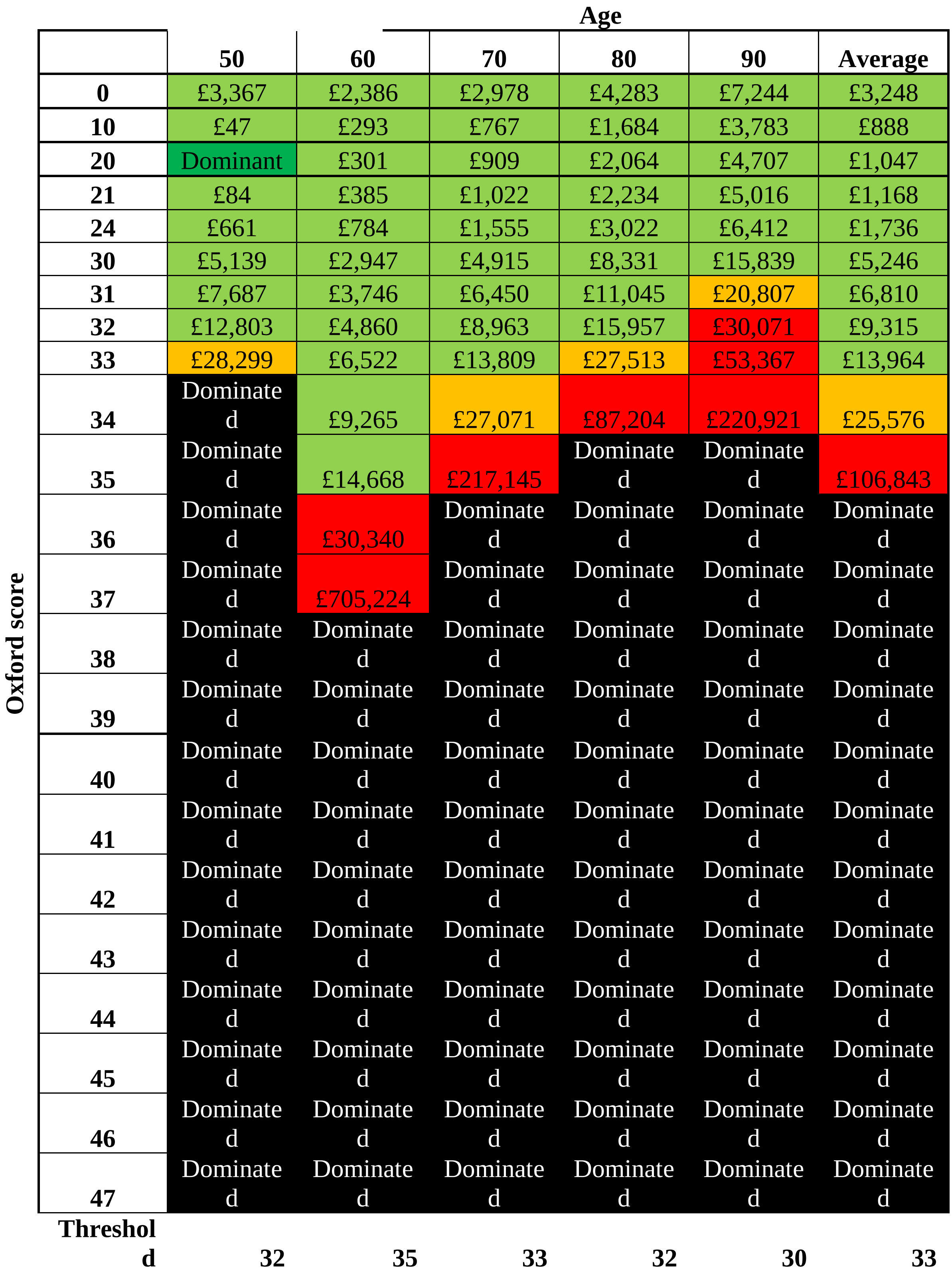
Oxford score

	50	60	70	80	90	Average
0	£1,531	£1,298	£1,558	£2,221	£3,982	£1,700
10	£26	£182	£467	£1,030	£2,412	£542
20	Dominant	£168	£489	£1,111	£2,653	£566
21	£40	£210	£535	£1,168	£2,750	£615
24	£274	£391	£730	£1,407	£3,143	£821
30	£1,140	£1,035	£1,437	£2,280	£4,589	£1,568
31	£1,350	£1,186	£1,610	£2,499	£4,963	£1,750
35	£2,466	£1,966	£2,551	£3,737	£7,191	£2,735
36	£2,838	£2,218	£2,874	£4,181	£8,041	£3,071
37	£3,261	£2,500	£3,249	£4,709	£9,087	£3,459
38	£3,749	£2,819	£3,690	£5,348	£10,410	£3,914
39	£4,318	£3,184	£4,219	£6,139	£12,135	£4,456
40	£4,994	£3,608	£4,868	£7,146	£14,484	£5,115
41	£5,814	£4,108	£5,684	£8,478	£17,884	£5,937
42	£6,835	£4,715	£6,771	£10,364	£23,304	£7,013



43	£8,218	£5,510	£8,291	£13,194	£33,196	£8,498
44	£10,106	£6,526	£10,517	£17,907	£57,167	£10,624
45	£12,816	£7,881	£14,123	£27,414	£202,000	£13,943
46	£17,094	£9,798	£21,056	£57,028	Dominated	£19,923
47	£17,288	£10,216	£22,584	£64,471	Dominated	£21,046
48	£14,925	£9,561	£19,320	£44,181	Dominated	£18,220
Threshold	**47**	**47**	**45**	**44**	**41**	**46**

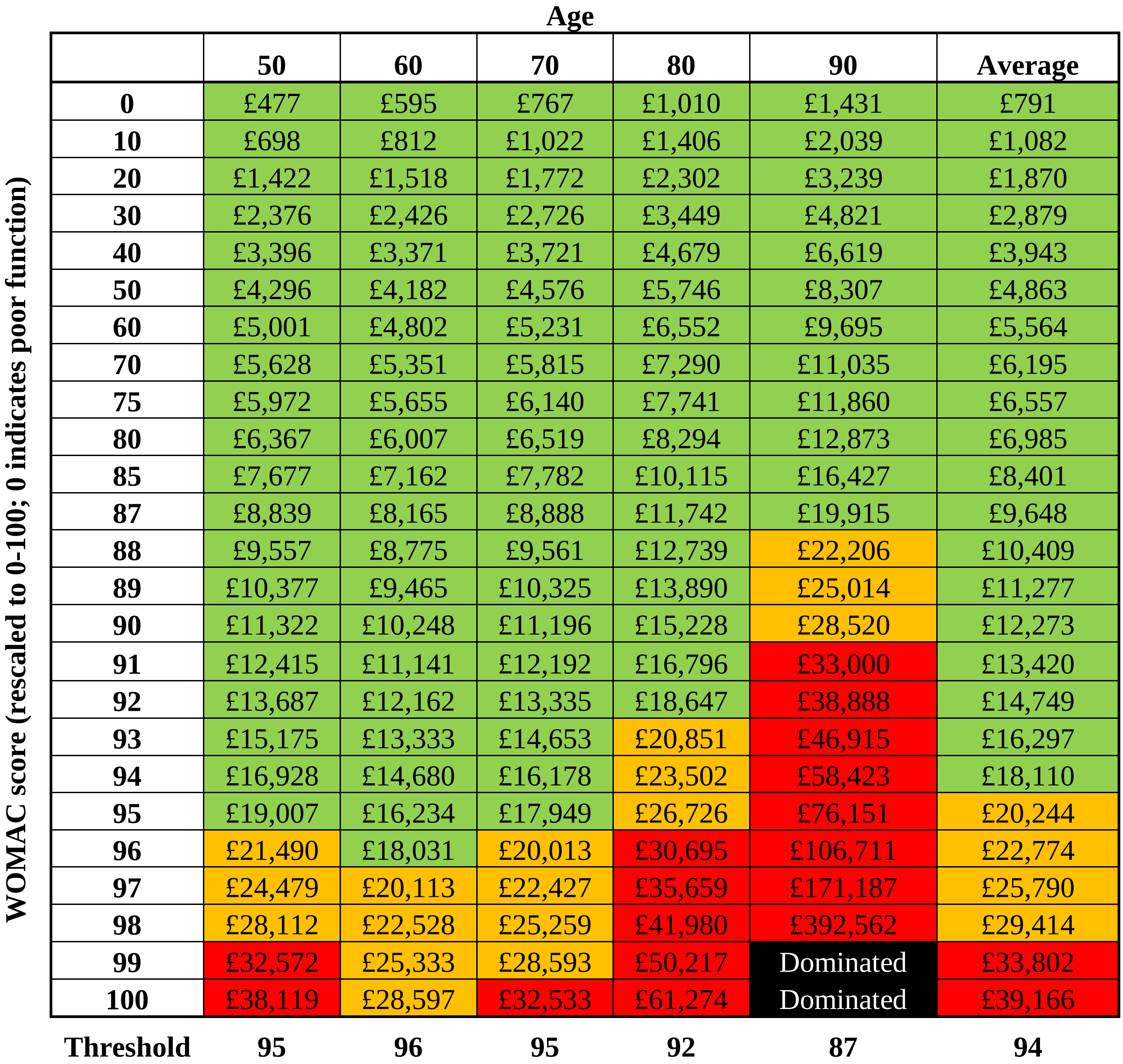
FIGURE 83 Cost-effectiveness of TKA in patients of different age and baseline OKS (averaged over men and women): Assuming that EQ-5D utility without TKA worsens by 0.025 per year



	Age					
Oxford score	50	60	70	80	90	Average
0	£3,367	£2,386	£2,978	£4,283	£7,244	£3,248
10	£47	£293	£767	£1,684	£3,783	£888
20	Dominant	£301	£909	£2,064	£4,707	£1,047
21	£84	£385	£1,022	£2,234	£5,016	£1,168
24	£661	£784	£1,555	£3,022	£6,412	£1,736
30	£5,139	£2,947	£4,915	£8,331	£15,839	£5,246
31	£7,687	£3,746	£6,450	£11,045	£20,807	£6,810
32	£12,803	£4,860	£8,963	£15,957	£30,071	£9,315
33	£28,299	£6,522	£13,809	£27,513	£53,367	£13,964
34	Dominated	£9,265	£27,071	£87,204	£220,921	£25,576
35	Dominated	£14,668	£217,145	Dominated	Dominated	£106,843
36	Dominated	£30,340	Dominated	Dominated	Dominated	Dominated
37	Dominated	£705,224	Dominated	Dominated	Dominated	Dominated
38	Dominated	Dominated	Dominated	Dominated	Dominated	Dominated
39	Dominated	Dominated	Dominated	Dominated	Dominated	Dominated
40	Dominated	Dominated	Dominated	Dominated	Dominated	Dominated
41	Dominated	Dominated	Dominated	Dominated	Dominated	Dominated
42	Dominated	Dominated	Dominated	Dominated	Dominated	Dominated
43	Dominated	Dominated	Dominated	Dominated	Dominated	Dominated
44	Dominated	Dominated	Dominated	Dominated	Dominated	Dominated
45	Dominated	Dominated	Dominated	Dominated	Dominated	Dominated
46	Dominated	Dominated	Dominated	Dominated	Dominated	Dominated
47	Dominated	Dominated	Dominated	Dominated	Dominated	Dominated
Threshold	32	35	33	32	30	33

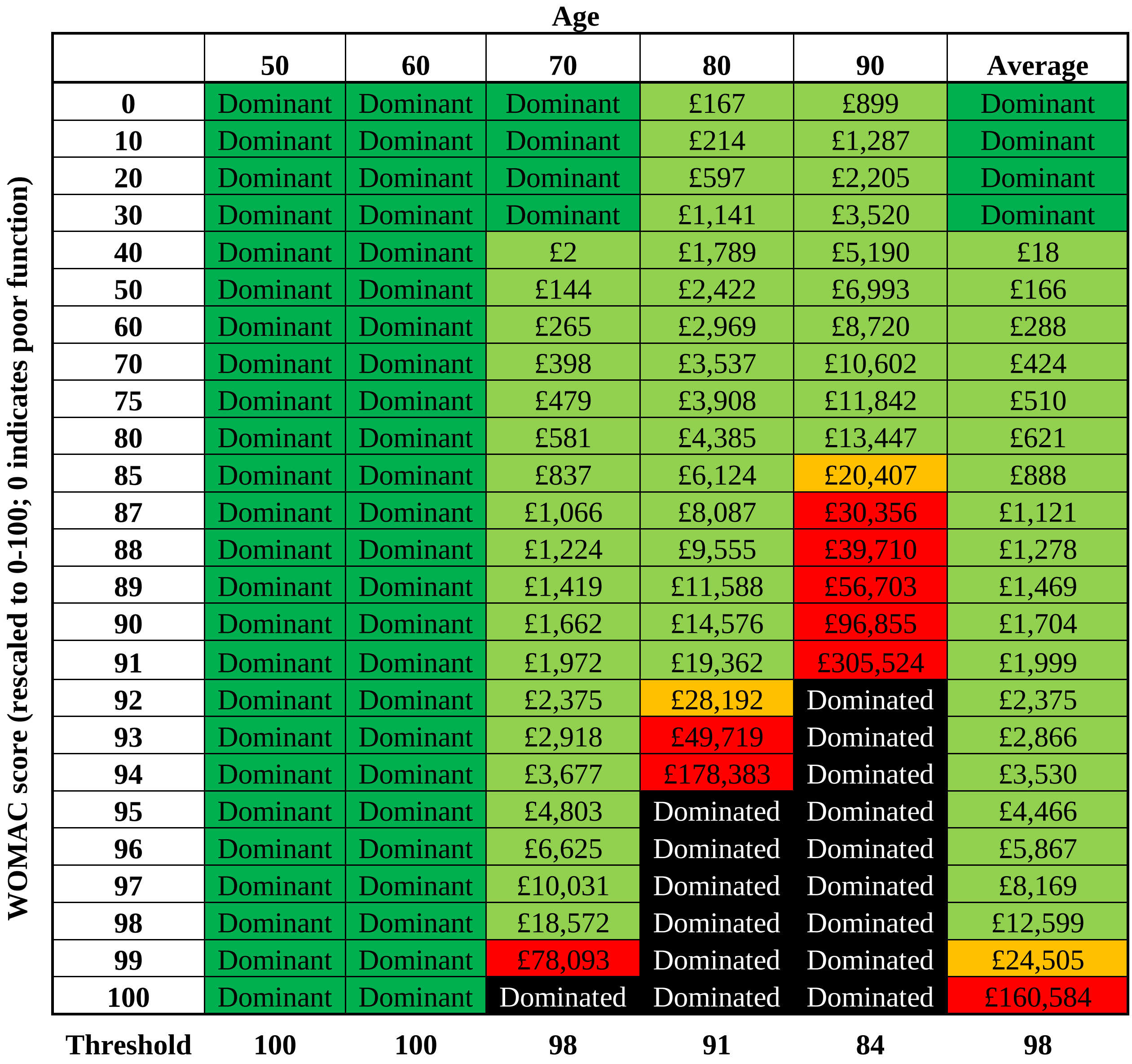
FIGURE 84 Cost-effectiveness of TKA in patients of different age and baseline OKS (averaged over men and women): Assuming that EQ-5D utility without TKA increases by 0.115 in the first year and follows age-related decline thereafter

WOMAC in TKA



WOMAC score (rescaled to 0-100; 0 indicates poor function)	Age					
	50	60	70	80	90	Average
0	£477	£595	£767	£1,010	£1,431	£791
10	£698	£812	£1,022	£1,406	£2,039	£1,082
20	£1,422	£1,518	£1,772	£2,302	£3,239	£1,870
30	£2,376	£2,426	£2,726	£3,449	£4,821	£2,879
40	£3,396	£3,371	£3,721	£4,679	£6,619	£3,943
50	£4,296	£4,182	£4,576	£5,746	£8,307	£4,863
60	£5,001	£4,802	£5,231	£6,552	£9,695	£5,564
70	£5,628	£5,351	£5,815	£7,290	£11,035	£6,195
75	£5,972	£5,655	£6,140	£7,741	£11,860	£6,557
80	£6,367	£6,007	£6,519	£8,294	£12,873	£6,985
85	£7,677	£7,162	£7,782	£10,115	£16,427	£8,401
87	£8,839	£8,165	£8,888	£11,742	£19,915	£9,648
88	£9,557	£8,775	£9,561	£12,739	£22,206	£10,409
89	£10,377	£9,465	£10,325	£13,890	£25,014	£11,277
90	£11,322	£10,248	£11,196	£15,228	£28,520	£12,273
91	£12,415	£11,141	£12,192	£16,796	£33,000	£13,420
92	£13,687	£12,162	£13,335	£18,647	£38,888	£14,749
93	£15,175	£13,333	£14,653	£20,851	£46,915	£16,297
94	£16,928	£14,680	£16,178	£23,502	£58,423	£18,110
95	£19,007	£16,234	£17,949	£26,726	£76,151	£20,244
96	£21,490	£18,031	£20,013	£30,695	£106,711	£22,774
97	£24,479	£20,113	£22,427	£35,659	£171,187	£25,790
98	£28,112	£22,528	£25,259	£41,980	£392,562	£29,414
99	£32,572	£25,333	£28,593	£50,217	Dominated	£33,802
100	£38,119	£28,597	£32,533	£61,274	Dominated	£39,166
Threshold	**95**	**96**	**95**	**92**	**87**	**94**

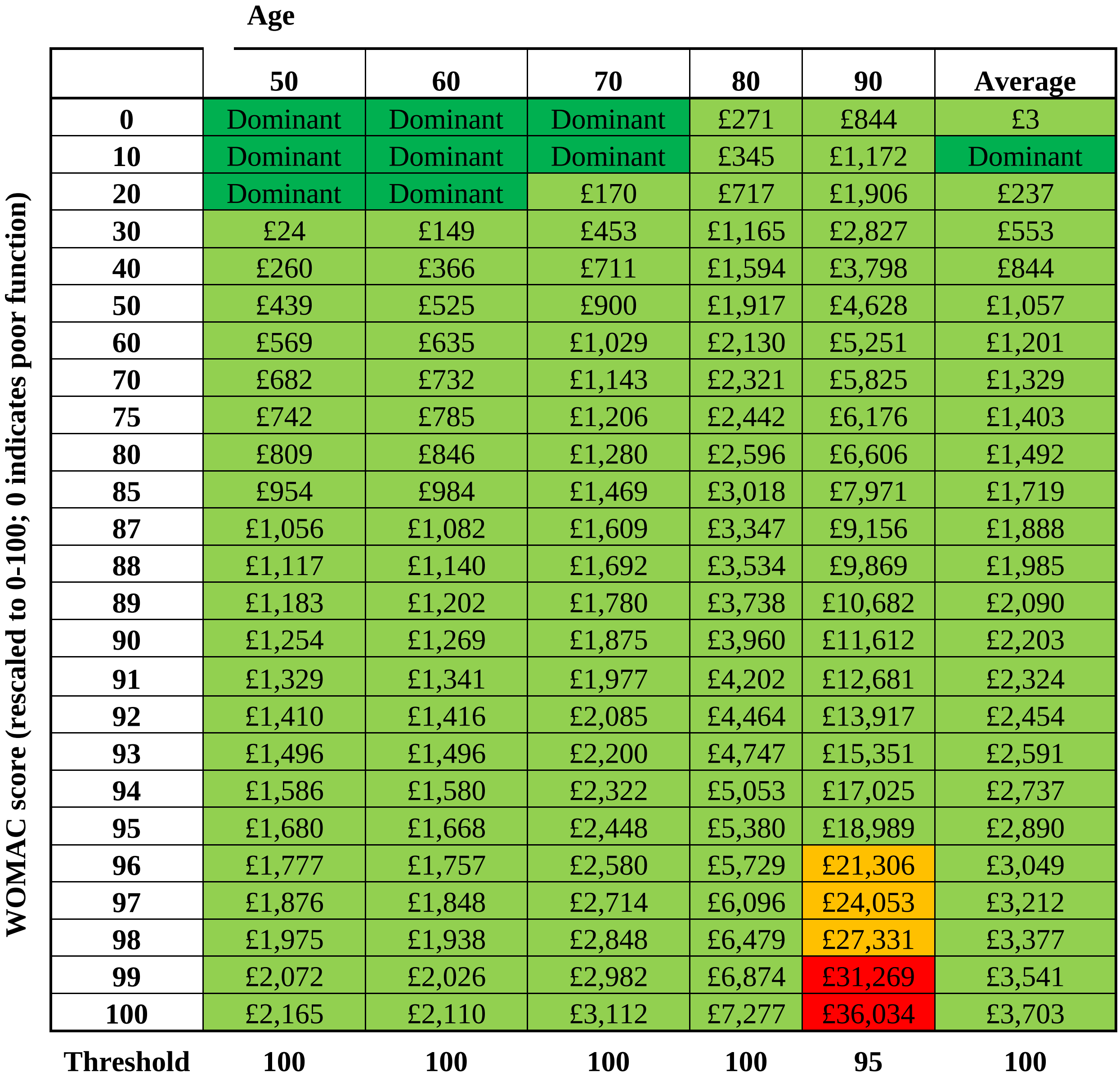
FIGURE 85 Cost-effectiveness of TKA in patients of different age and baseline WOMAC (averaged over men and women): 5 year time horizon



Age

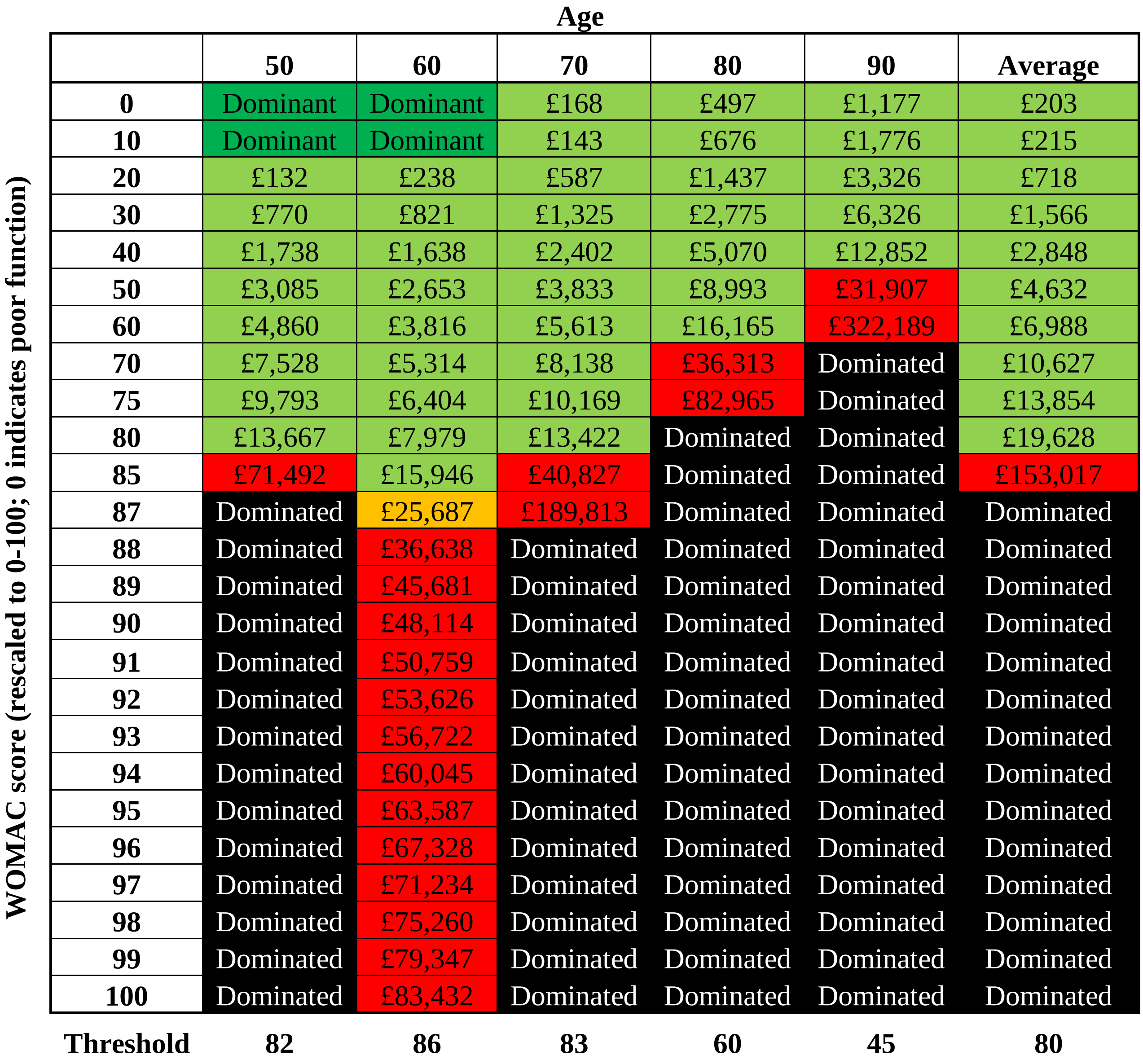
WOMAC score (rescaled to 0-100; 0 indicates poor function)	50	60	70	80	90	Average
0	Dominant	Dominant	Dominant	£167	£899	Dominant
10	Dominant	Dominant	Dominant	£214	£1,287	Dominant
20	Dominant	Dominant	Dominant	£597	£2,205	Dominant
30	Dominant	Dominant	Dominant	£1,141	£3,520	Dominant
40	Dominant	Dominant	£2	£1,789	£5,190	£18
50	Dominant	Dominant	£144	£2,422	£6,993	£166
60	Dominant	Dominant	£265	£2,969	£8,720	£288
70	Dominant	Dominant	£398	£3,537	£10,602	£424
75	Dominant	Dominant	£479	£3,908	£11,842	£510
80	Dominant	Dominant	£581	£4,385	£13,447	£621
85	Dominant	Dominant	£837	£6,124	£20,407	£888
87	Dominant	Dominant	£1,066	£8,087	£30,356	£1,121
88	Dominant	Dominant	£1,224	£9,555	£39,710	£1,278
89	Dominant	Dominant	£1,419	£11,588	£56,703	£1,469
90	Dominant	Dominant	£1,662	£14,576	£96,855	£1,704
91	Dominant	Dominant	£1,972	£19,362	£305,524	£1,999
92	Dominant	Dominant	£2,375	£28,192	Dominated	£2,375
93	Dominant	Dominant	£2,918	£49,719	Dominated	£2,866
94	Dominant	Dominant	£3,677	£178,383	Dominated	£3,530
95	Dominant	Dominant	£4,803	Dominated	Dominated	£4,466
96	Dominant	Dominant	£6,625	Dominated	Dominated	£5,867
97	Dominant	Dominant	£10,031	Dominated	Dominated	£8,169
98	Dominant	Dominant	£18,572	Dominated	Dominated	£12,599
99	Dominant	Dominant	£78,093	Dominated	Dominated	£24,505
100	Dominant	Dominant	Dominated	Dominated	Dominated	£160,584
Threshold	**100**	**100**	**98**	**91**	**84**	**98**

FIGURE 86 Cost-effectiveness of TKA in patients of different age and baseline WOMAC (averaged over men and women): 60 year time horizon



	Age					
WOMAC score (rescaled to 0-100; 0 indicates poor function)	50	60	70	80	90	Average
0	Dominant	Dominant	Dominant	£271	£844	£3
10	Dominant	Dominant	Dominant	£345	£1,172	Dominant
20	Dominant	Dominant	£170	£717	£1,906	£237
30	£24	£149	£453	£1,165	£2,827	£553
40	£260	£366	£711	£1,594	£3,798	£844
50	£439	£525	£900	£1,917	£4,628	£1,057
60	£569	£635	£1,029	£2,130	£5,251	£1,201
70	£682	£732	£1,143	£2,321	£5,825	£1,329
75	£742	£785	£1,206	£2,442	£6,176	£1,403
80	£809	£846	£1,280	£2,596	£6,606	£1,492
85	£954	£984	£1,469	£3,018	£7,971	£1,719
87	£1,056	£1,082	£1,609	£3,347	£9,156	£1,888
88	£1,117	£1,140	£1,692	£3,534	£9,869	£1,985
89	£1,183	£1,202	£1,780	£3,738	£10,682	£2,090
90	£1,254	£1,269	£1,875	£3,960	£11,612	£2,203
91	£1,329	£1,341	£1,977	£4,202	£12,681	£2,324
92	£1,410	£1,416	£2,085	£4,464	£13,917	£2,454
93	£1,496	£1,496	£2,200	£4,747	£15,351	£2,591
94	£1,586	£1,580	£2,322	£5,053	£17,025	£2,737
95	£1,680	£1,668	£2,448	£5,380	£18,989	£2,890
96	£1,777	£1,757	£2,580	£5,729	£21,306	£3,049
97	£1,876	£1,848	£2,714	£6,096	£24,053	£3,212
98	£1,975	£1,938	£2,848	£6,479	£27,331	£3,377
99	£2,072	£2,026	£2,982	£6,874	£31,269	£3,541
100	£2,165	£2,110	£3,112	£7,277	£36,034	£3,703
Threshold	**100**	**100**	**100**	**100**	**95**	**100**

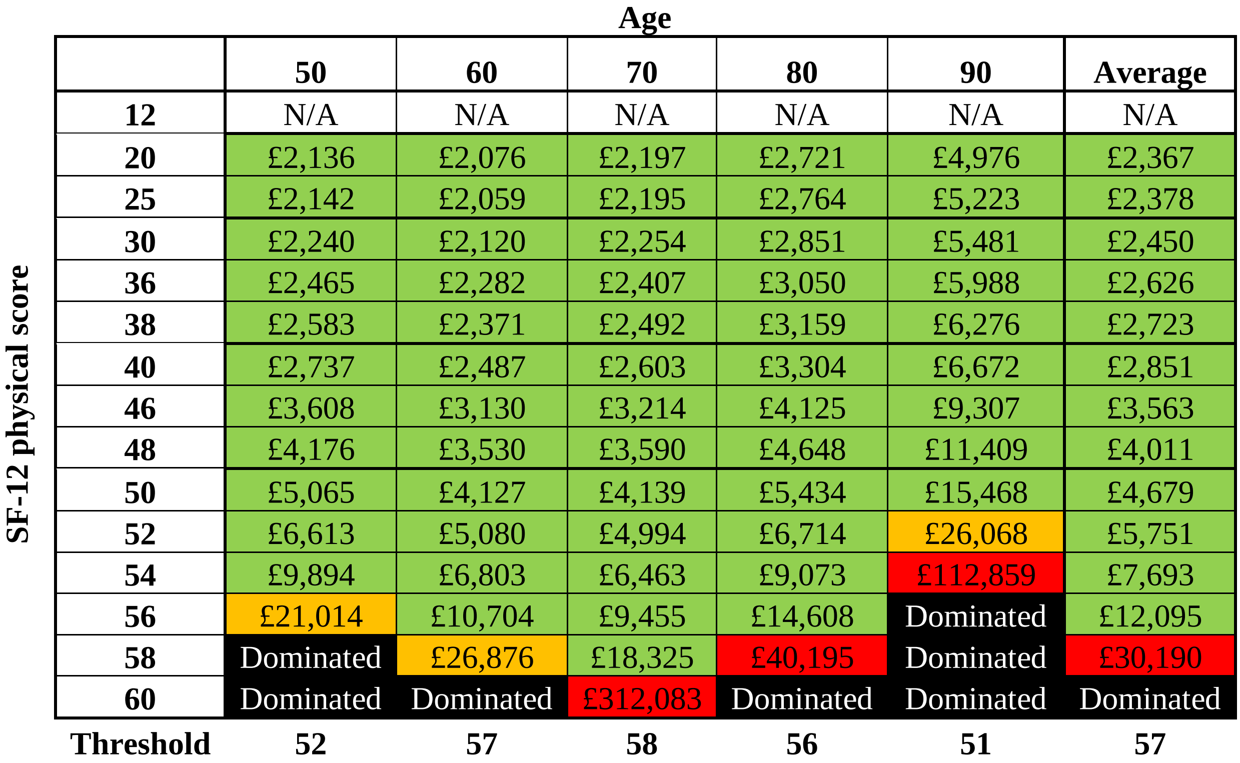
FIGURE 87 Cost-effectiveness of TKA in patients of different age and baseline WOMAC (averaged over men and women): Assuming that EQ-5D utility without TKA worsens by 0.025 per year



WOMAC score (rescaled to 0-100; 0 indicates poor function)	Age					
	50	**60**	**70**	**80**	**90**	**Average**
0	Dominant	Dominant	£168	£497	£1,177	£203
10	Dominant	Dominant	£143	£676	£1,776	£215
20	£132	£238	£587	£1,437	£3,326	£718
30	£770	£821	£1,325	£2,775	£6,326	£1,566
40	£1,738	£1,638	£2,402	£5,070	£12,852	£2,848
50	£3,085	£2,653	£3,833	£8,993	£31,907	£4,632
60	£4,860	£3,816	£5,613	£16,165	£322,189	£6,988
70	£7,528	£5,314	£8,138	£36,313	Dominated	£10,627
75	£9,793	£6,404	£10,169	£82,965	Dominated	£13,854
80	£13,667	£7,979	£13,422	Dominated	Dominated	£19,628
85	£71,492	£15,946	£40,827	Dominated	Dominated	£153,017
87	Dominated	£25,687	£189,813	Dominated	Dominated	Dominated
88	Dominated	£36,638	Dominated	Dominated	Dominated	Dominated
89	Dominated	£45,681	Dominated	Dominated	Dominated	Dominated
90	Dominated	£48,114	Dominated	Dominated	Dominated	Dominated
91	Dominated	£50,759	Dominated	Dominated	Dominated	Dominated
92	Dominated	£53,626	Dominated	Dominated	Dominated	Dominated
93	Dominated	£56,722	Dominated	Dominated	Dominated	Dominated
94	Dominated	£60,045	Dominated	Dominated	Dominated	Dominated
95	Dominated	£63,587	Dominated	Dominated	Dominated	Dominated
96	Dominated	£67,328	Dominated	Dominated	Dominated	Dominated
97	Dominated	£71,234	Dominated	Dominated	Dominated	Dominated
98	Dominated	£75,260	Dominated	Dominated	Dominated	Dominated
99	Dominated	£79,347	Dominated	Dominated	Dominated	Dominated
100	Dominated	£83,432	Dominated	Dominated	Dominated	Dominated
Threshold	**82**	**86**	**83**	**60**	**45**	**80**

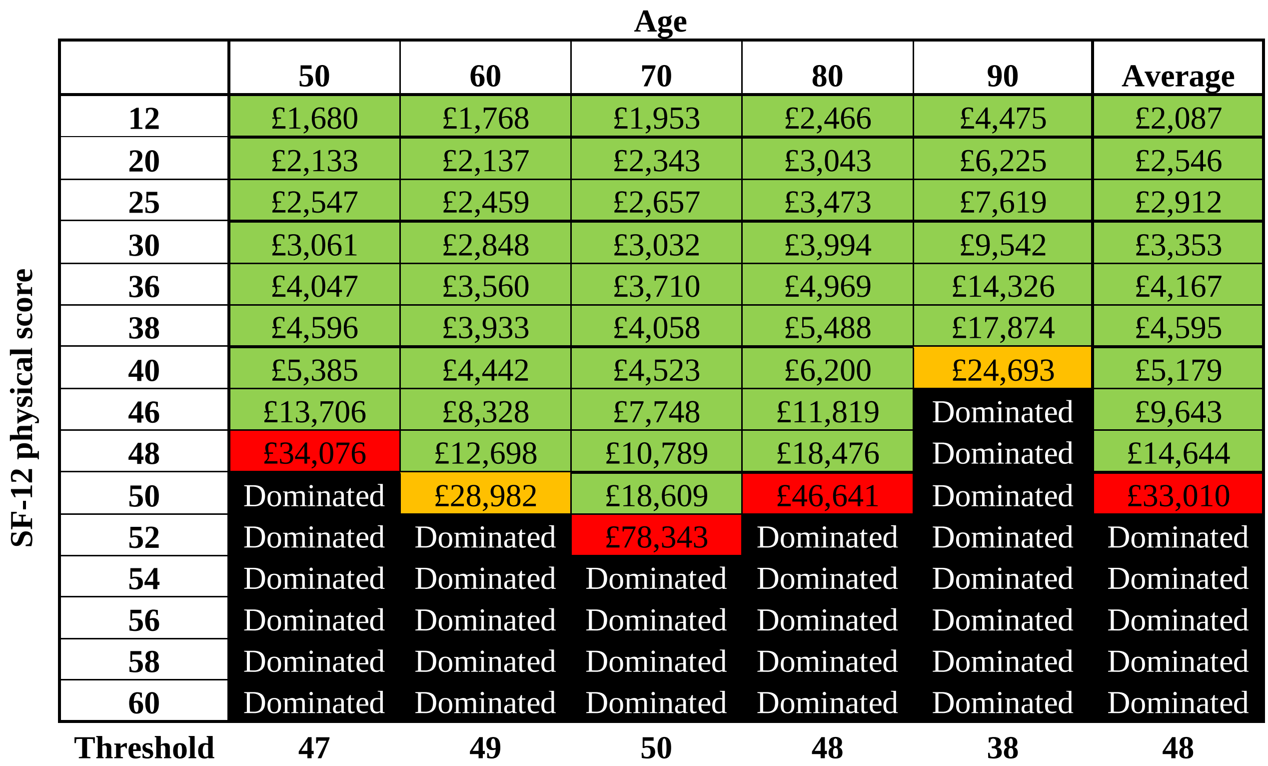
FIGURE 88 Cost-effectiveness of TKA in patients of different age and baseline WOMAC (averaged over men and women): Assuming that EQ-5D utility without TKA increases by 0.115 in the first year and follows age-related decline thereafter

SF-12 in TKA



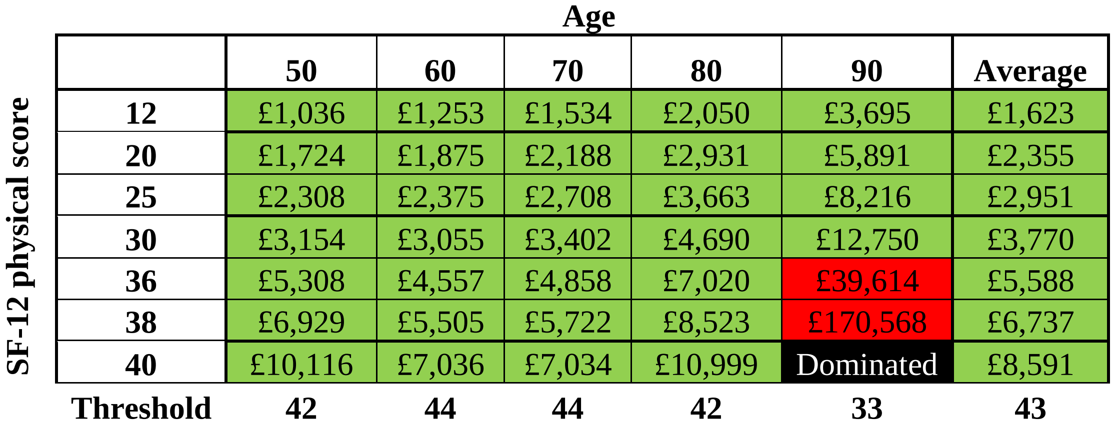
	Age					
SF-12 physical score	50	60	70	80	90	Average
12	N/A	N/A	N/A	N/A	N/A	N/A
20	£2,136	£2,076	£2,197	£2,721	£4,976	£2,367
25	£2,142	£2,059	£2,195	£2,764	£5,223	£2,378
30	£2,240	£2,120	£2,254	£2,851	£5,481	£2,450
36	£2,465	£2,282	£2,407	£3,050	£5,988	£2,626
38	£2,583	£2,371	£2,492	£3,159	£6,276	£2,723
40	£2,737	£2,487	£2,603	£3,304	£6,672	£2,851
46	£3,608	£3,130	£3,214	£4,125	£9,307	£3,563
48	£4,176	£3,530	£3,590	£4,648	£11,409	£4,011
50	£5,065	£4,127	£4,139	£5,434	£15,468	£4,679
52	£6,613	£5,080	£4,994	£6,714	£26,068	£5,751
54	£9,894	£6,803	£6,463	£9,073	£112,859	£7,693
56	£21,014	£10,704	£9,455	£14,608	Dominated	£12,095
58	Dominated	£26,876	£18,325	£40,195	Dominated	£30,190
60	Dominated	Dominated	£312,083	Dominated	Dominated	Dominated
Threshold	52	57	58	56	51	57

FIGURE 89 Cost-effectiveness of TKA in patients of different age and baseline SF-12 (averaged over men and women): 5 year time horizon, mental score 30



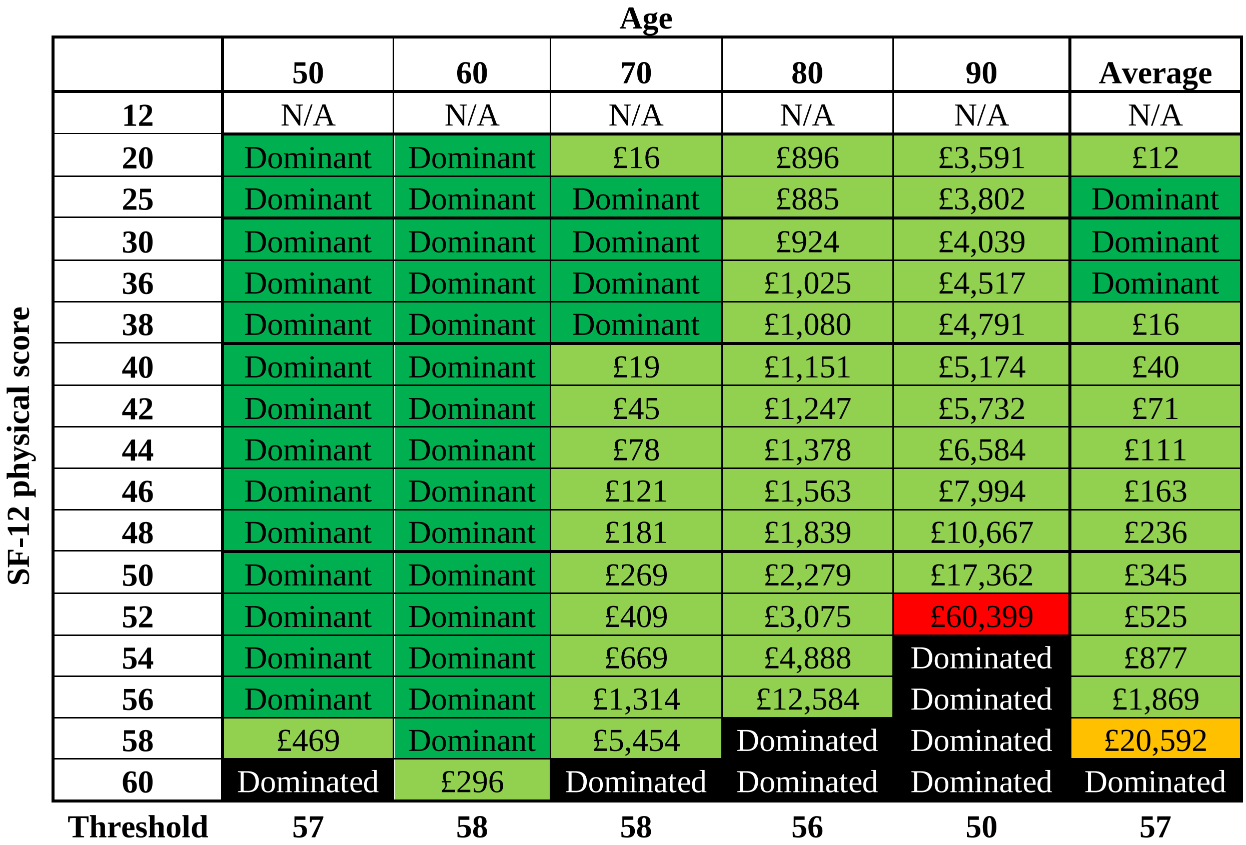
SF-12 physical score	Age 50	60	70	80	90	Average
12	£1,680	£1,768	£1,953	£2,466	£4,475	£2,087
20	£2,133	£2,137	£2,343	£3,043	£6,225	£2,546
25	£2,547	£2,459	£2,657	£3,473	£7,619	£2,912
30	£3,061	£2,848	£3,032	£3,994	£9,542	£3,353
36	£4,047	£3,560	£3,710	£4,969	£14,326	£4,167
38	£4,596	£3,933	£4,058	£5,488	£17,874	£4,595
40	£5,385	£4,442	£4,523	£6,200	£24,693	£5,179
46	£13,706	£8,328	£7,748	£11,819	Dominated	£9,643
48	£34,076	£12,698	£10,789	£18,476	Dominated	£14,644
50	Dominated	£28,982	£18,609	£46,641	Dominated	£33,010
52	Dominated	Dominated	£78,343	Dominated	Dominated	Dominated
54	Dominated	Dominated	Dominated	Dominated	Dominated	Dominated
56	Dominated	Dominated	Dominated	Dominated	Dominated	Dominated
58	Dominated	Dominated	Dominated	Dominated	Dominated	Dominated
60	Dominated	Dominated	Dominated	Dominated	Dominated	Dominated
Threshold	**47**	**49**	**50**	**48**	**38**	**48**

FIGURE 90 Cost-effectiveness of TKA in patients of different age and baseline SF-12 (averaged over men and women): 5 year time horizon, mental score 50



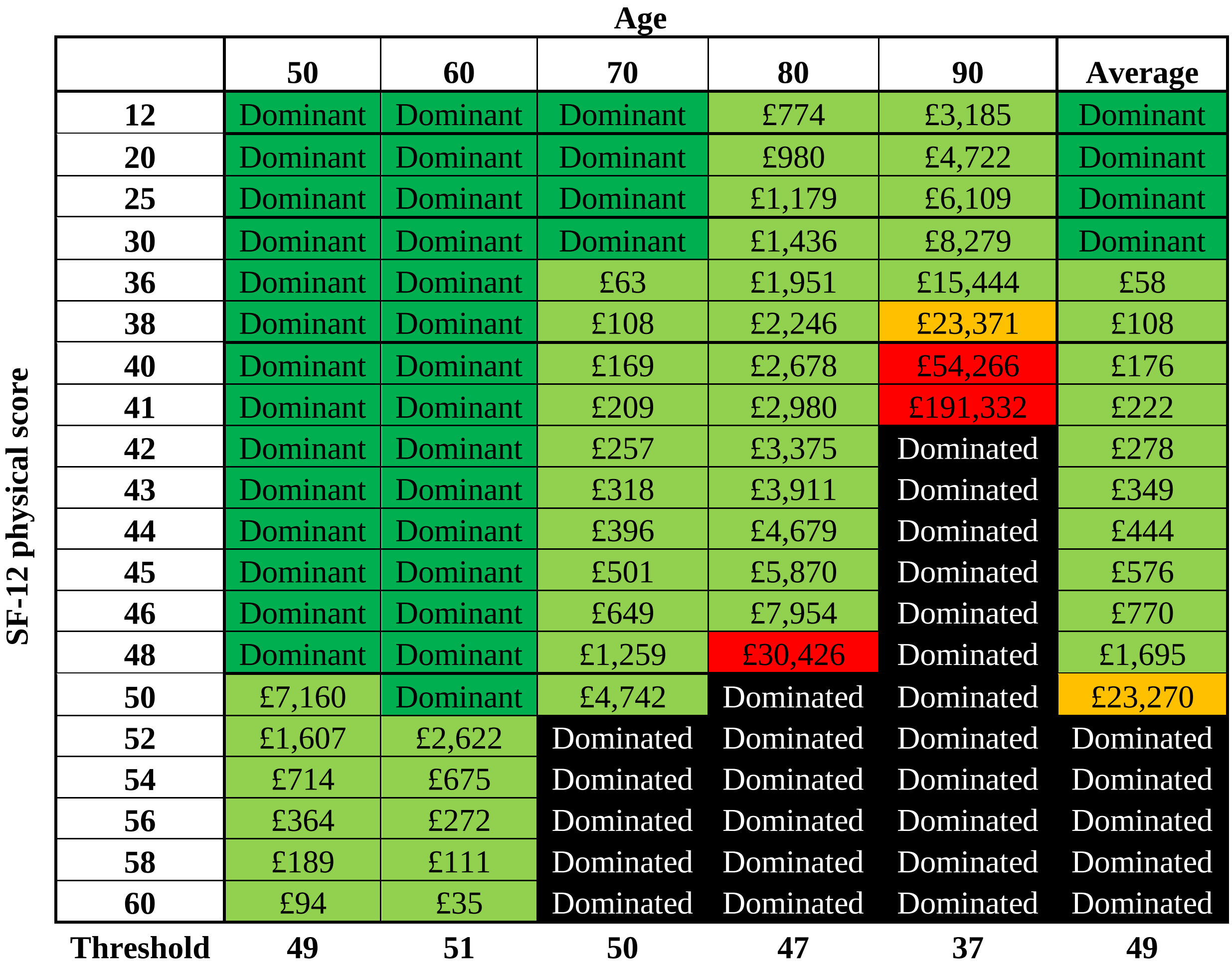
	Age					
SF-12 physical score	**50**	**60**	**70**	**80**	**90**	**Average**
12	£1,036	£1,253	£1,534	£2,050	£3,695	£1,623
20	£1,724	£1,875	£2,188	£2,931	£5,891	£2,355
25	£2,308	£2,375	£2,708	£3,663	£8,216	£2,951
30	£3,154	£3,055	£3,402	£4,690	£12,750	£3,770
36	£5,308	£4,557	£4,858	£7,020	£39,614	£5,588
38	£6,929	£5,505	£5,722	£8,523	£170,568	£6,737
40	£10,116	£7,036	£7,034	£10,999	Dominated	£8,591
Threshold	**42**	**44**	**44**	**42**	**33**	**43**

FIGURE 91 Cost-effectiveness of TKA in patients of different age and baseline SF-12 (averaged over men and women): 5 year time horizon, mental score 70



	Age					
SF-12 physical score	50	60	70	80	90	Average
12	N/A	N/A	N/A	N/A	N/A	N/A
20	Dominant	Dominant	£16	£896	£3,591	£12
25	Dominant	Dominant	Dominant	£885	£3,802	Dominant
30	Dominant	Dominant	Dominant	£924	£4,039	Dominant
36	Dominant	Dominant	Dominant	£1,025	£4,517	Dominant
38	Dominant	Dominant	Dominant	£1,080	£4,791	£16
40	Dominant	Dominant	£19	£1,151	£5,174	£40
42	Dominant	Dominant	£45	£1,247	£5,732	£71
44	Dominant	Dominant	£78	£1,378	£6,584	£111
46	Dominant	Dominant	£121	£1,563	£7,994	£163
48	Dominant	Dominant	£181	£1,839	£10,667	£236
50	Dominant	Dominant	£269	£2,279	£17,362	£345
52	Dominant	Dominant	£409	£3,075	£60,399	£525
54	Dominant	Dominant	£669	£4,888	Dominated	£877
56	Dominant	Dominant	£1,314	£12,584	Dominated	£1,869
58	£469	Dominant	£5,454	Dominated	Dominated	£20,592
60	Dominated	£296	Dominated	Dominated	Dominated	Dominated
Threshold	57	58	58	56	50	57

FIGURE 92 Cost-effectiveness of TKA in patients of different age and baseline SF-12 (averaged over men and women): 60 year time horizon, mental score 30

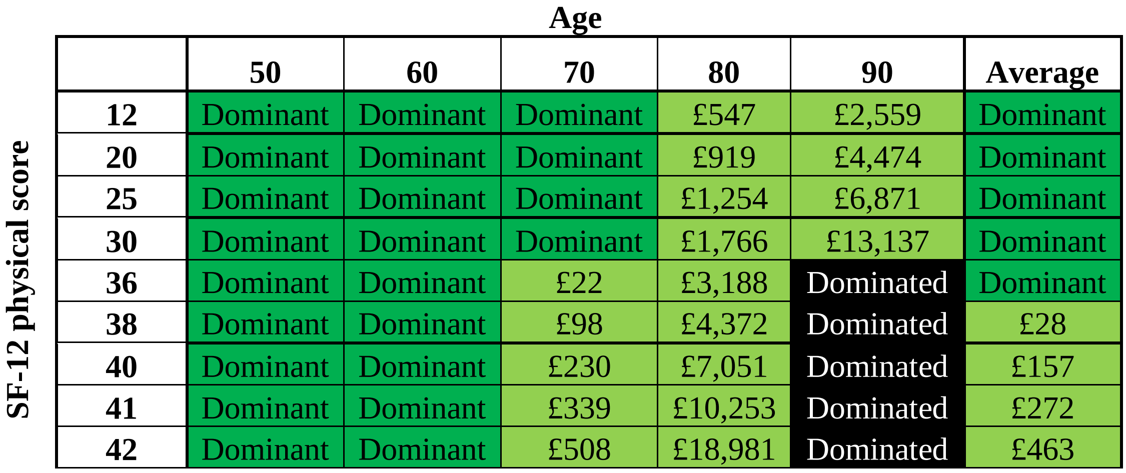


Age

SF-12 physical score

	50	60	70	80	90	Average
12	Dominant	Dominant	Dominant	£774	£3,185	Dominant
20	Dominant	Dominant	Dominant	£980	£4,722	Dominant
25	Dominant	Dominant	Dominant	£1,179	£6,109	Dominant
30	Dominant	Dominant	Dominant	£1,436	£8,279	Dominant
36	Dominant	Dominant	£63	£1,951	£15,444	£58
38	Dominant	Dominant	£108	£2,246	£23,371	£108
40	Dominant	Dominant	£169	£2,678	£54,266	£176
41	Dominant	Dominant	£209	£2,980	£191,332	£222
42	Dominant	Dominant	£257	£3,375	Dominated	£278
43	Dominant	Dominant	£318	£3,911	Dominated	£349
44	Dominant	Dominant	£396	£4,679	Dominated	£444
45	Dominant	Dominant	£501	£5,870	Dominated	£576
46	Dominant	Dominant	£649	£7,954	Dominated	£770
48	Dominant	Dominant	£1,259	£30,426	Dominated	£1,695
50	£7,160	Dominant	£4,742	Dominated	Dominated	£23,270
52	£1,607	£2,622	Dominated	Dominated	Dominated	Dominated
54	£714	£675	Dominated	Dominated	Dominated	Dominated
56	£364	£272	Dominated	Dominated	Dominated	Dominated
58	£189	£111	Dominated	Dominated	Dominated	Dominated
60	£94	£35	Dominated	Dominated	Dominated	Dominated
Threshold	**49**	**51**	**50**	**47**	**37**	**49**

FIGURE 93 Cost-effectiveness of TKA in patients of different age and baseline SF-12 (averaged over men and women): 60 year time horizon, mental score 50

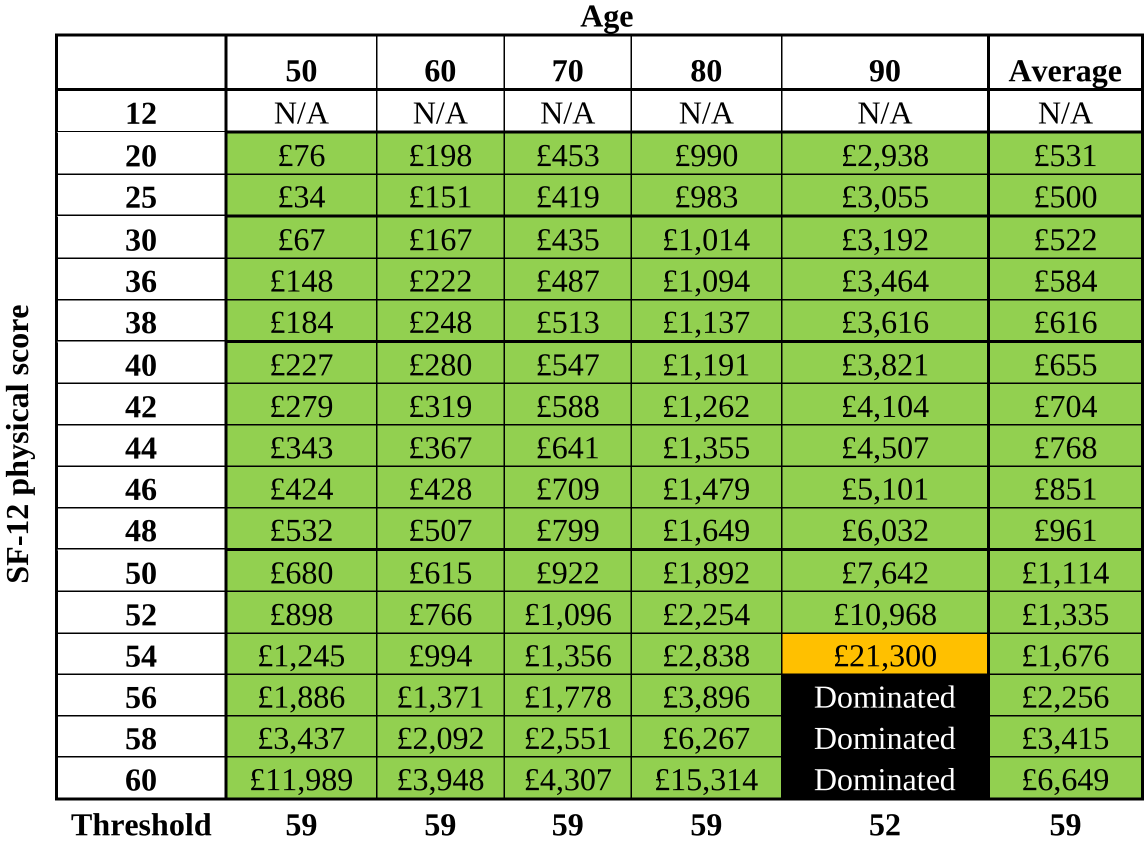


Age

SF-12 physical score

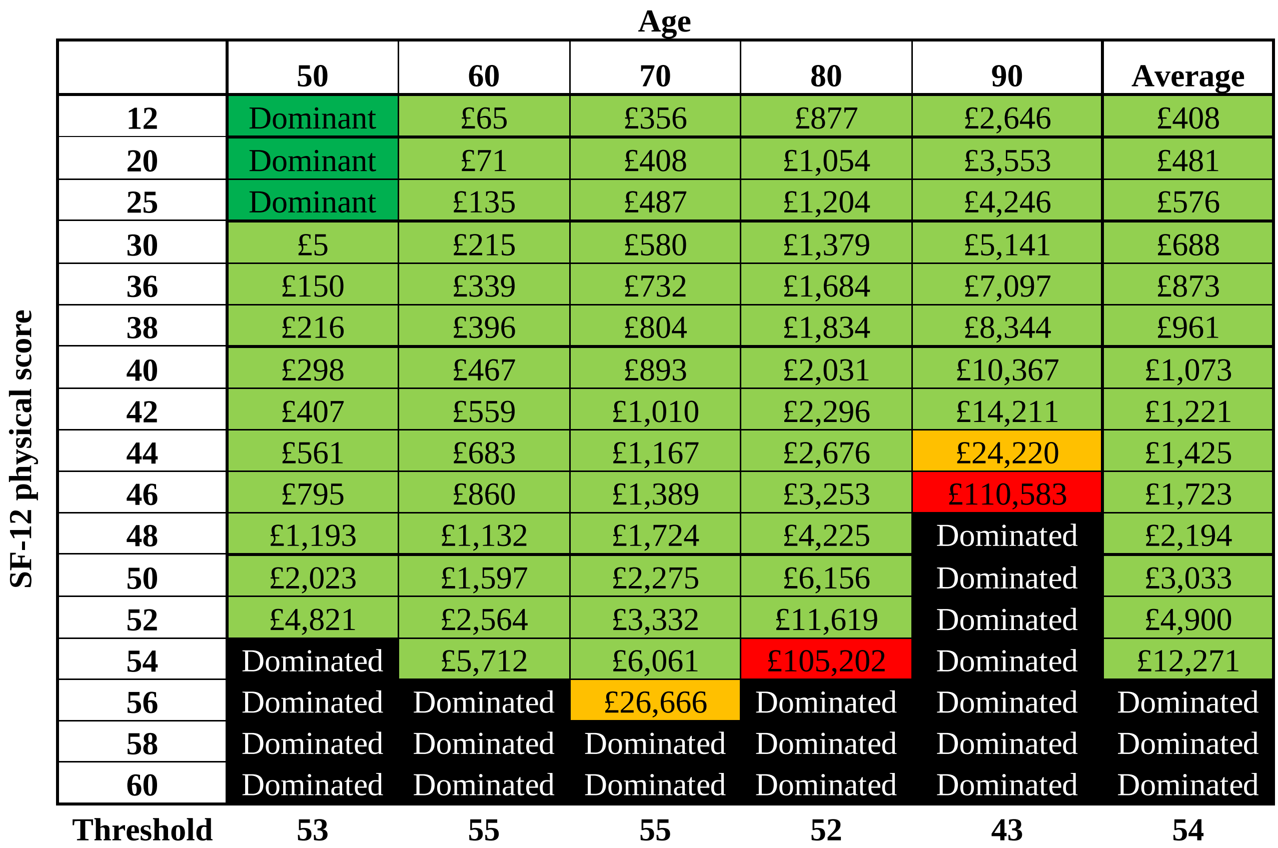
	50	60	70	80	90	Average
12	Dominant	Dominant	Dominant	£547	£2,559	Dominant
20	Dominant	Dominant	Dominant	£919	£4,474	Dominant
25	Dominant	Dominant	Dominant	£1,254	£6,871	Dominant
30	Dominant	Dominant	Dominant	£1,766	£13,137	Dominant
36	Dominant	Dominant	£22	£3,188	Dominated	Dominant
38	Dominant	Dominant	£98	£4,372	Dominated	£28
40	Dominant	Dominant	£230	£7,051	Dominated	£157
41	Dominant	Dominant	£339	£10,253	Dominated	£272
42	Dominant	Dominant	£508	£18,981	Dominated	£463

FIGURE 94 Cost-effectiveness of TKA in patients of different age and baseline SF-12 (averaged over men and women): 60 year time horizon, mental score 70



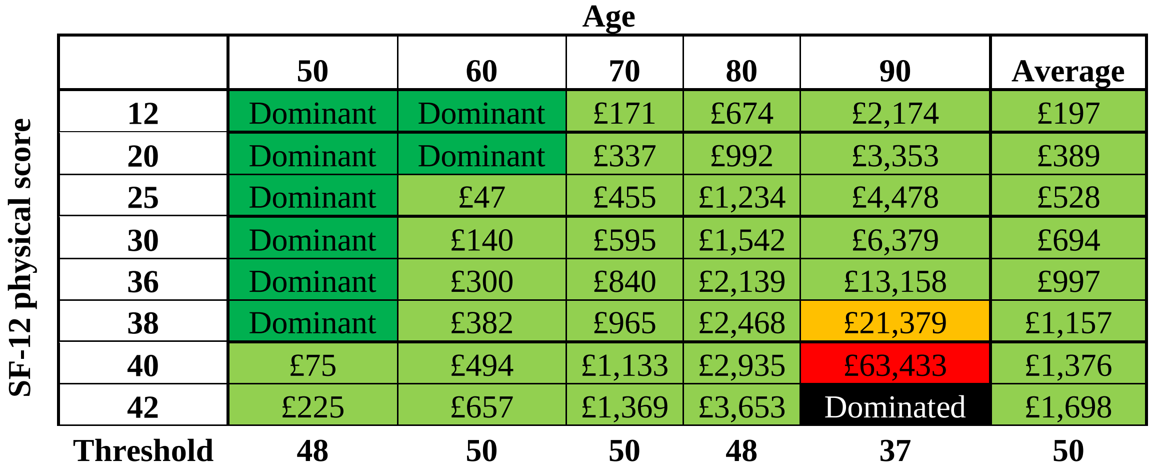
	Age					
SF-12 physical score	**50**	**60**	**70**	**80**	**90**	**Average**
12	N/A	N/A	N/A	N/A	N/A	N/A
20	£76	£198	£453	£990	£2,938	£531
25	£34	£151	£419	£983	£3,055	£500
30	£67	£167	£435	£1,014	£3,192	£522
36	£148	£222	£487	£1,094	£3,464	£584
38	£184	£248	£513	£1,137	£3,616	£616
40	£227	£280	£547	£1,191	£3,821	£655
42	£279	£319	£588	£1,262	£4,104	£704
44	£343	£367	£641	£1,355	£4,507	£768
46	£424	£428	£709	£1,479	£5,101	£851
48	£532	£507	£799	£1,649	£6,032	£961
50	£680	£615	£922	£1,892	£7,642	£1,114
52	£898	£766	£1,096	£2,254	£10,968	£1,335
54	£1,245	£994	£1,356	£2,838	£21,300	£1,676
56	£1,886	£1,371	£1,778	£3,896	Dominated	£2,256
58	£3,437	£2,092	£2,551	£6,267	Dominated	£3,415
60	£11,989	£3,948	£4,307	£15,314	Dominated	£6,649
Threshold	**59**	**59**	**59**	**59**	**52**	**59**

FIGURE 95 Cost-effectiveness of TKA in patients of different age and baseline SF-12 (averaged over men and women): Assuming that EQ-5D utility without TKA worsens by 0.025 per year, mental score 30



	Age					
SF-12 physical score	50	60	70	80	90	Average
12	Dominant	£65	£356	£877	£2,646	£408
20	Dominant	£71	£408	£1,054	£3,553	£481
25	Dominant	£135	£487	£1,204	£4,246	£576
30	£5	£215	£580	£1,379	£5,141	£688
36	£150	£339	£732	£1,684	£7,097	£873
38	£216	£396	£804	£1,834	£8,344	£961
40	£298	£467	£893	£2,031	£10,367	£1,073
42	£407	£559	£1,010	£2,296	£14,211	£1,221
44	£561	£683	£1,167	£2,676	£24,220	£1,425
46	£795	£860	£1,389	£3,253	£110,583	£1,723
48	£1,193	£1,132	£1,724	£4,225	Dominated	£2,194
50	£2,023	£1,597	£2,275	£6,156	Dominated	£3,033
52	£4,821	£2,564	£3,332	£11,619	Dominated	£4,900
54	Dominated	£5,712	£6,061	£105,202	Dominated	£12,271
56	Dominated	Dominated	£26,666	Dominated	Dominated	Dominated
58	Dominated	Dominated	Dominated	Dominated	Dominated	Dominated
60	Dominated	Dominated	Dominated	Dominated	Dominated	Dominated
Threshold	53	55	55	52	43	54

FIGURE 96 Cost-effectiveness of TKA in patients of different age and baseline SF-12 (averaged over men and women): Assuming that EQ-5D utility without TKA worsens by 0.025 per year, mental score 50

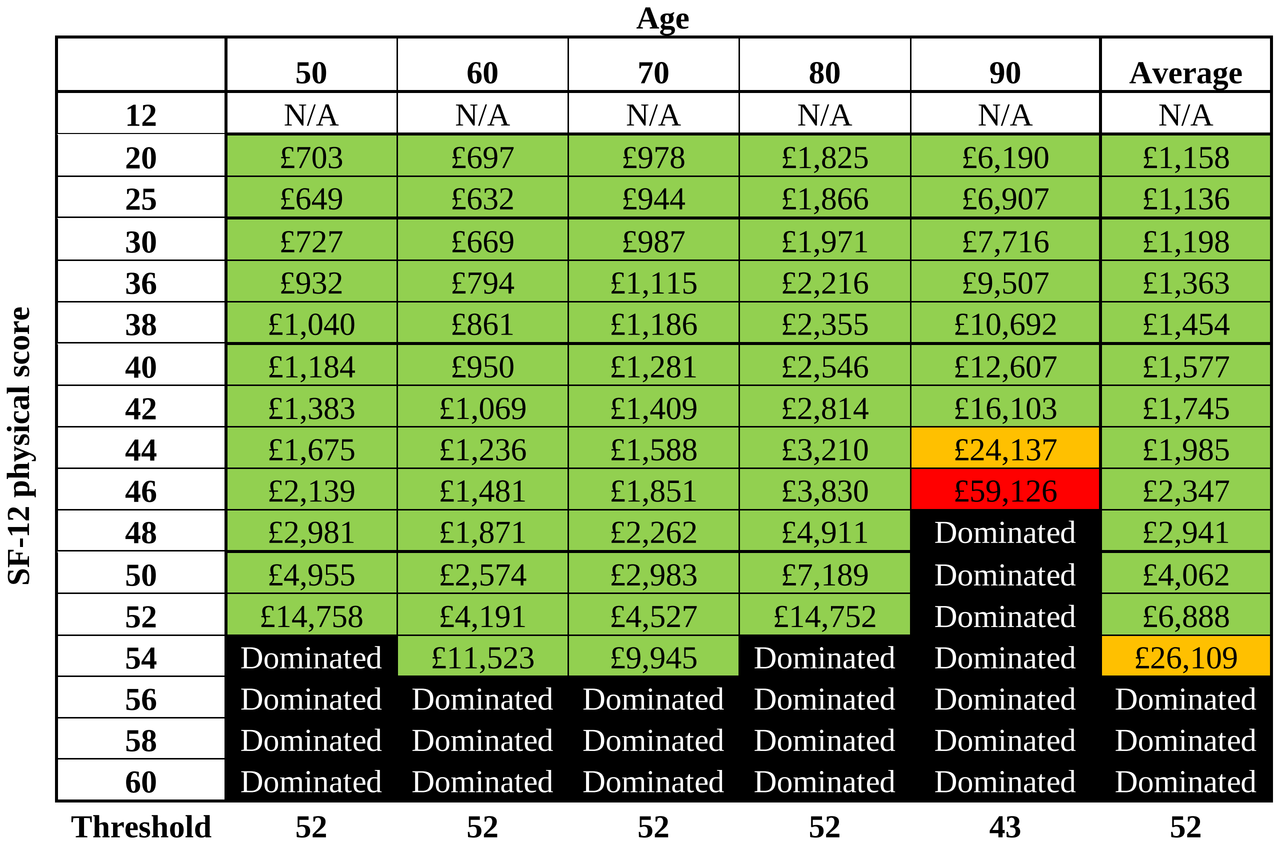


Age

SF-12 physical score

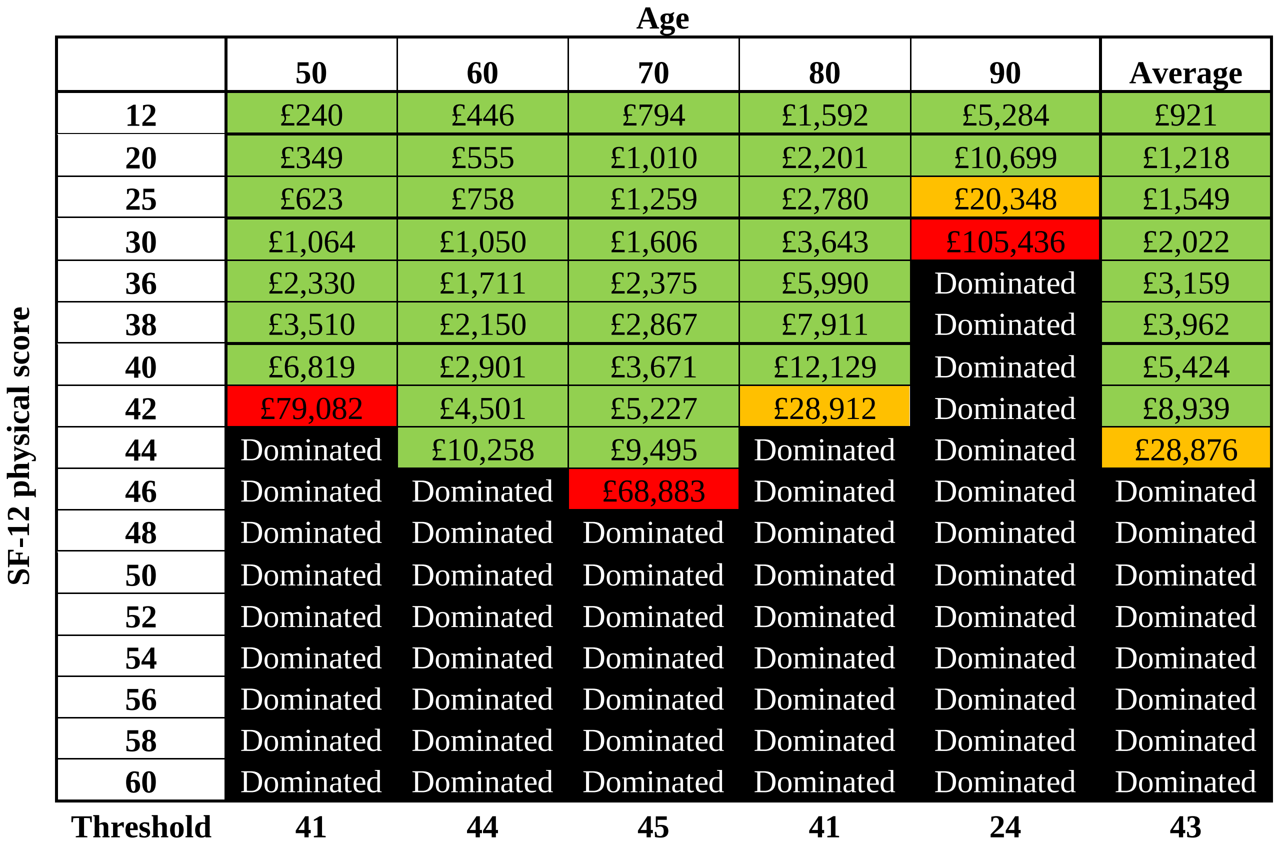
	50	60	70	80	90	Average
12	Dominant	Dominant	£171	£674	£2,174	£197
20	Dominant	Dominant	£337	£992	£3,353	£389
25	Dominant	£47	£455	£1,234	£4,478	£528
30	Dominant	£140	£595	£1,542	£6,379	£694
36	Dominant	£300	£840	£2,139	£13,158	£997
38	Dominant	£382	£965	£2,468	£21,379	£1,157
40	£75	£494	£1,133	£2,935	£63,433	£1,376
42	£225	£657	£1,369	£3,653	Dominated	£1,698
Threshold	**48**	**50**	**50**	**48**	**37**	**50**

FIGURE 97 Cost-effectiveness of TKA in patients of different age and baseline SF-12 (averaged over men and women): Assuming that EQ-5D utility without TKA worsens by 0.025 per year, mental score 70



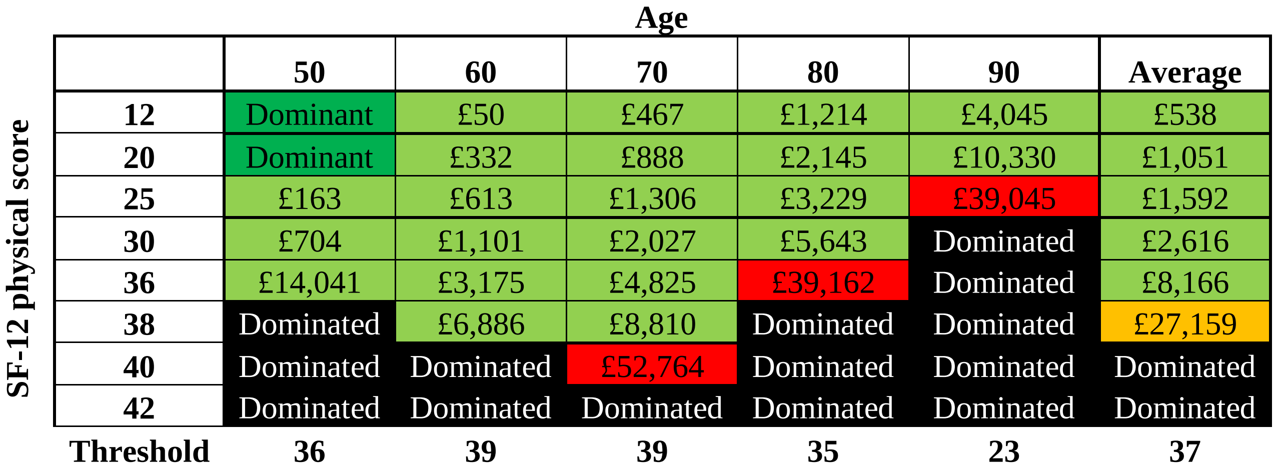
SF-12 physical score	Age					
	50	60	70	80	90	Average
12	N/A	N/A	N/A	N/A	N/A	N/A
20	£703	£697	£978	£1,825	£6,190	£1,158
25	£649	£632	£944	£1,866	£6,907	£1,136
30	£727	£669	£987	£1,971	£7,716	£1,198
36	£932	£794	£1,115	£2,216	£9,507	£1,363
38	£1,040	£861	£1,186	£2,355	£10,692	£1,454
40	£1,184	£950	£1,281	£2,546	£12,607	£1,577
42	£1,383	£1,069	£1,409	£2,814	£16,103	£1,745
44	£1,675	£1,236	£1,588	£3,210	£24,137	£1,985
46	£2,139	£1,481	£1,851	£3,830	£59,126	£2,347
48	£2,981	£1,871	£2,262	£4,911	Dominated	£2,941
50	£4,955	£2,574	£2,983	£7,189	Dominated	£4,062
52	£14,758	£4,191	£4,527	£14,752	Dominated	£6,888
54	Dominated	£11,523	£9,945	Dominated	Dominated	£26,109
56	Dominated	Dominated	Dominated	Dominated	Dominated	Dominated
58	Dominated	Dominated	Dominated	Dominated	Dominated	Dominated
60	Dominated	Dominated	Dominated	Dominated	Dominated	Dominated
Threshold	**52**	**52**	**52**	**52**	**43**	**52**

FIGURE 98 Cost-effectiveness of TKA in patients of different age and baseline SF-12 (averaged over men and women): Assuming that EQ-5D utility without TKA increases by 0.115 in the first year and follows age-related decline thereafter, mental score 30



	Age					
SF-12 physical score	**50**	**60**	**70**	**80**	**90**	**Average**
12	£240	£446	£794	£1,592	£5,284	£921
20	£349	£555	£1,010	£2,201	£10,699	£1,218
25	£623	£758	£1,259	£2,780	£20,348	£1,549
30	£1,064	£1,050	£1,606	£3,643	£105,436	£2,022
36	£2,330	£1,711	£2,375	£5,990	Dominated	£3,159
38	£3,510	£2,150	£2,867	£7,911	Dominated	£3,962
40	£6,819	£2,901	£3,671	£12,129	Dominated	£5,424
42	£79,082	£4,501	£5,227	£28,912	Dominated	£8,939
44	Dominated	£10,258	£9,495	Dominated	Dominated	£28,876
46	Dominated	Dominated	£68,883	Dominated	Dominated	Dominated
48	Dominated	Dominated	Dominated	Dominated	Dominated	Dominated
50	Dominated	Dominated	Dominated	Dominated	Dominated	Dominated
52	Dominated	Dominated	Dominated	Dominated	Dominated	Dominated
54	Dominated	Dominated	Dominated	Dominated	Dominated	Dominated
56	Dominated	Dominated	Dominated	Dominated	Dominated	Dominated
58	Dominated	Dominated	Dominated	Dominated	Dominated	Dominated
60	Dominated	Dominated	Dominated	Dominated	Dominated	Dominated
Threshold	**41**	**44**	**45**	**41**	**24**	**43**

FIGURE 99 Cost-effectiveness of TKA in patients of different age and baseline SF-12 (averaged over men and women): Assuming that EQ-5D utility without TKA increases by 0.115 in the first year and follows age-related decline thereafter, mental score 50



	Age					
SF-12 physical score	**50**	**60**	**70**	**80**	**90**	**Average**
12	Dominant	£50	£467	£1,214	£4,045	£538
20	Dominant	£332	£888	£2,145	£10,330	£1,051
25	£163	£613	£1,306	£3,229	£39,045	£1,592
30	£704	£1,101	£2,027	£5,643	Dominated	£2,616
36	£14,041	£3,175	£4,825	£39,162	Dominated	£8,166
38	Dominated	£6,886	£8,810	Dominated	Dominated	£27,159
40	Dominated	Dominated	£52,764	Dominated	Dominated	Dominated
42	Dominated	Dominated	Dominated	Dominated	Dominated	Dominated
Threshold	**36**	**39**	**39**	**35**	**23**	**37**

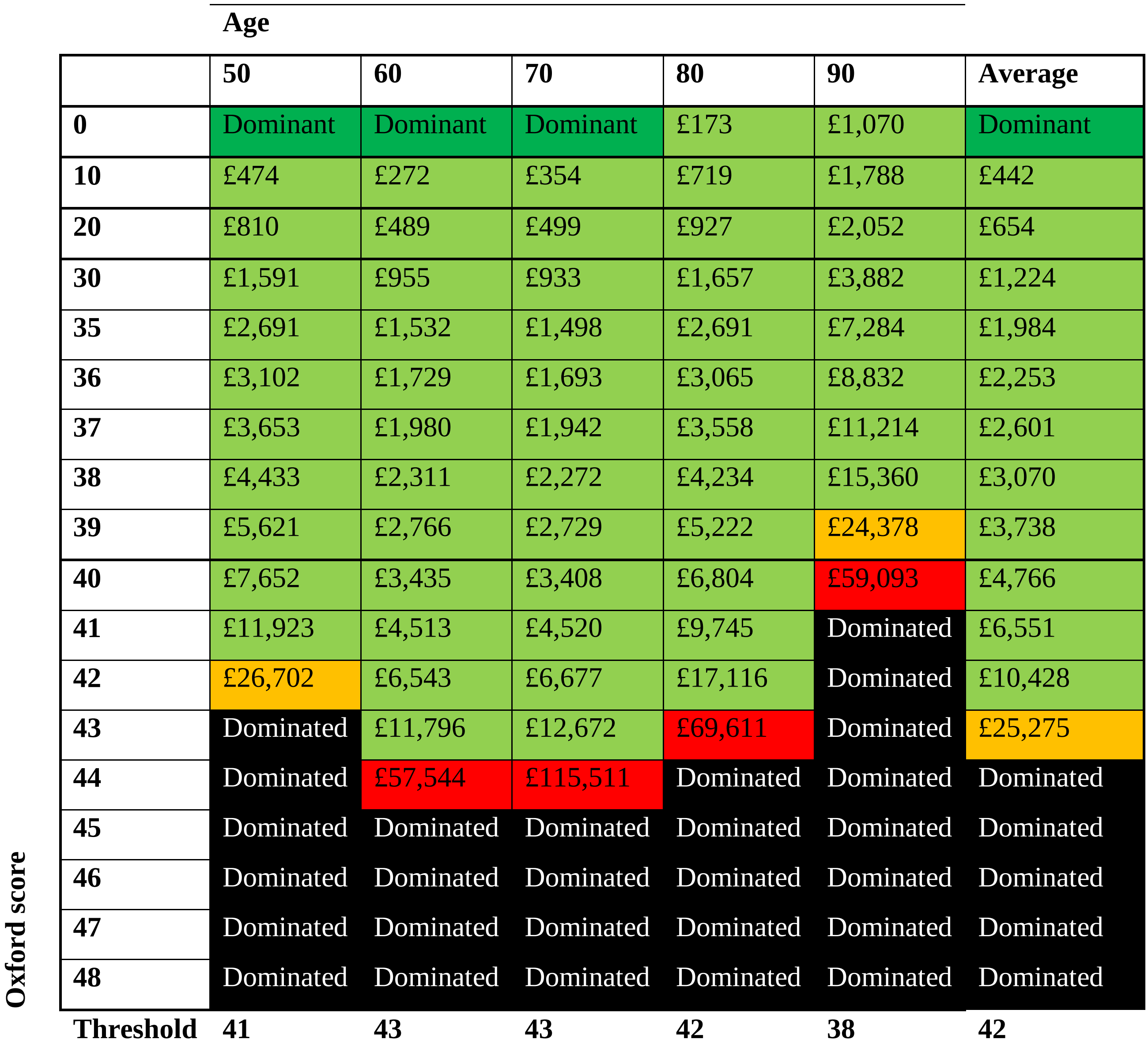
FIGURE 100 Cost-effectiveness of TKA in patients of different age and baseline SF-12 (averaged over men and women): Assuming that EQ-5D utility without TKA increases by 0.115 in the first year and follows age-related decline thereafter, mental score70

OHS in THA

Oxford score

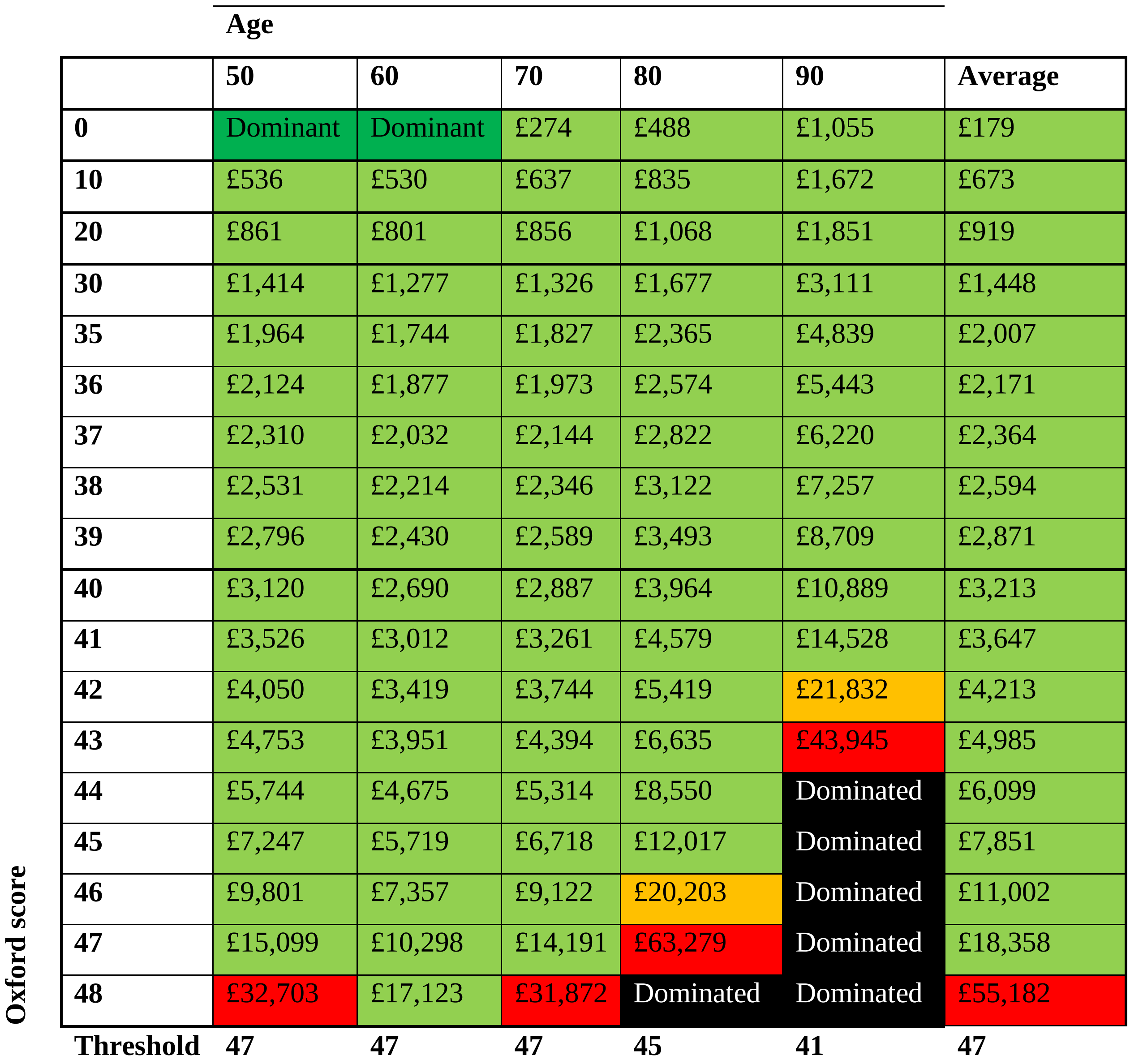
	Age					
	50	**60**	**70**	**80**	**90**	**Average**
0	£507	£986	£1,740	£1,935	£2,320	£1,507
10	£1,437	£1,516	£1,783	£1,956	£2,710	£1,759
20	£2,056	£2,078	£2,268	£2,514	£3,226	£2,295
30	£3,533	£3,451	£3,707	£4,219	£5,979	£3,822
35	£5,457	£5,167	£5,646	£6,673	£11,093	£5,894
36	£6,121	£5,740	£6,311	£7,561	£13,409	£6,615
37	£6,969	£6,455	£7,155	£8,724	£16,962	£7,539
38	£8,089	£7,377	£8,264	£10,316	£23,103	£8,766
39	£9,637	£8,606	£9,783	£12,627	£36,277	£10,473
40	£11,916	£10,328	£11,993	£16,283	£84,754	£13,012
41	£15,606	£12,917	£15,501	£22,946	Dominated	£17,186
42	£22,605	£17,243	£21,930	£38,907	Dominated	£25,323
43	£40,988	£25,941	£37,529	£128,586	Dominated	£48,174
44	£219,528	£52,409	£130,652	Dominated	Dominated	£502,036
45	Dominated	Dominated	Dominated	Dominated	Dominated	Dominated
46	Dominated	Dominated	Dominated	Dominated	Dominated	Dominated
47	Dominated	Dominated	Dominated	Dominated	Dominated	Dominated
48	Dominated	Dominated	Dominated	Dominated	Dominated	Dominated
Threshold	**41**	**42**	**41**	**40**	**37**	**41**

FIGURE 101 Cost-effectiveness of THA in patients of different age and baseline OHS (averaged over men and women): 5 year time horizon



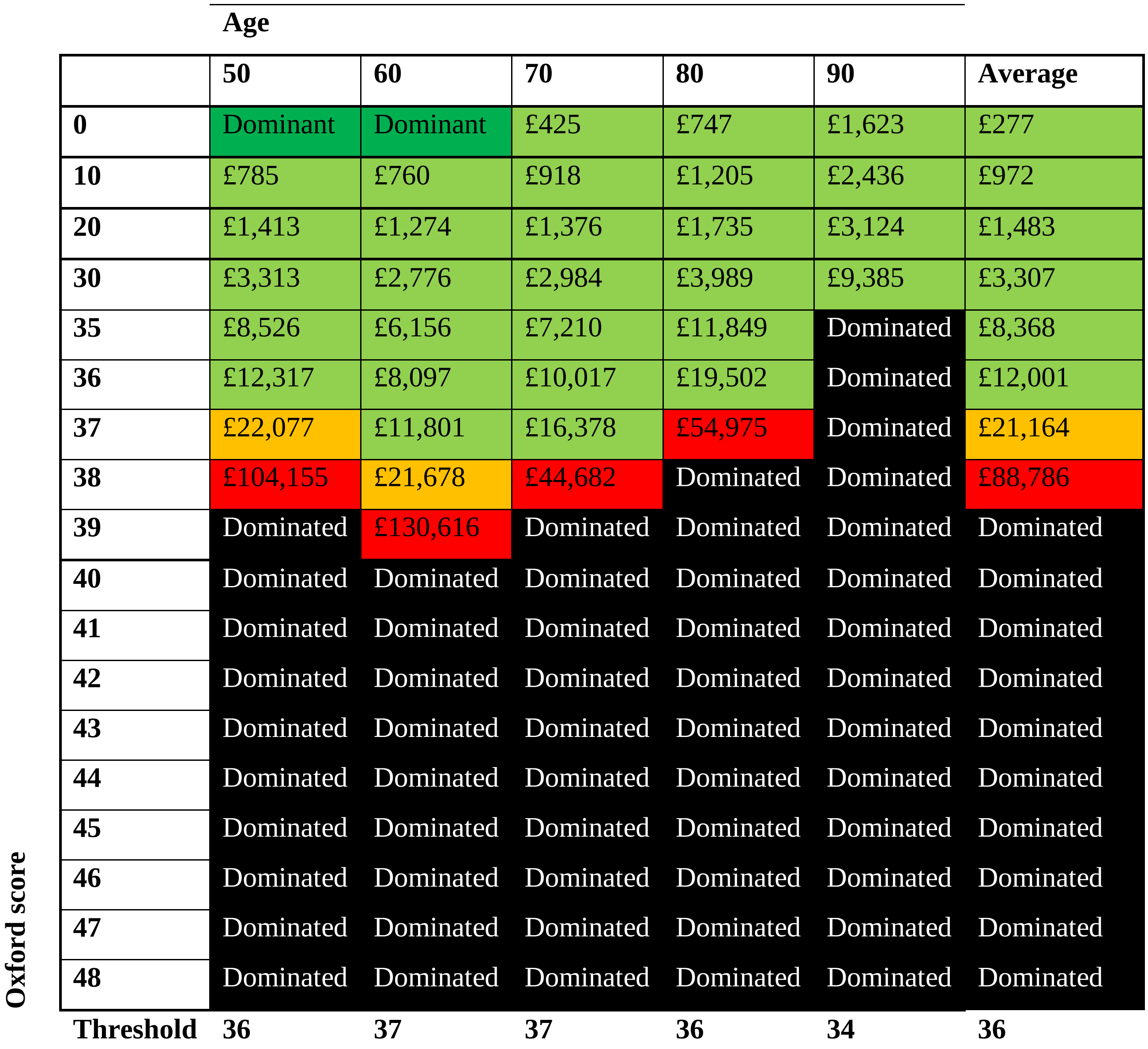
		Age					
		50	60	70	80	90	Average
Oxford score	0	Dominant	Dominant	Dominant	£173	£1,070	Dominant
	10	£474	£272	£354	£719	£1,788	£442
	20	£810	£489	£499	£927	£2,052	£654
	30	£1,591	£955	£933	£1,657	£3,882	£1,224
	35	£2,691	£1,532	£1,498	£2,691	£7,284	£1,984
	36	£3,102	£1,729	£1,693	£3,065	£8,832	£2,253
	37	£3,653	£1,980	£1,942	£3,558	£11,214	£2,601
	38	£4,433	£2,311	£2,272	£4,234	£15,360	£3,070
	39	£5,621	£2,766	£2,729	£5,222	£24,378	£3,738
	40	£7,652	£3,435	£3,408	£6,804	£59,093	£4,766
	41	£11,923	£4,513	£4,520	£9,745	Dominated	£6,551
	42	£26,702	£6,543	£6,677	£17,116	Dominated	£10,428
	43	Dominated	£11,796	£12,672	£69,611	Dominated	£25,275
	44	Dominated	£57,544	£115,511	Dominated	Dominated	Dominated
	45	Dominated	Dominated	Dominated	Dominated	Dominated	Dominated
	46	Dominated	Dominated	Dominated	Dominated	Dominated	Dominated
	47	Dominated	Dominated	Dominated	Dominated	Dominated	Dominated
	48	Dominated	Dominated	Dominated	Dominated	Dominated	Dominated
	Threshold	41	43	43	42	38	42

FIGURE 102 Cost-effectiveness of THA in patients of different age and baseline OHS (averaged over men and women): 60 year time horizon



Oxford score	Age					
	50	60	70	80	90	Average
0	Dominant	Dominant	£274	£488	£1,055	£179
10	£536	£530	£637	£835	£1,672	£673
20	£861	£801	£856	£1,068	£1,851	£919
30	£1,414	£1,277	£1,326	£1,677	£3,111	£1,448
35	£1,964	£1,744	£1,827	£2,365	£4,839	£2,007
36	£2,124	£1,877	£1,973	£2,574	£5,443	£2,171
37	£2,310	£2,032	£2,144	£2,822	£6,220	£2,364
38	£2,531	£2,214	£2,346	£3,122	£7,257	£2,594
39	£2,796	£2,430	£2,589	£3,493	£8,709	£2,871
40	£3,120	£2,690	£2,887	£3,964	£10,889	£3,213
41	£3,526	£3,012	£3,261	£4,579	£14,528	£3,647
42	£4,050	£3,419	£3,744	£5,419	£21,832	£4,213
43	£4,753	£3,951	£4,394	£6,635	£43,945	£4,985
44	£5,744	£4,675	£5,314	£8,550	Dominated	£6,099
45	£7,247	£5,719	£6,718	£12,017	Dominated	£7,851
46	£9,801	£7,357	£9,122	£20,203	Dominated	£11,002
47	£15,099	£10,298	£14,191	£63,279	Dominated	£18,358
48	£32,703	£17,123	£31,872	Dominated	Dominated	£55,182
Threshold	**47**	**47**	**47**	**45**	**41**	**47**

FIGURE 103 Cost-effectiveness of THA in patients of different age and baseline OHS (averaged over men and women): Assuming that EQ-5D utility without THA worsens by 0.025 per year



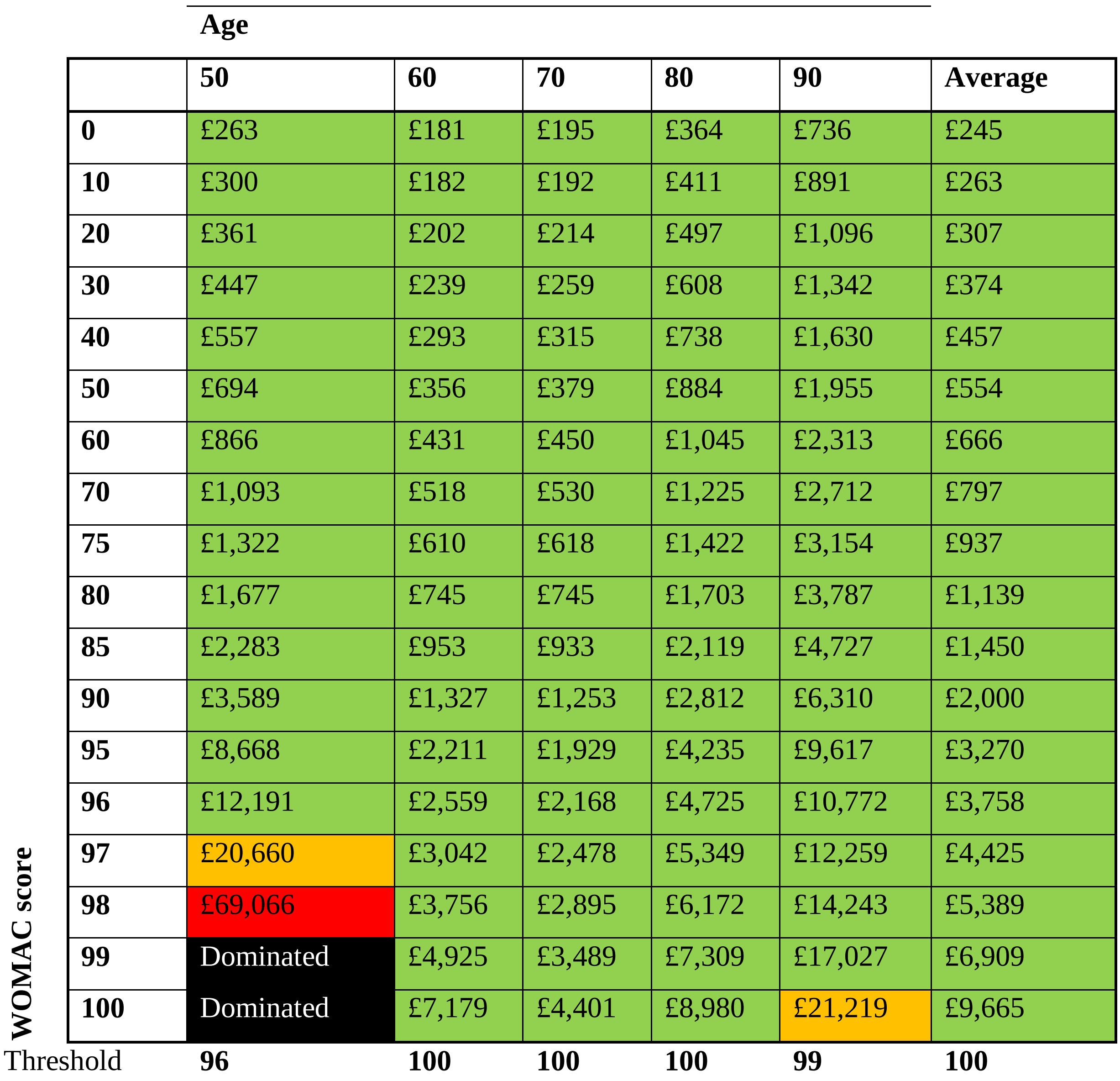
		Age					
		50	**60**	**70**	**80**	**90**	**Average**
Oxford score	**0**	Dominant	Dominant	£425	£747	£1,623	£277
	10	£785	£760	£918	£1,205	£2,436	£972
	20	£1,413	£1,274	£1,376	£1,735	£3,124	£1,483
	30	£3,313	£2,776	£2,984	£3,989	£9,385	£3,307
	35	£8,526	£6,156	£7,210	£11,849	Dominated	£8,368
	36	£12,317	£8,097	£10,017	£19,502	Dominated	£12,001
	37	£22,077	£11,801	£16,378	£54,975	Dominated	£21,164
	38	£104,155	£21,678	£44,682	Dominated	Dominated	£88,786
	39	Dominated	£130,616	Dominated	Dominated	Dominated	Dominated
	40	Dominated	Dominated	Dominated	Dominated	Dominated	Dominated
	41	Dominated	Dominated	Dominated	Dominated	Dominated	Dominated
	42	Dominated	Dominated	Dominated	Dominated	Dominated	Dominated
	43	Dominated	Dominated	Dominated	Dominated	Dominated	Dominated
	44	Dominated	Dominated	Dominated	Dominated	Dominated	Dominated
	45	Dominated	Dominated	Dominated	Dominated	Dominated	Dominated
	46	Dominated	Dominated	Dominated	Dominated	Dominated	Dominated
	47	Dominated	Dominated	Dominated	Dominated	Dominated	Dominated
	48	Dominated	Dominated	Dominated	Dominated	Dominated	Dominated
	Threshold	**36**	**37**	**37**	**36**	**34**	**36**

FIGURE 104 Cost-effectiveness of THA in patients of different age and baseline OHS (averaged over men and women): Assuming that EQ-5D utility without THA increases by 0.115 in the first year and follows age-related decline thereafter

WOMAC in THA

WOMAC score	Age					
	50	**60**	**70**	**80**	**90**	**Average**
0	£763	£826	£879	£966	£1,139	£887
10	£941	£1,018	£1,083	£1,190	£1,404	£1,093
20	£1,160	£1,252	£1,332	£1,463	£1,729	£1,345
30	£1,423	£1,533	£1,630	£1,790	£2,118	£1,646
40	£1,730	£1,861	£1,974	£2,169	£2,570	£1,996
50	£2,077	£2,231	£2,362	£2,594	£3,080	£2,390
60	£2,462	£2,639	£2,787	£3,061	£3,642	£2,823
70	£2,897	£3,093	£3,258	£3,577	£4,267	£3,305
75	£3,371	£3,591	£3,781	£4,148	£4,960	£3,836
80	£4,045	£4,299	£4,522	£4,958	£5,949	£4,590
85	£5,043	£5,343	£5,612	£6,150	£7,417	£5,702
90	£6,708	£7,071	£7,414	£8,122	£9,880	£7,543
95	£10,131	£10,570	£11,047	£12,107	£14,992	£11,274
96	£11,310	£11,759	£12,277	£13,458	£16,767	£12,542
97	£12,813	£13,262	£13,830	£15,166	£19,042	£14,148
98	£14,796	£15,225	£15,853	£17,394	£22,064	£16,246
99	£17,536	£17,901	£18,601	£20,426	£26,276	£19,107
100	£21,570	£21,764	£22,550	£24,793	£32,559	£23,244
Threshold	**99**	**99**	**99**	**98**	**97**	**99**

FIGURE 105 Cost-effectiveness of THA in patients of different age and baseline WOMAC (averaged over men and women): 5 year time horizon

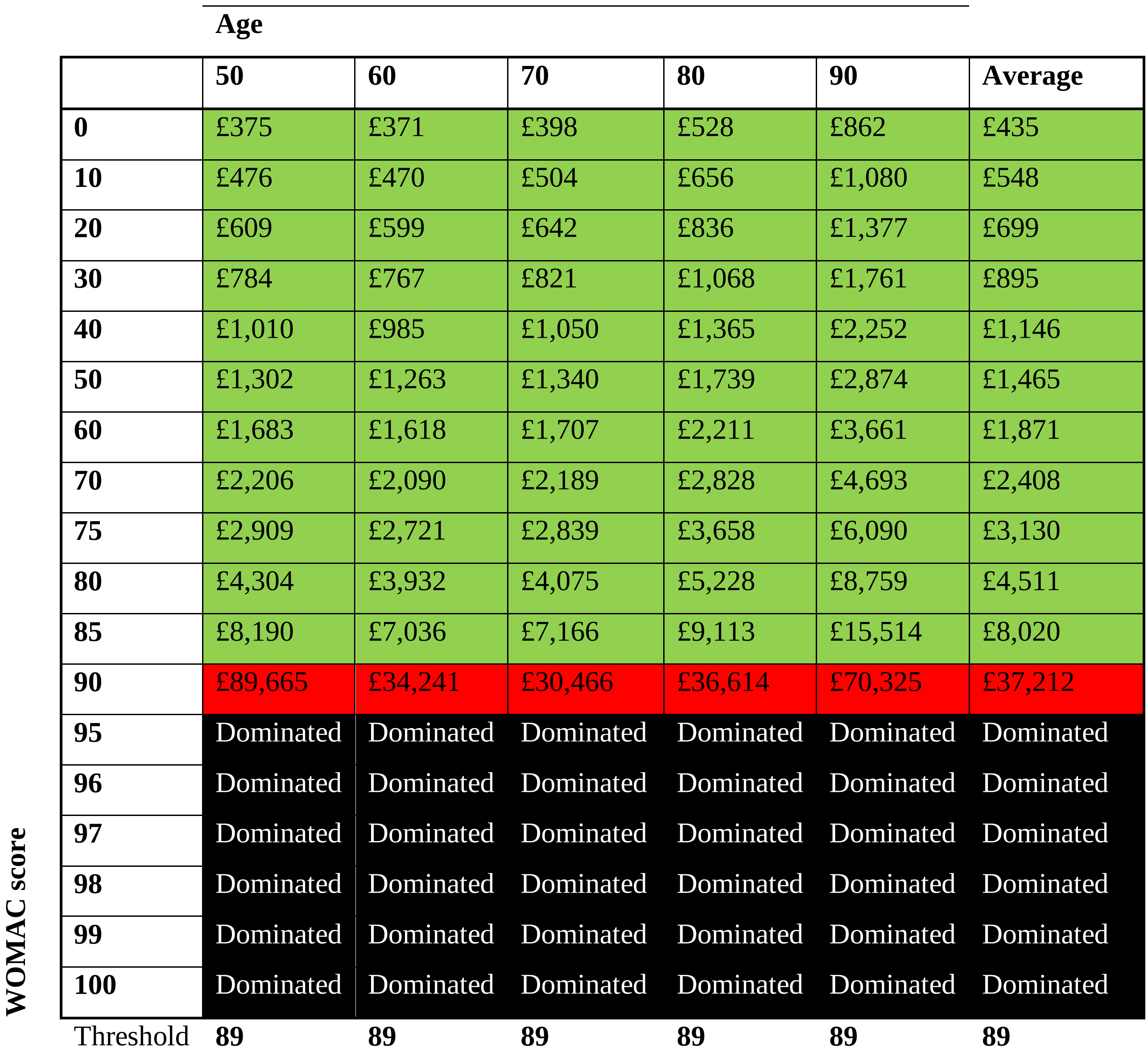


	Age					
WOMAC score	**50**	**60**	**70**	**80**	**90**	**Average**
0	£263	£181	£195	£364	£736	£245
10	£300	£182	£192	£411	£891	£263
20	£361	£202	£214	£497	£1,096	£307
30	£447	£239	£259	£608	£1,342	£374
40	£557	£293	£315	£738	£1,630	£457
50	£694	£356	£379	£884	£1,955	£554
60	£866	£431	£450	£1,045	£2,313	£666
70	£1,093	£518	£530	£1,225	£2,712	£797
75	£1,322	£610	£618	£1,422	£3,154	£937
80	£1,677	£745	£745	£1,703	£3,787	£1,139
85	£2,283	£953	£933	£2,119	£4,727	£1,450
90	£3,589	£1,327	£1,253	£2,812	£6,310	£2,000
95	£8,668	£2,211	£1,929	£4,235	£9,617	£3,270
96	£12,191	£2,559	£2,168	£4,725	£10,772	£3,758
97	£20,660	£3,042	£2,478	£5,349	£12,259	£4,425
98	£69,066	£3,756	£2,895	£6,172	£14,243	£5,389
99	Dominated	£4,925	£3,489	£7,309	£17,027	£6,909
100	Dominated	£7,179	£4,401	£8,980	£21,219	£9,665
Threshold	**96**	**100**	**100**	**100**	**99**	**100**

FIGURE 106 Cost-effectiveness of THA in patients of different age and baseline WOMAC (averaged over men and women): 60 year time horizon

	Age					
WOMAC score	**50**	**60**	**70**	**80**	**90**	**Average**
0	£308	£305	£329	£440	£730	£360
10	£372	£369	£397	£522	£878	£433
20	£450	£444	£479	£631	£1,065	£522
30	£539	£531	£572	£755	£1,282	£624
40	£637	£628	£675	£892	£1,525	£738
50	£744	£731	£784	£1,039	£1,787	£859
60	£855	£839	£897	£1,191	£2,062	£984
70	£975	£952	£1,015	£1,349	£2,354	£1,116
75	£1,092	£1,064	£1,136	£1,513	£2,660	£1,250
80	£1,245	£1,211	£1,294	£1,727	£3,067	£1,424
85	£1,445	£1,403	£1,500	£2,009	£3,617	£1,653
90	£1,723	£1,669	£1,786	£2,405	£4,416	£1,972
95	£2,144	£2,070	£2,219	£3,016	£5,711	£2,457
96	£2,257	£2,177	£2,335	£3,181	£6,076	£2,587
97	£2,383	£2,296	£2,464	£3,367	£6,494	£2,733
98	£2,525	£2,430	£2,610	£3,579	£6,980	£2,898
99	£2,687	£2,583	£2,777	£3,821	£7,550	£3,086
100	£2,873	£2,757	£2,968	£4,102	£8,229	£3,303
Threshold	**100**	**100**	**100**	**100**	**100**	**100**

FIGURE 107 Cost-effectiveness of THA in patients of different age and baseline WOMAC (averaged over men and women): Assuming that EQ-5D utility without THA worsens by 0.025 per year



	Age					
WOMAC score	**50**	**60**	**70**	**80**	**90**	**Average**
0	£375	£371	£398	£528	£862	£435
10	£476	£470	£504	£656	£1,080	£548
20	£609	£599	£642	£836	£1,377	£699
30	£784	£767	£821	£1,068	£1,761	£895
40	£1,010	£985	£1,050	£1,365	£2,252	£1,146
50	£1,302	£1,263	£1,340	£1,739	£2,874	£1,465
60	£1,683	£1,618	£1,707	£2,211	£3,661	£1,871
70	£2,206	£2,090	£2,189	£2,828	£4,693	£2,408
75	£2,909	£2,721	£2,839	£3,658	£6,090	£3,130
80	£4,304	£3,932	£4,075	£5,228	£8,759	£4,511
85	£8,190	£7,036	£7,166	£9,113	£15,514	£8,020
90	£89,665	£34,241	£30,466	£36,614	£70,325	£37,212
95	Dominated	Dominated	Dominated	Dominated	Dominated	Dominated
96	Dominated	Dominated	Dominated	Dominated	Dominated	Dominated
97	Dominated	Dominated	Dominated	Dominated	Dominated	Dominated
98	Dominated	Dominated	Dominated	Dominated	Dominated	Dominated
99	Dominated	Dominated	Dominated	Dominated	Dominated	Dominated
100	Dominated	Dominated	Dominated	Dominated	Dominated	Dominated
Threshold	**89**	**89**	**89**	**89**	**89**	**89**

FIGURE 108 Cost-effectiveness of THA in patients of different age and baseline WOMAC (averaged over men and women): Assuming that EQ-5D utility without THA increases by 0.115 in the first year and follows age-related decline thereafter

SF-12 in THA

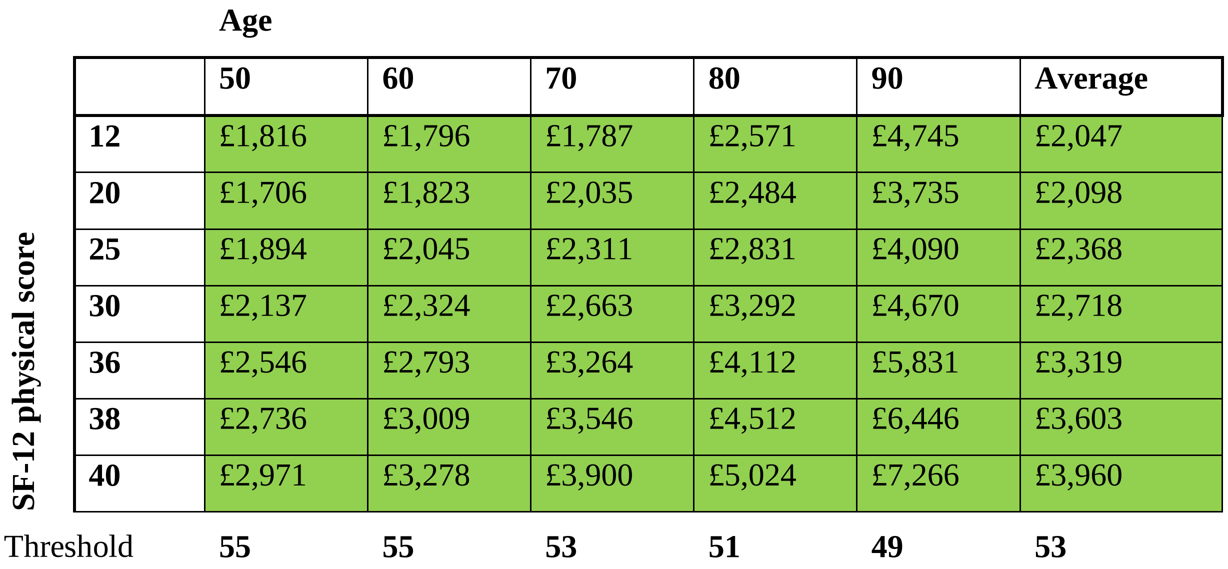
Age

	50	**60**	**70**	**80**	**90**	**Average**
20	£2,306	£2,173	£2,346	£3,346	£177,127	£2,658
25	£2,063	£2,032	£2,228	£2,998	£10,413	£2,437
30	£2,026	£2,042	£2,266	£2,979	£7,344	£2,437
36	£2,119	£2,038	£2,134	£3,180	£6,756	£2,446
38	£2,183	£1,982	£2,216	£3,189	£6,880	£2,479
40	£2,113	£2,066	£2,321	£3,036	£7,162	£2,498
46	£2,371	£2,498	£2,859	£3,843	£9,633	£3,056
48	£2,606	£2,748	£3,175	£4,350	£11,723	£3,402
50	£2,940	£3,101	£3,627	£5,113	£15,796	£3,903
52	£3,440	£3,623	£4,313	£6,366	£26,471	£4,676
54	£4,250	£4,459	£5,453	£8,724	£113,532	£5,992
56	£5,745	£5,972	£7,649	£14,552	Dominated	£8,613
58	£9,276	£9,391	£13,326	£48,417	Dominated	£16,212
60	£26,044	£23,102	£53,991	Dominated	Dominated	£169,334
Threshold	**59**	**59**	**59**	**57**	**51**	**59**

FIGURE 109 Cost-effectiveness of THA in patients of different age and baseline SF-12 (averaged over men and women): 5 year time horizon, mental score 30

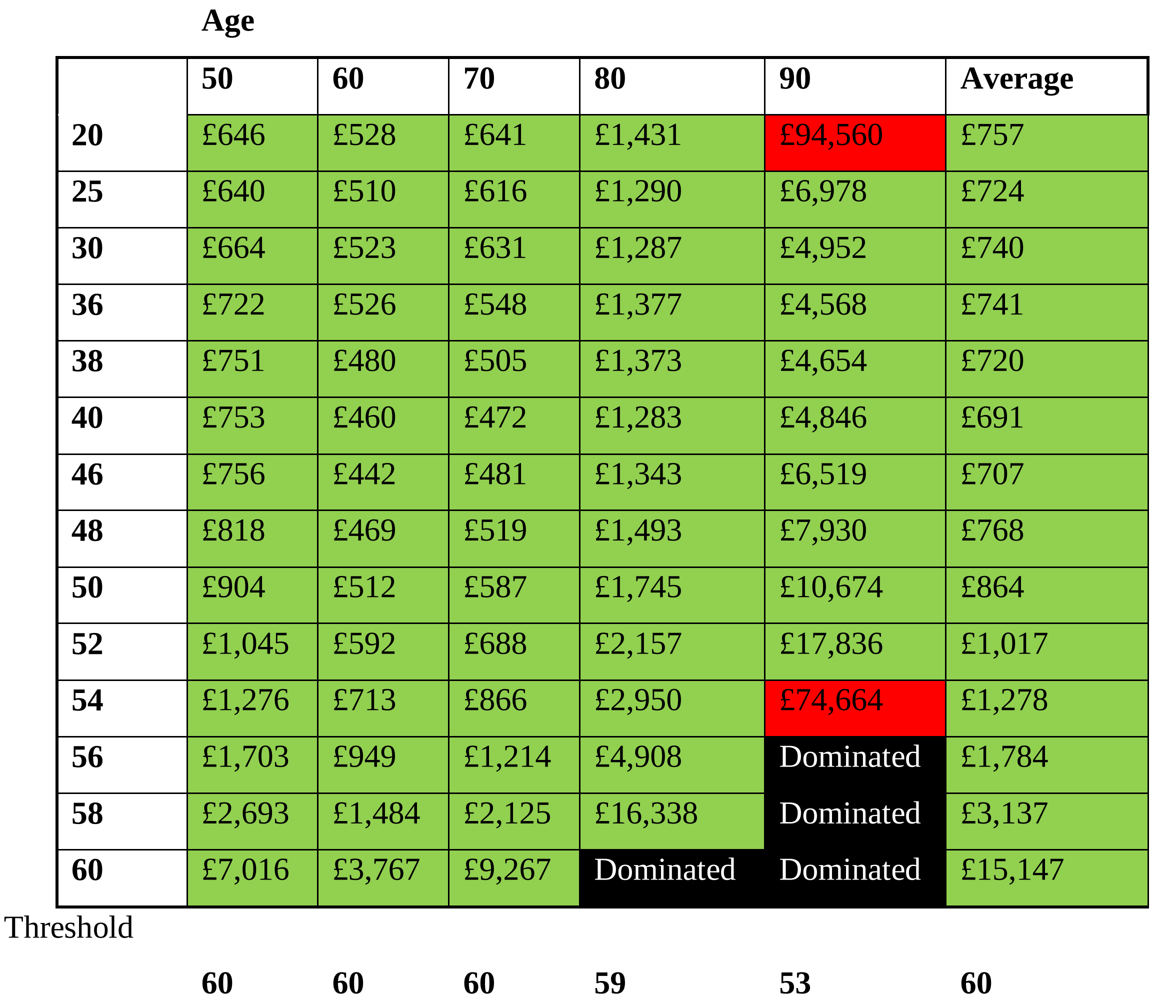
SF-12 physical score	Age 50	60	70	80	90	Average
12	£2,439	£2,303	£2,501	£3,603	£8,908,802	£2,836
20	£2,020	£2,070	£2,167	£3,007	£6,275	£2,406
25	£1,824	£1,934	£2,177	£2,797	£5,774	£2,305
30	£1,958	£2,101	£2,396	£3,083	£5,974	£2,520
36	£2,218	£2,404	£2,787	£3,628	£6,166	£2,900
38	£2,342	£2,546	£2,971	£3,895	£6,642	£3,089
40	£2,497	£2,722	£3,199	£4,234	£7,296	£3,325
46	£3,306	£3,630	£4,409	£6,153	£11,878	£4,593
48	£3,808	£4,189	£5,180	£7,485	£16,067	£5,411
50	£4,565	£5,030	£6,377	£9,738	£26,105	£6,698
52	£5,811	£6,409	£8,438	£14,218	£77,988	£8,957
54	£8,170	£8,988	£12,642	£26,687	Dominated	£13,746
56	£13,981	£15,171	£24,949	£180,831	Dominated	£29,374
58	£45,912	£45,087	£283,277	Dominated	Dominated	Dominated
60	Dominated	Dominated	Dominated	Dominated	Dominated	Dominated
Threshold	**57**	**57**	**55**	**53**	**49**	**55**

FIGURE 110 Cost-effectiveness of THA in patients of different age and baseline SF-12 (averaged over men and women): 5 year time horizon, mental score 50



		Age					
		50	**60**	**70**	**80**	**90**	**Average**
SF-12 physical score	**12**	£1,816	£1,796	£1,787	£2,571	£4,745	£2,047
	20	£1,706	£1,823	£2,035	£2,484	£3,735	£2,098
	25	£1,894	£2,045	£2,311	£2,831	£4,090	£2,368
	30	£2,137	£2,324	£2,663	£3,292	£4,670	£2,718
	36	£2,546	£2,793	£3,264	£4,112	£5,831	£3,319
	38	£2,736	£3,009	£3,546	£4,512	£6,446	£3,603
	40	£2,971	£3,278	£3,900	£5,024	£7,266	£3,960
Threshold		**55**	**55**	**53**	**51**	**49**	**53**

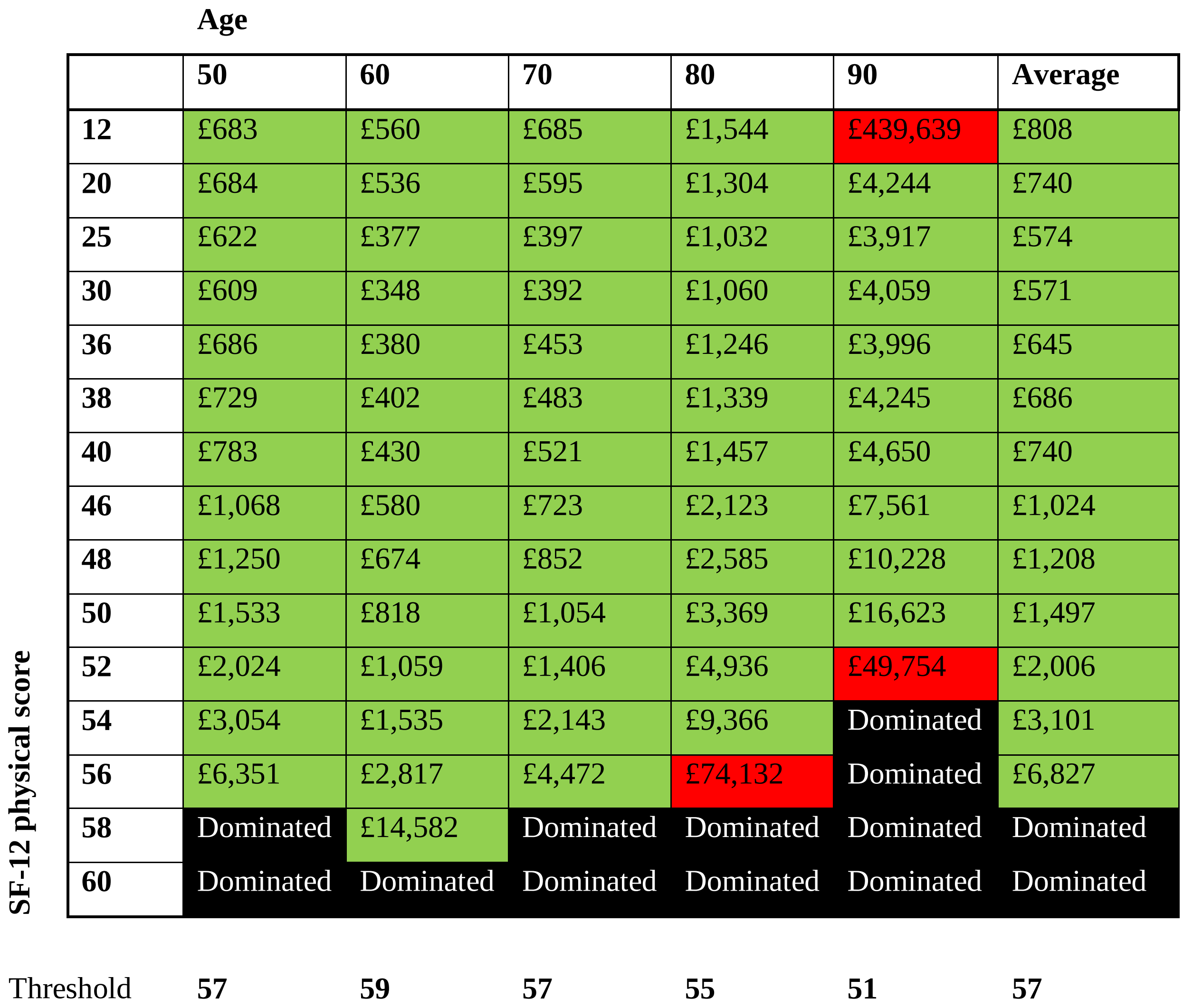
FIGURE 111 Cost-effectiveness of THA in patients of different age and baseline SF-12 (averaged over men and women): 5 year time horizon, mental score 70



Age

	50	**60**	**70**	**80**	**90**	**Average**
20	£646	£528	£641	£1,431	£94,560	£757
25	£640	£510	£616	£1,290	£6,978	£724
30	£664	£523	£631	£1,287	£4,952	£740
36	£722	£526	£548	£1,377	£4,568	£741
38	£751	£480	£505	£1,373	£4,654	£720
40	£753	£460	£472	£1,283	£4,846	£691
46	£756	£442	£481	£1,343	£6,519	£707
48	£818	£469	£519	£1,493	£7,930	£768
50	£904	£512	£587	£1,745	£10,674	£864
52	£1,045	£592	£688	£2,157	£17,836	£1,017
54	£1,276	£713	£866	£2,950	£74,664	£1,278
56	£1,703	£949	£1,214	£4,908	Dominated	£1,784
58	£2,693	£1,484	£2,125	£16,338	Dominated	£3,137
60	£7,016	£3,767	£9,267	Dominated	Dominated	£15,147
Threshold	**60**	**60**	**60**	**59**	**53**	**60**

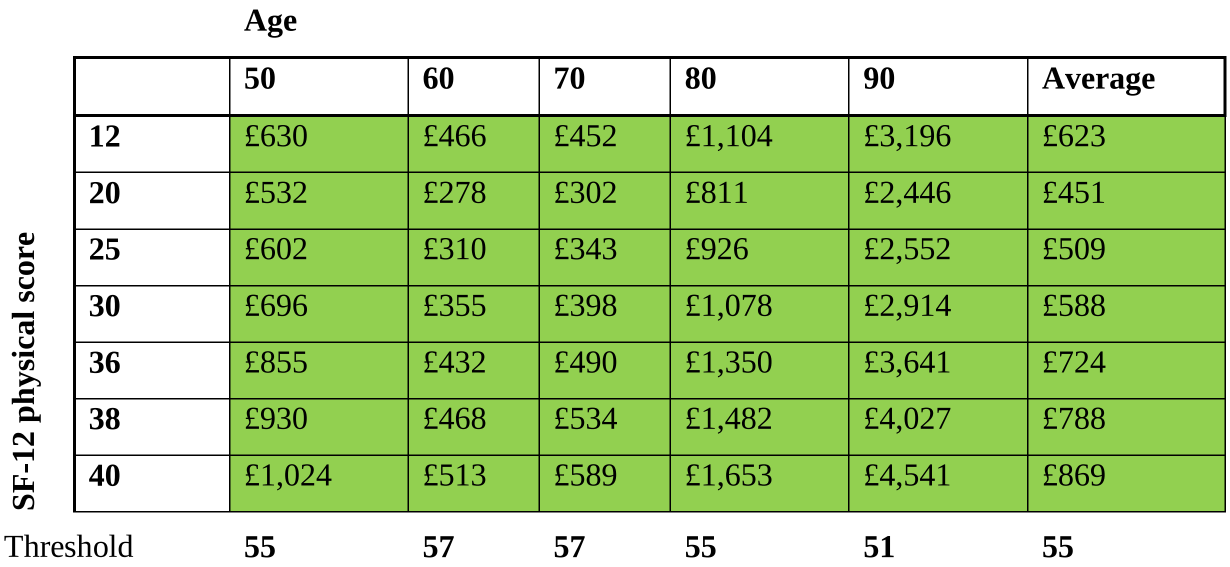
FIGURE 112 Cost-effectiveness of THA in patients of different age and baseline SF-12 (averaged over men and women): 60 year time horizon, mental score 30



Age

SF-12 physical score	50	60	70	80	90	Average
12	£683	£560	£685	£1,544	£439,639	£808
20	£684	£536	£595	£1,304	£4,244	£740
25	£622	£377	£397	£1,032	£3,917	£574
30	£609	£348	£392	£1,060	£4,059	£571
36	£686	£380	£453	£1,246	£3,996	£645
38	£729	£402	£483	£1,339	£4,245	£686
40	£783	£430	£521	£1,457	£4,650	£740
46	£1,068	£580	£723	£2,123	£7,561	£1,024
48	£1,250	£674	£852	£2,585	£10,228	£1,208
50	£1,533	£818	£1,054	£3,369	£16,623	£1,497
52	£2,024	£1,059	£1,406	£4,936	£49,754	£2,006
54	£3,054	£1,535	£2,143	£9,366	Dominated	£3,101
56	£6,351	£2,817	£4,472	£74,132	Dominated	£6,827
58	Dominated	£14,582	Dominated	Dominated	Dominated	Dominated
60	Dominated	Dominated	Dominated	Dominated	Dominated	Dominated
Threshold	**57**	**59**	**57**	**55**	**51**	**57**

FIGURE 113 Cost-effectiveness of THA in patients of different age and baseline SF-12 (averaged over men and women): 60 year time horizon, mental score 50

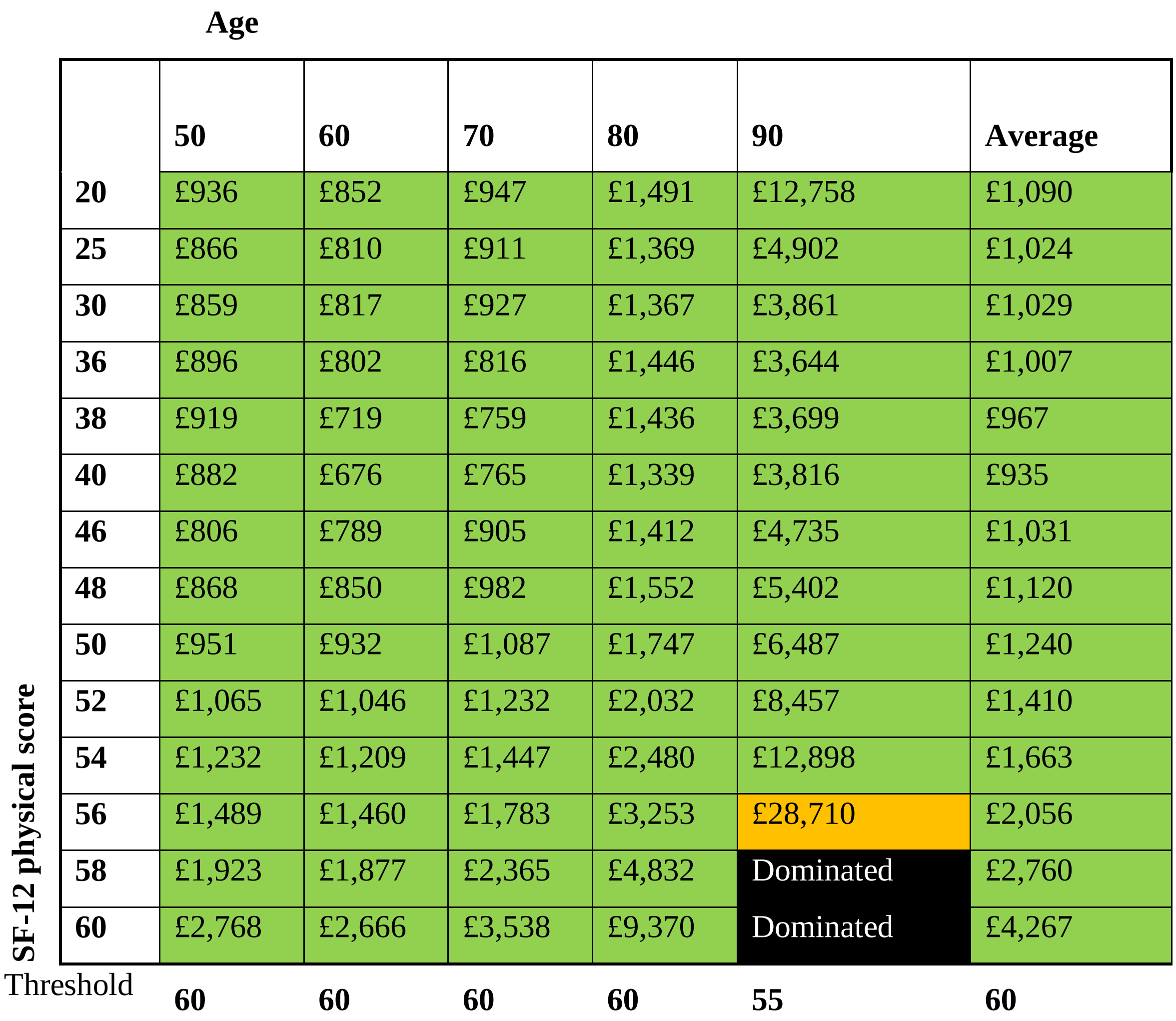


Age

SF-12 physical score

	50	**60**	**70**	**80**	**90**	**Average**
12	£630	£466	£452	£1,104	£3,196	£623
20	£532	£278	£302	£811	£2,446	£451
25	£602	£310	£343	£926	£2,552	£509
30	£696	£355	£398	£1,078	£2,914	£588
36	£855	£432	£490	£1,350	£3,641	£724
38	£930	£468	£534	£1,482	£4,027	£788
40	£1,024	£513	£589	£1,653	£4,541	£869
Threshold	**55**	**57**	**57**	**55**	**51**	**55**

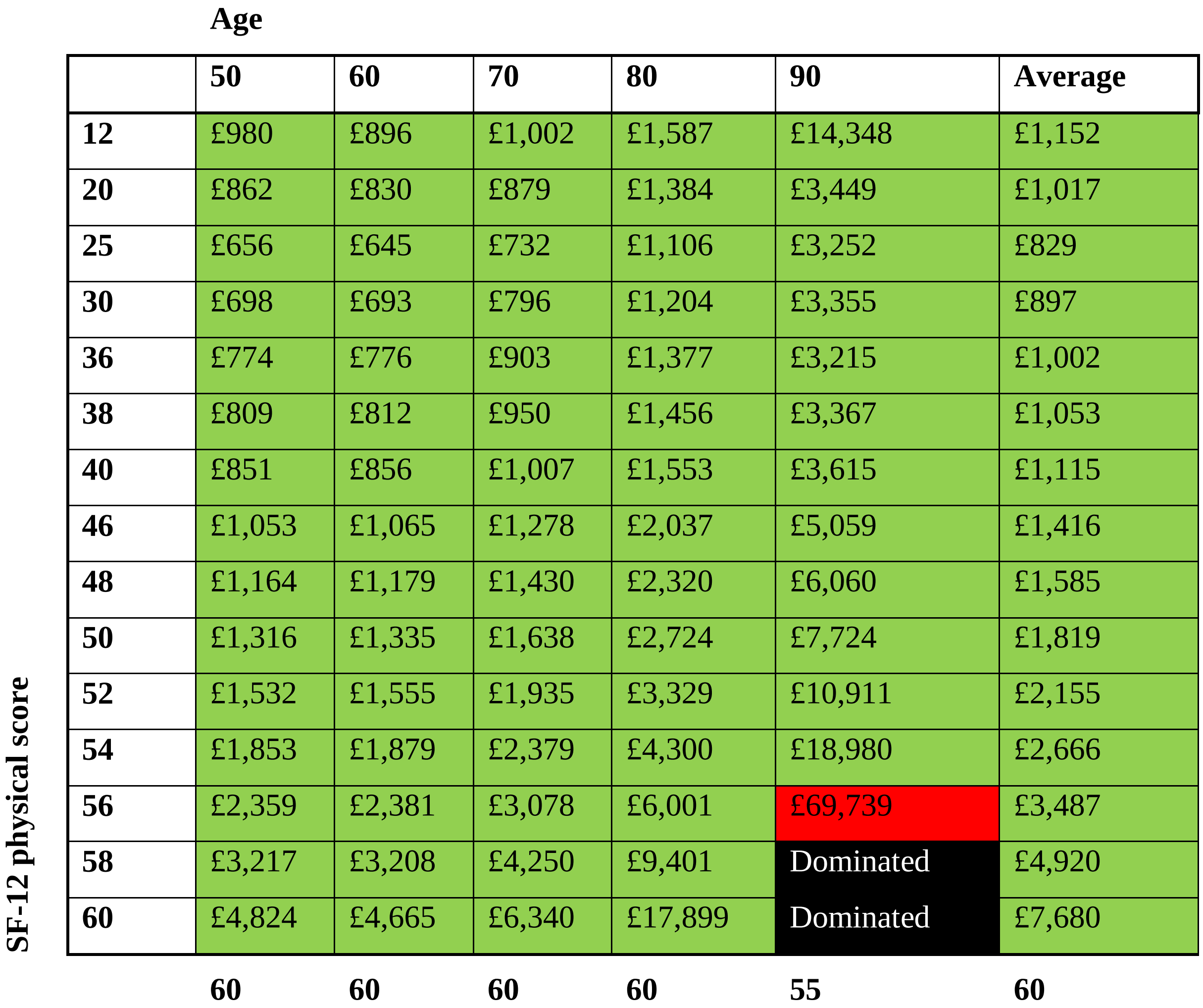
FIGURE 114 Cost-effectiveness of THA in patients of different age and baseline SF-12 (averaged over men and women): 60 year time horizon, mental score 70



Age

SF-12 physical score	50	60	70	80	90	Average
20	£936	£852	£947	£1,491	£12,758	£1,090
25	£866	£810	£911	£1,369	£4,902	£1,024
30	£859	£817	£927	£1,367	£3,861	£1,029
36	£896	£802	£816	£1,446	£3,644	£1,007
38	£919	£719	£759	£1,436	£3,699	£967
40	£882	£676	£765	£1,339	£3,816	£935
46	£806	£789	£905	£1,412	£4,735	£1,031
48	£868	£850	£982	£1,552	£5,402	£1,120
50	£951	£932	£1,087	£1,747	£6,487	£1,240
52	£1,065	£1,046	£1,232	£2,032	£8,457	£1,410
54	£1,232	£1,209	£1,447	£2,480	£12,898	£1,663
56	£1,489	£1,460	£1,783	£3,253	£28,710	£2,056
58	£1,923	£1,877	£2,365	£4,832	Dominated	£2,760
60	£2,768	£2,666	£3,538	£9,370	Dominated	£4,267
Threshold	**60**	**60**	**60**	**60**	**55**	**60**

FIGURE 115 Cost-effectiveness of THA in patients of different age and baseline SF-12 (averaged over men and women): Assuming that EQ-5D utility without THA worsens by 0.025 per year, mental score 30



Age

SF-12 physical score

	50	**60**	**70**	**80**	**90**	**Average**
12	£980	£896	£1,002	£1,587	£14,348	£1,152
20	£862	£830	£879	£1,384	£3,449	£1,017
25	£656	£645	£732	£1,106	£3,252	£829
30	£698	£693	£796	£1,204	£3,355	£897
36	£774	£776	£903	£1,377	£3,215	£1,002
38	£809	£812	£950	£1,456	£3,367	£1,053
40	£851	£856	£1,007	£1,553	£3,615	£1,115
46	£1,053	£1,065	£1,278	£2,037	£5,059	£1,416
48	£1,164	£1,179	£1,430	£2,320	£6,060	£1,585
50	£1,316	£1,335	£1,638	£2,724	£7,724	£1,819
52	£1,532	£1,555	£1,935	£3,329	£10,911	£2,155
54	£1,853	£1,879	£2,379	£4,300	£18,980	£2,666
56	£2,359	£2,381	£3,078	£6,001	£69,739	£3,487
58	£3,217	£3,208	£4,250	£9,401	Dominated	£4,920
60	£4,824	£4,665	£6,340	£17,899	Dominated	£7,680
	60	**60**	**60**	**60**	**55**	**60**

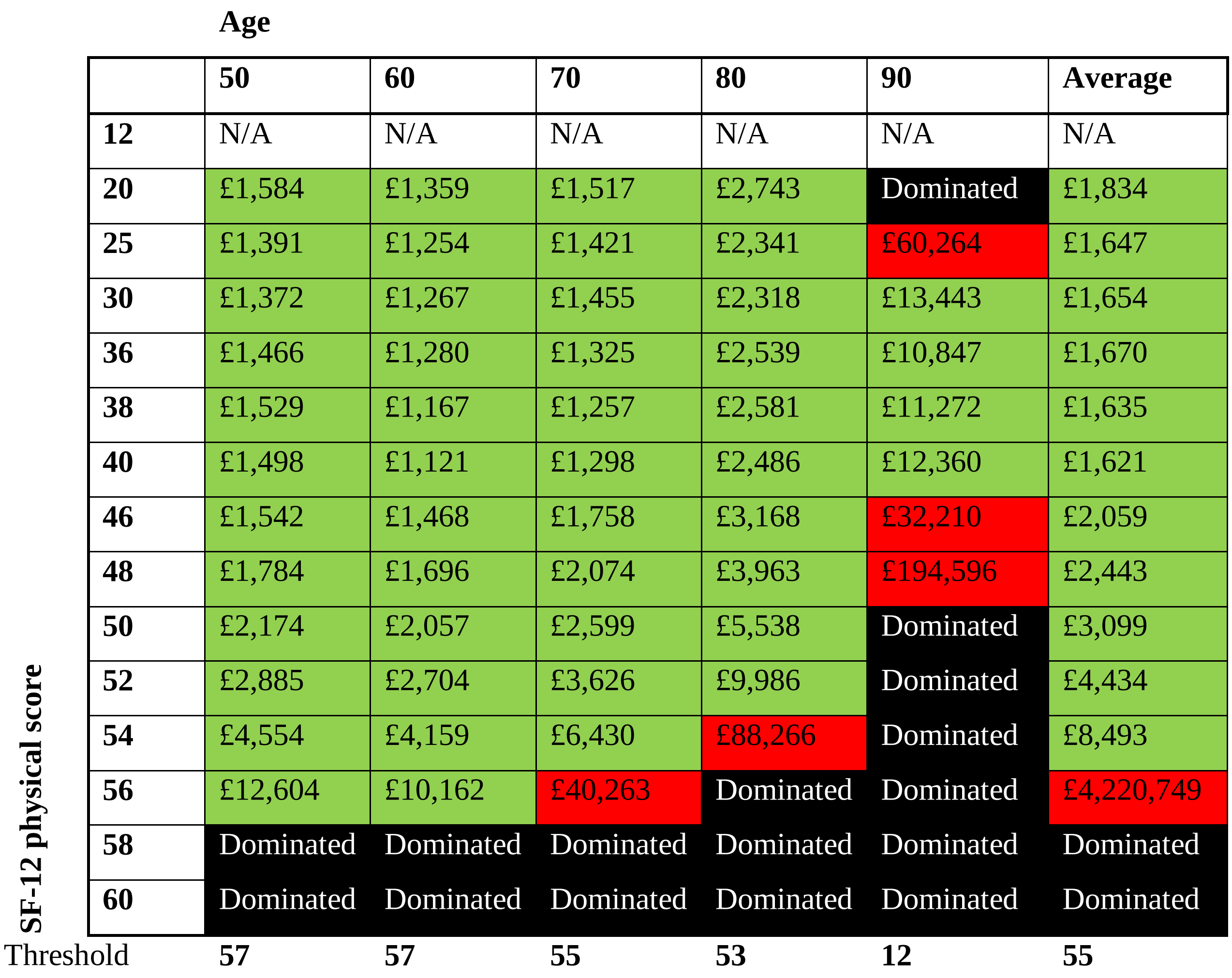
FIGURE 116 Cost-effectiveness of THA in patients of different age and baseline SF-12 (averaged over men and women): Assuming that EQ-5D utility without THA worsens by 0.025 per year, mental score 50

Age

SF-12 physical score

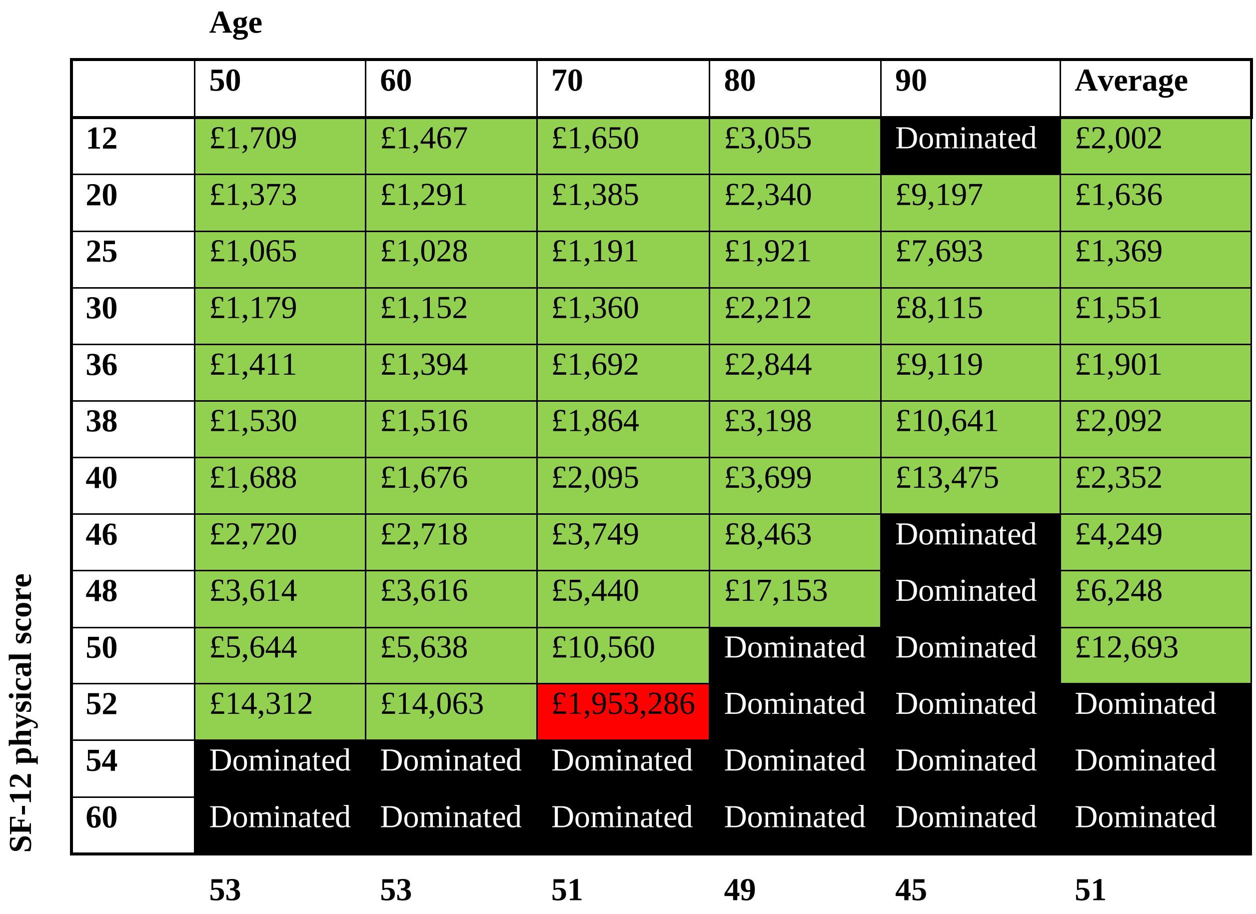
	50	**60**	**70**	**80**	**90**	**Average**
12	£787	£724	£693	£1,196	£2,712	£861
20	£617	£603	£672	£967	£2,124	£745
25	£675	£664	£747	£1,078	£2,201	£822
30	£745	£738	£838	£1,217	£2,450	£919
36	£857	£853	£982	£1,445	£2,911	£1,074
38	£905	£903	£1,045	£1,548	£3,139	£1,143
40	£964	£963	£1,122	£1,674	£3,425	£1,226
	60	**60**	**60**	**60**	**55**	**60**

FIGURE 117 Cost-effectiveness of THA in patients of different age and baseline SF-12 (averaged over men and women): Assuming that EQ-5D utility without THA worsens by 0.025 per year, mental score 70



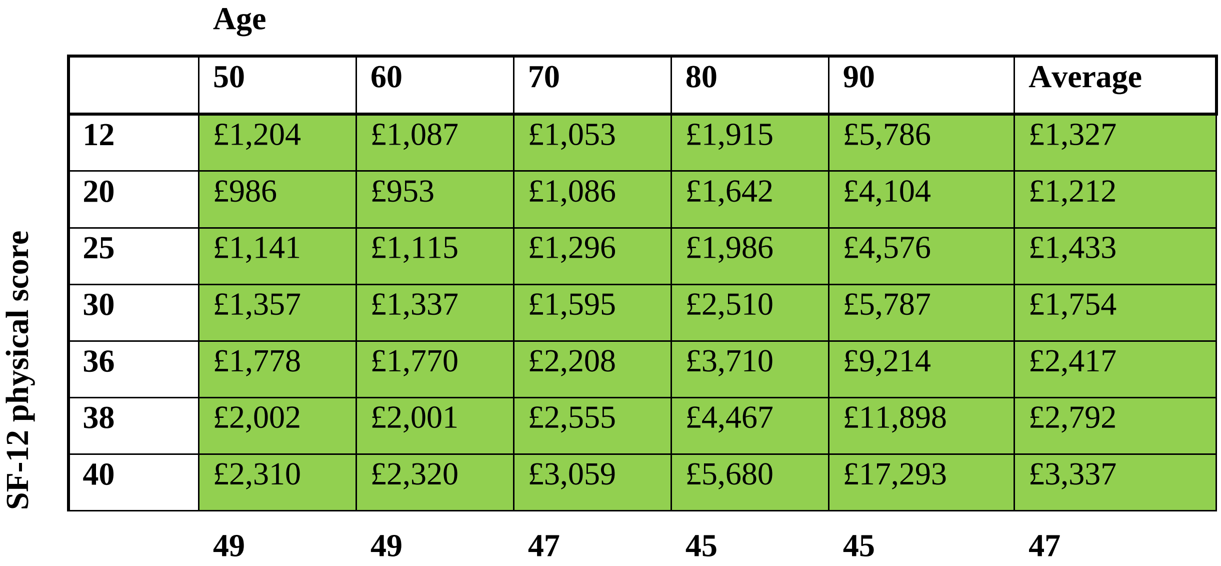
	Age					
SF-12 physical score	**50**	**60**	**70**	**80**	**90**	**Average**
12	N/A	N/A	N/A	N/A	N/A	N/A
20	£1,584	£1,359	£1,517	£2,743	Dominated	£1,834
25	£1,391	£1,254	£1,421	£2,341	£60,264	£1,647
30	£1,372	£1,267	£1,455	£2,318	£13,443	£1,654
36	£1,466	£1,280	£1,325	£2,539	£10,847	£1,670
38	£1,529	£1,167	£1,257	£2,581	£11,272	£1,635
40	£1,498	£1,121	£1,298	£2,486	£12,360	£1,621
46	£1,542	£1,468	£1,758	£3,168	£32,210	£2,059
48	£1,784	£1,696	£2,074	£3,963	£194,596	£2,443
50	£2,174	£2,057	£2,599	£5,538	Dominated	£3,099
52	£2,885	£2,704	£3,626	£9,986	Dominated	£4,434
54	£4,554	£4,159	£6,430	£88,266	Dominated	£8,493
56	£12,604	£10,162	£40,263	Dominated	Dominated	£4,220,749
58	Dominated	Dominated	Dominated	Dominated	Dominated	Dominated
60	Dominated	Dominated	Dominated	Dominated	Dominated	Dominated
Threshold	**57**	**57**	**55**	**53**	**12**	**55**

FIGURE 118 Cost-effectiveness of THA in patients of different age and baseline SF-12 (averaged over men and women): Assuming that EQ-5D utility without THA increases by 0.115 in the first year and follows age-related decline thereafter, mental score 30



	Age					
SF-12 physical score	**50**	**60**	**70**	**80**	**90**	**Average**
12	£1,709	£1,467	£1,650	£3,055	Dominated	£2,002
20	£1,373	£1,291	£1,385	£2,340	£9,197	£1,636
25	£1,065	£1,028	£1,191	£1,921	£7,693	£1,369
30	£1,179	£1,152	£1,360	£2,212	£8,115	£1,551
36	£1,411	£1,394	£1,692	£2,844	£9,119	£1,901
38	£1,530	£1,516	£1,864	£3,198	£10,641	£2,092
40	£1,688	£1,676	£2,095	£3,699	£13,475	£2,352
46	£2,720	£2,718	£3,749	£8,463	Dominated	£4,249
48	£3,614	£3,616	£5,440	£17,153	Dominated	£6,248
50	£5,644	£5,638	£10,560	Dominated	Dominated	£12,693
52	£14,312	£14,063	£1,953,286	Dominated	Dominated	Dominated
54	Dominated	Dominated	Dominated	Dominated	Dominated	Dominated
60	Dominated	Dominated	Dominated	Dominated	Dominated	Dominated
	53	**53**	**51**	**49**	**45**	**51**

FIGURE 119 Cost-effectiveness of THA in patients of different age and baseline SF-12 (averaged over men and women): Assuming that EQ-5D utility without THA increases by 0.115 in the first year and follows age-related decline thereafter, mental score 50



SF-12 physical score	Age 50	60	70	80	90	Average
12	£1,204	£1,087	£1,053	£1,915	£5,786	£1,327
20	£986	£953	£1,086	£1,642	£4,104	£1,212
25	£1,141	£1,115	£1,296	£1,986	£4,576	£1,433
30	£1,357	£1,337	£1,595	£2,510	£5,787	£1,754
36	£1,778	£1,770	£2,208	£3,710	£9,214	£2,417
38	£2,002	£2,001	£2,555	£4,467	£11,898	£2,792
40	£2,310	£2,320	£3,059	£5,680	£17,293	£3,337
	49	**49**	**47**	**45**	**45**	**47**

FIGURE 120 Cost-effectiveness of THA in patients of different age and baseline SF-12 (averaged over men and women): Assuming that EQ-5D utility without THA increases by 0.115 in the first year and follows age-related decline thereafter, mental score 70

Online Supplement 14 - Relative Threshold values using improvement criterion B

Tables 155 provide the predicted and observed percentiles the quantile regression model overall and by population subset. Table 156 provides sensitivity and specificity values (with 95% CIs) for the relative threshold using B improvement criterion: 5 score.

TABLE 155 Quantile regression predicted and observed percentiles

Baseline covariate			**Predicted**				**Observed**			
			Percentiles				Percentiles			
		N	10th	20th	30th	50th	10th	20th	30th	50th
	Total	209, 761	29	36	39	42	29	36	39	41
Age category	< 60	37,904	31	37	40	44	33	39	40	42
	60-<80	144,064	30	36	39	42	30	37	39	42
	80+	27,793	24	32	36	40	23	32	37	40
Gender	Male	84,673	31	37	39	42	30	38	39	42
	Female	125,058	28	35	38	42	28	36	39	41
Year of NHS PROMs	2009-11	96,041	28	35	38	42	28	36	39	40
	2012-15	113,720	30	37	39	42	30	37	39	42

TABLE 156 Hip: Sensitivity and Specificity for the Relative threshold using B improvement criterion: 5 score

		10th Centile		20th Centile		30th Centile		50th Centile	
		Sen (95% CIs)	Spec (95% CIs)	Sen (95% CIs)	Spec (95% CIs)	Sen (95% CIs)	Spec (95% CIs)	Sen (95% CIs)	Spec (95% CIs)
	Total	92(92,92)	26(25,27)	99(99,99)	9(9,10)	100(100,100)	5(5,5)	100(100,100)	2(2,2)
Age category	< 60	95(95,95)	20(20,21)	99(99,99)	8(7,8)	100(100,100)	4(4,4)	100(100,100)	1(1,1)
	60-<80	94(93,94)	23(23,24)	99(99,99)	9(9,10)	100(100,100)	5(5,5)	100(100,100)	2(2,2)
	80+	79(79,80)	43(42,43)	96(96,96)	18(17,18)	99(99,99)	9(9,10)	100(100,100)	4(4,4)
Gender	Male	95(95,95)	20(20,21)	99(99,99)	8(7,8)	100(100,100)	5(5,5)	100(100,100)	2(2,2)
	Female	90(90,90)	29(28,30)	99(99,99)	11(10,11)	100(100,100)	6(6,7)	100(100,100)	2(2,2)
Year of NHS PROMs	2009-11	90(90,90)	29(28,30)	99(99,99)	11(10,11)	100(100,100)	6(6,7)	100(100,100)	2(2,2)
	2012-15	94(93,94)	23(23,24)	99(99,99)	8(7,8)	100(100,100)	5(5,5)	100(100,100)	2(2,2)

Table 157 provide the predicted and observed percentiles the quantile regression model overall and by population subset. Table 158 provides sensitivity and specificity values (with 95% CIs) for the relative threshold using B improvement criterion: 5 score.

TABLE 157 Knee: Quantile regression predicted and observed percentiles

Baseline covariate			**Predicted**				**Observed**			
			Percentiles				Percentiles			
		N	10th	20th	30th	50th	10th	20th	30th	50th
	Total	222,933	16	29	34	39	17	29	34	38
Age category	< 60	29,349	-	25	32	38	1	22	34	37
	60-<80	164,132	18	30	34	39	18	29	34	39
	80+	29,452	19	28	33	39	17	27	34	38
Gender	Male	96,006	-	30	34	39	1	29	34	38
	Female	126,885	16	29	33	39	18	28	33	39
Year of NHS PROMs	2009-11	102,448	-	29	33	38	13	28	33	38
	2012-15	120,485	19	30	34	39	18	30	34	40

TABLE 158 Knee: Sensitivity and Specificity for the Relative threshold using B improvement criterion: 5 score

		10th Centile		20th Centile		30th Centile		50th Centile	
		Sen (95% CIs)	Spec (95% CIs)	Sen (95% CIs)	Spec (95% CIs)	Sen (95% CIs)	Spec (95% CIs)	Sen (95% CIs)	Spec (95% CIs)
	Total	42(42,42)	71(71,71)	93(92,93)	21(20,21)	98(98,98)	9(8,9)	100(100,100)	2(2,2)
Age category	< 60			82(82,82)	35(34,35)	97(97,97)	13(12,13)	100(100,100)	3(3,3)
	60-<80	51(51,52)	64(63,64)	94(94,94)	18(18,18)	98(98,98)	9(8,9)	100(100,100)	2(2,2)
	80+	57(56,57)	60(59,60)	91(90,91)	24(24,24)	98(98,98)	11(10,11)	100(100,100)	2(2,2)
Gender	Male			94(94,94)	18(18,18)	98(98,98)	9(8,9)	100(100,100)	2(2,2)
	Female	42(42,42)	71(71,71)	93(92,93)	21(20,21)	98(98,98)	11(10,11)	100(100,100)	2(2,2)
Year of NHS PROMs	2009-11			93(92,93)	21(20,21)	98(98,98)	11(10,11)	100(100,100)	3(3,3)
	2012-15	57(56,57)	60(59,60)	94(94,94)	18(18,18)	98(98,98)	9(8,9)	100(100,100)	2(2,2)

Figures 121-126 show the observed and predicted probabilities for the PROMs dataset by pre-operative OHS value using the in the six age gender subsets.

FIGURE 121 Observed percentage improvement with smoothed line using A improvement criterion: PROMs (OHS), <60 Male subset

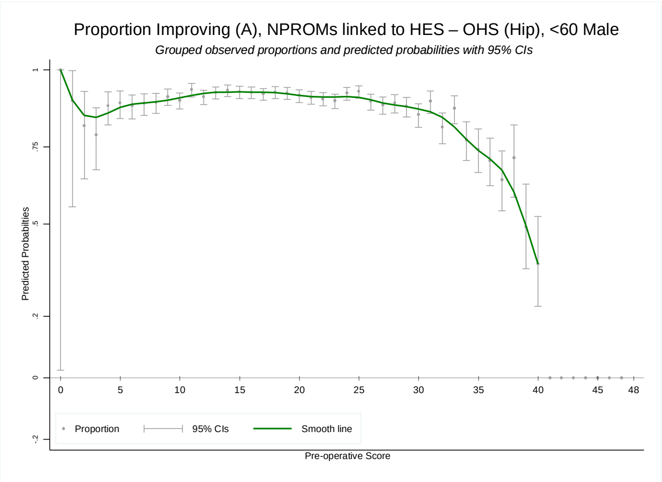


FIGURE 122 Observed percentage improvement with smoothed line using A improvement criterion: PROMs (OHS). <60 Female subset

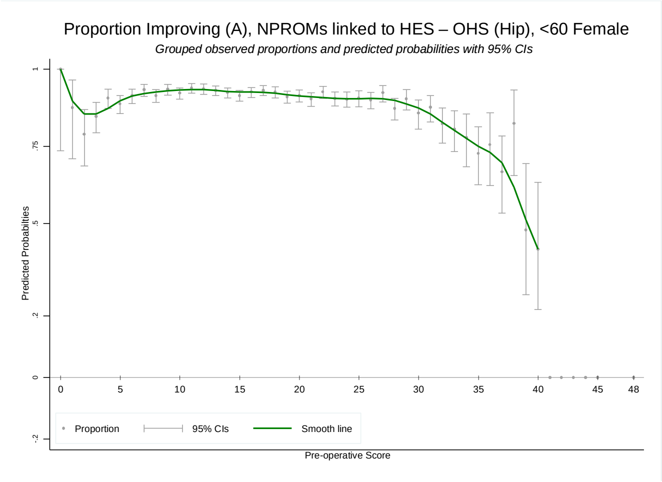


FIGURE 123 Observed percentage improvement with smoothed line using A improvement criterion: PROMs (OHS). 60-<80 Male subset

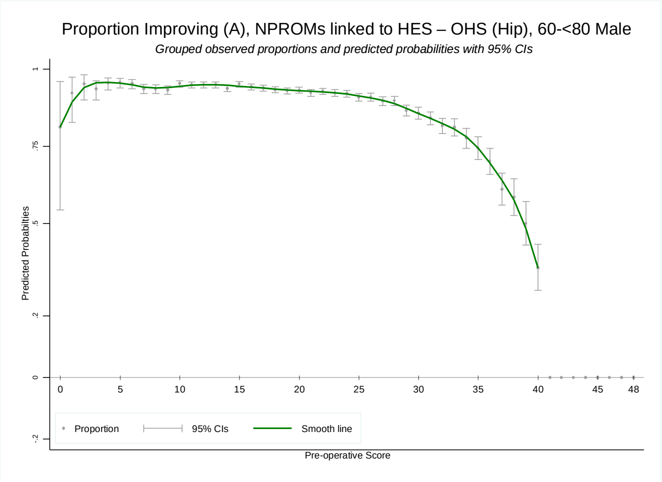


FIGURE 124 Observed percentage improvement with smoothed line using A improvement criterion: PROMs (OHS). 60-<80 Female subset

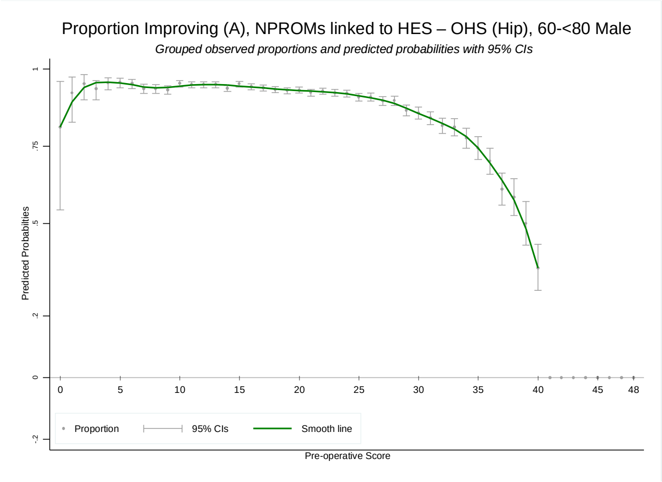


FIGURE 125 Observed percentage improvement with smoothed line using A improvement criterion: PROMs (OHS). 80+ Male subset

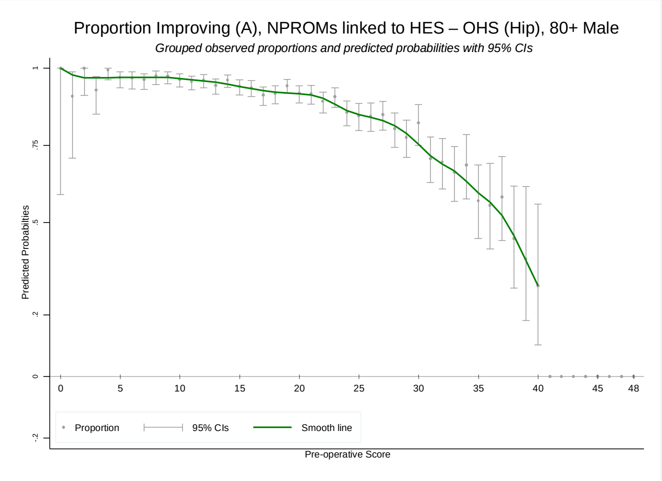
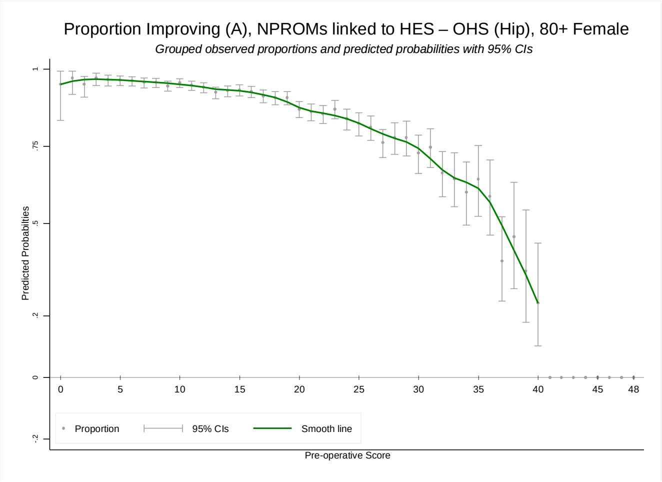


FIGURE 126 Observed percentage improvement with smoothed line using A improvement criterion: PROMs (OHS). 80+ Male subset



Figures 127 – 132 show the observed and predicted probabilities for the PROMs dataset by pre-operative OKS value using the in the six age gender subsets.

FIGURE 127 Observed percentage improvement with smoothed line using A improvement criterion: PROMs (OKS). <60 Male subset

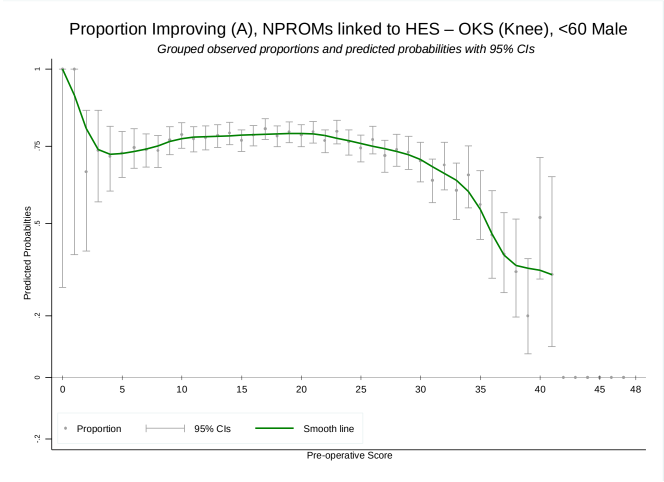


FIGURE 128 Observed percentage improvement with smoothed line using A improvement criterion: PROMs (OKS). <60 Female subset

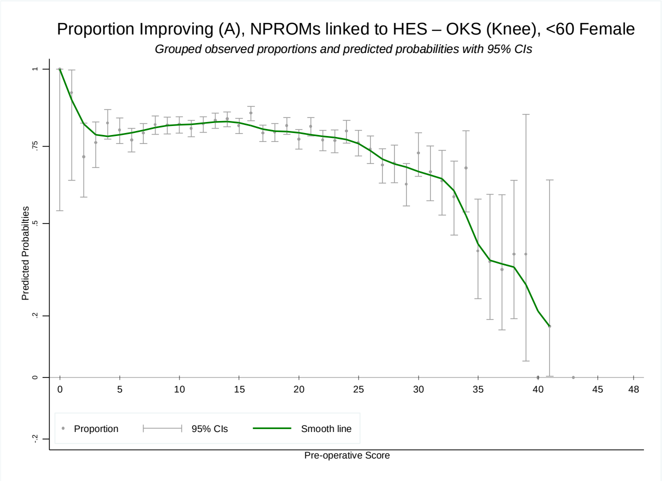


FIGURE 129 Observed percentage improvement with smoothed line using A improvement criterion: PROMs (OHS). 60-<80 Male subset

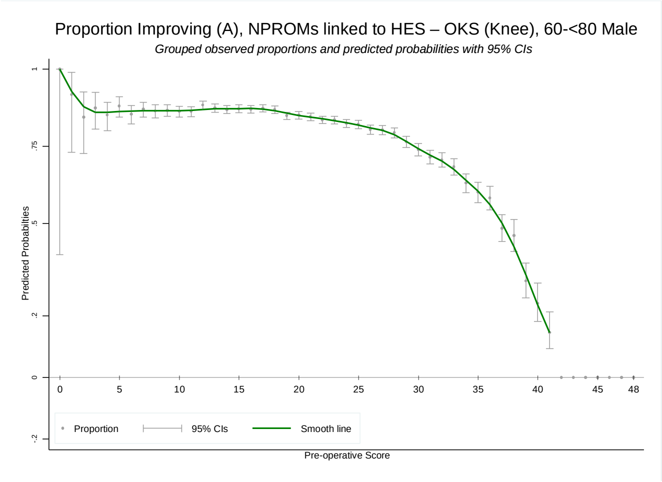


FIGURE 130 Observed percentage improvement with smoothed line using A improvement criterion: PROMs (OHS). 60-<80 Female subset

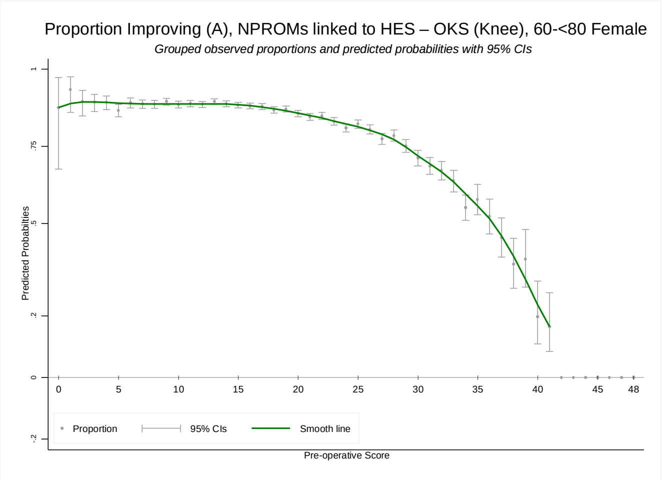


FIGURE 131 Observed percentage improvement with smoothed line using A improvement criterion: PROMs (OHS). 80+Male subset

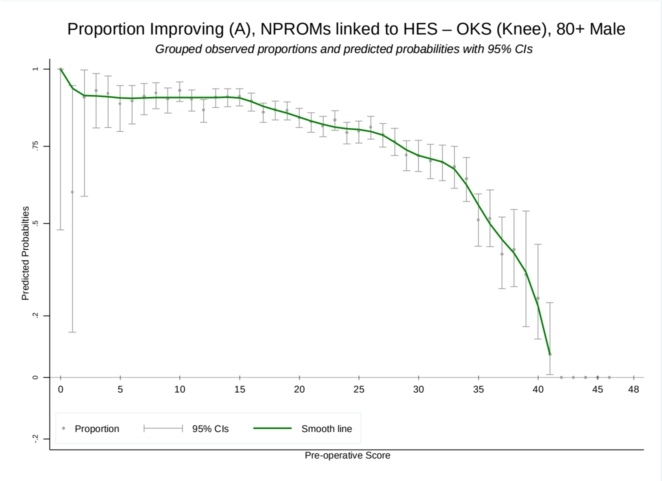
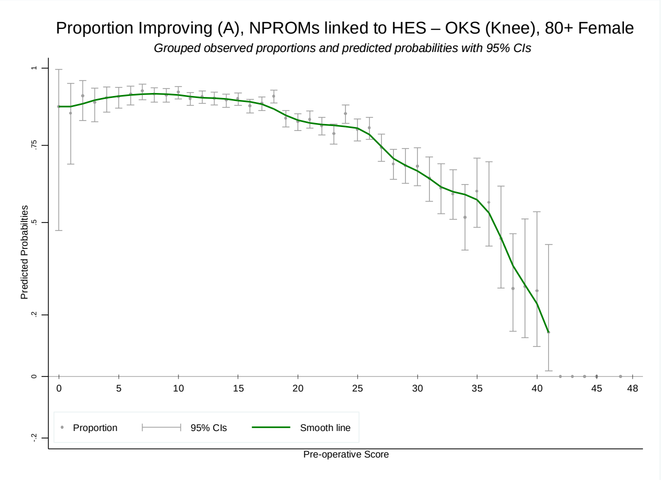


FIGURE 132 Observed percentage improvement with smoothed line using A improvement criterion: PROMs (OHS). 80+ Female subset



Online Supplement 15 – Data manipulation, regression methods and results and inputs for the economic evaluation described in Chapter 7

Methods for manipulating and analysing NHS PROMs/HES linked data

Outline of the approach

APC data were requested for all patients with either a record in the NHS PROMs data or one of the following procedure codes:

- One of the following Office of Population Censuses and Surveys Classification of Surgical Operations and Procedures version 4 (OPCS-4) codes: W371, W379, W381, W389, W391, W399, W931, W939, W941, W949, W951, W959, W401, W408, W409, W411, W418, W419, W421, W428, W429, W521, W528, W529, W531, W538, W539, W541, W548, W549, W166; or
- OPCS-4 Code W581 with Z843; or
- One of the following OPCS-3 Codes: W12, W16, W82, W83, W85, W87, W89, W91.

For these patients, all existing hospital episodes recorded between April 2009 and October 2015 were extracted. Within the APC data, episodes referring to the same patient were identifiable by an encrypted ID number. The NHS PROMs data contained an episode key, which enabled us to link records in the PROMs data to the corresponding episodes in the APC data. The PROMs dataset included 847,314 records, while the APC HES data set included records for 8,468,000 admissions for 1,779,650 patients.

These two datasets were linked and manipulated to create the following datasets, which were used to estimate inputs for the Markov model described in this chapter:

- Linked PROMs/HES data for pre-operative and six-month utility estimates
- Linked PROMs/HES data for estimating the cost of primary arthroplasty
- Linked PROMs/HES data for estimating the cost of revision arthroplasty and the utility before/after revision
- Linked PROMs/HES data for readmissions related to arthroplasty

In the following section, we provide a brief overview over the key assumptions and processes involved in creating these datasets.

Methods for linking PROMs and HES data

We linked records from the NHS PROMs data to records from the APC HES data using the episode key provided. It was necessary to link the two datasets even for models of utility, since the NHS PROMs extract did not contain patients' age; PROMs records that could not be linked to HES were therefore excluded from all analyses. As described in *Chapter 6, Dataset,* the NHS PROMs data contained a number of duplicate records in terms of the provided episode key and year indicator. We assumed that the majority of these duplicates were created when NHS PROMs records were updated. Consequently, we sorted the data by episode key, year and last status date. The status date indicates when the record was last updated. Among those records that had duplicates in terms of episode key and year, we retained the relevant record with the latest status date, since this record would most likely be the most up-to-date record for the specific patient. After excluding 194,377 duplicates and 8,281 PROMs records that could not be linked to HES, 644,656 records with linked PROMs/HES data (329,685 for knee arthroplasty and 314,971for hip arthroplasty) were included in the dataset.

Methods for linking PROMs and HES data for primary and revision arthroplasty

We then linked arthroplasty procedures conducted on the same patient during different hospital episodes using the encrypted ID number. The linked episodes included episodes for primary arthroplasty as well as episodes for revision arthroplasty. We identified an episode as revision arthroplasty if:

- The NHS PROMs record indicated that the procedure was a revision (n=40,689); or
- Based on the APC HES data the patient had already had the same procedure (i.e. knee or hip surgery) on the same joint (right- or left-sided procedure, identified using OPCS-4 codes Z942 and Z943) at an earlier date; this procedure identified an additional 1,934 revisions not flagged in the NHS PROMs record.

The dataset also contained a number of duplicate entries based on patient ID, joint, side of the operation and date of admission. These records are most likely double-entries in the APC HES data. These records were sorted by the quality of the match between NHS PROMs and APC HES data and then by episode key, and the record with the best match was retained among the duplicates. All duplicates other than the best match were excluded from the regression analyses estimating the cost of primary arthroplasty. We included entries with missing data on side of the operation, unless these observations were excluded as duplicates.

The dataset used to estimate regression models predicting six-month EQ-5D utility and pre-operative EQ-5D utility conditional on Oxford score, age and sex was generated by dropping all episodes flagged as revisions; this dataset included 309,001 primary knee arthroplasty procedures and 286,812 primary hip arthroplasty procedures with complete data on pre-operative OKS/OHS, of which 223,836 knee procedures and 208,499 hip procedures had complete data on EQ-5D six months after arthroplasty.

The dataset used to estimate the utility before and after revision procedures was generated by linking the dataset used to estimate the cost of revision arthroplasty (i.e. APC HES data on revision procedures linked to the PROMs questionnaire of the primary arthroplasty procedure) to the PROMs record for the revision procedure. This dataset included 3,404 knee revisions and 2,346 hip revisions that had complete data on OKS/OHS before primary arthroplasty and returned PROMs questionnaires before and/or after revision surgery.

Datasets were also generated containing the full APC HES records for all primary and revision arthroplasty procedures; these were grouped using the methods described in *Valuing Admissions Using The Payment Grouper* to obtain costs based on the National Schedule 2014/15.[154]

Methods for identifying arthroplasty-related readmissions

The APC HES data contained all hospital episodes for patients who underwent primary knee/hip arthroplasty. In addition to estimates of the cost of primary and revision arthroplasty, the Markov model required estimates of the cost of readmissions in the years after primary arthroplasty that were related to the joint in question.

To identify episodes representing readmissions related to primary joint arthroplasty, we first excluded all episodes that were previously identified as primary or revision arthroplasty. Then, for each patient in the data we linked their non-arthroplasty admissions to all primary arthroplasty episodes for that patient. However, we excluded primary arthroplasty episodes with missing data on side of the operation, since our matching procedure included checks on the side of the operation. As mentioned above, this only affected a small proportion of all primary arthroplasty episodes. For 70.6% of all episodes that could be matched to at least one primary arthroplasty episode (2,053,409/2,908,145), this resulted in one match. For those episodes with several matches, we identified the best match (i.e. the most relevant primary arthroplasty episode for each admission episode) as follows:

- We excluded primary arthroplasty episodes as irrelevant if the admission occurred before the arthroplasty episode.
- We linked admissions to arthroplasty episodes if the admission occurred within 30 days after the respective arthroplasty episodes. If this would result in one admission being matched to more than one primary arthroplasty episode, we matched the admission to the closest arthroplasty episode.
- We excluded arthroplasty episodes as irrelevant if the admission episode referred to a different joint or side of the body from the arthroplasty episode. The OPCS-4 procedure codes used to identify admissions relating to the knee comprised Z846, Z765, Z845, Z844, Z774 or Z787, while those used to identify admissions relating to the hip comprised Z843, Z761 or Z756. In addition, for episodes without a relevant procedure code we used the ICD-10 diagnosis codes M16.X (arthritis of the hip) to identify hip admissions, while knee admission were identified using the diagnosis code M17.X (arthritis of the knee).
- For the remaining admissions, we matched the admission to the closest arthroplasty episode (i.e. the minimum distance between the admission dates).

All in all, this resulted in 147,651 matched admission episodes. In total, 2,201,060 admission episodes were matched to a primary arthroplasty procedure.

Next, we applied a set of criteria to the matched admissions to identify whether these admissions are likely related to arthroplasty. These criteria were developed based on discussions with a clinical registrar and a clinical coding manager. We defined admissions as related to arthroplasty if:

- The admission occurred within the 30-day period after the primary arthroplasty episode, regardless of diagnosis or procedure codes. Since the relevant readmissions were identified with respect to the primary arthroplasty episode, we could not identify readmissions within 30 days of revision arthroplasty.
- The admission had a primary diagnosis of hip or knee arthritis: i.e. the ICD-10 code was M17.X for admissions linked to a knee arthroplasty episode, or M16.X for admissions linked to a hip arthroplasty episode.
- The admission had a procedure code referring to the hip or knee joint. Admission episodes were classified as knee- or hip-related admissions if they had an OPCS-4 procedure code relating to the hip or knee (Z846, Z765, Z845, Z844, Z774 or Z787 for knees; Z843, Z761 or Z756 for hips), or a diagnosis of knee or hip arthritis (ICD-10 codes M17.X for knees and M16.X for hips).
- The admission had one of the following diagnosis codes associated with the main infections that are likely to be caused by arthroplasty (since readmissions more than 30 days after the admission for primary or revision arthroplasty are most likely to occur due to infections, either of the skin, the joint or the prosthesis):

- M25.X with Z96.6 – “Other joint disorder, not elsewhere classified” and “Presence of orthopedic joint implant”
- T81.X with either Z96.6 or Y83.1 – “Complications of procedures, not elsewhere classified” and “Presence of orthopedic joint implant” or “Surgical operation with implant of artificial internal device […]”
- T84.X – “Complications of internal orthopedic prosthetic devices, implants and grafts”
- M96.X – “Intraoperative and postprocedural complications and disorders of musculoskeletal system, not elsewhere classified”
- M00.X with Z96.6 – “Pyogenic arthritis” and “Presence of orthopedic joint implant”
- M86.X with Z96.6 – “Osteomyelitis” and “Presence of orthopedic joint implant”

We retained all admissions that could be linked to a primary arthroplasty episode with a pre-operative PROMs questionnaire and met one of the criteria described above as readmissions related to TJR; these admissions were valued using the methods described in the next section. All other readmissions were dropped from the analysis and were excluded from estimates the cost of readmissions. In total, the dataset contained 171,459 relevant admissions, of which 75,803 occurred within the first 30 days, 41,583 had a relevant primary diagnosis, 6,613 had a relevant procedure code, and 83,774 had diagnosis for infection.

Valuing admissions using the payment grouper

We used the NHS Local Payment Grouper for 2014/15[153] to obtain the relevant HRGs for all primary arthroplasty and revision arthroplasty episodes and all relevant readmissions. Since we had no data on days spent in critical care, special care or rehabilitation, we assumed that all records had values of zero for these variables. This may have resulted in a slight underestimation of the total cost of arthroplasty, although this is unlikely to have affected the results as the proportion of patients admitted to these services is likely to be very small.

Moreover, the grouping process identified a small number of errors related to admissions that could not be grouped due to inaccurate or ambiguous coding in the HES data. For example, among the 602,287 primary arthroplasty episodes retained, 1,391 episodes could not be grouped without additional data cleaning. To retain as many observations as possible, we cleaned the data using the following principles:

- For primary arthroplasty, if the primary diagnosis was R69.X (illness, unspecified), we changed the primary diagnosis to M17.9 (knee arthritis) and M16.9 (hip arthritis) for knee arthroplasty and hip arthroplasty, respectively.

- Invalid values for main speciality and treatment speciality were changed to a generic value of “110”.
- If one of the diagnosis codes was invalid, we changed the diagnosis to the most appropriate valid diagnosis code: i.e. either an unspecified diagnosis code within the same ICD-10 3-digit section (e.g. changing N18.0 to N18.9) or to the closest diagnosis code within the same ICD-10 3-digit section.
- If the primary procedure code was one of W521, W531, W541 or W581 and the secondary procedure code did not start with a Z, we searched for one of the following codes and exchanged the position of that code and the original secondary procedure code: Z843, Z761, Z756, Z846, Z765, Z845, Z844, Z774 or Z787.
- If the primary diagnosis code was valid as an ICD-10 code but invalid as a primary diagnosis, we changed the position of the diagnosis codes (i.e. the original primary diagnosis would be moved towards the end of the diagnoses list, the original secondary diagnosis would become the primary diagnosis, the third diagnosis would become the new secondary diagnosis etc.).
- Finally, for primary and revision arthroplasty only, we dropped episodes with missing values for age and episode duration.

The episodes were then grouped using the NHS Local Payment grouper 2014/15.[153] This provided us with HRGs for the episodes as well as HRGs for unbundled procedures (mostly diagnostic imaging services). We then valued all episodes by merging the HRGs with the corresponding tariffs from the National Schedule 2014/15.[154] For readmissions, we first determined whether an admission was an elective procedure or an emergency, and then applied the relevant tariff. All primary and revision procedures were assumed to be elective. The total cost of an episode was determined as the sum of the base cost of the respective HRGs, the costs for excess bed-days (i.e. length of stay above the trim point) and any costs for unbundled procedures.

For primary and revision arthroplasty episodes, we valued only episodes that could be grouped after applying the principles above and which had no missing data; this approach excluded only 0.02% (152/608,170) of episodes, ensures that the admissions included in the regression analyses are accurate and is unlikely to have introduced any bias into the analysis. However, for readmissions, we imputed the costs for episodes that could not be grouped (3.2% [5,474/171,459] of the total), since omitting these readmissions from the analysis would have caused us to systematically underestimate the average cost of readmissions. If data on length of stay were available for these ungrouped admissions, we applied the average cost per bed-day for readmissions in the dataset that fell into the same category (i.e. readmissions within 30 days of arthroplasty, readmissions with a primary diagnosis of hip or knee arthritis, readmissions with a relevant procedure code, or readmissions with a diagnosis for infection). If data on length of stay were missing, we applied the average cost per admission for readmissions in the same category.

We then estimated how many years of readmissions cost data were available for each patient up to and including the year when they died or before the year when they were administratively censored. Since the PROMs/HES extract was not linked to ONS mortality records, we used the PROMs/HES data to identify the date of death for patients who were known to have died in English hospitals between 2009 and 2015. The “discharge method” variable indicates when patients died in hospital. This measure is likely to underestimate mortality and therefore slightly underestimate readmission costs, since around 44% of deaths occur in the usual places of residence.[185] However, this approximation is unlikely to have a significant effect on the conclusions, since the median follow-up time in the PROMs/HES extract was only two years and the model predicts that annual mortality will be less than 3% for 70-year-olds in the first five years after arthroplasty. We retained any observed admissions in the year of death. The resulting dataset contained one record for each primary arthroplasty episode and for each year in which the patient could be observed, taking account of censoring due to death in hospital or due to the lack of follow-up data beyond October 2015. We also created an indicator whether the patient had revision surgery in a certain year, or whether the patient had revision surgery in any previous year in order to identify which records should be included in each regression analysis described in *Online Supplement 15*.

We then aggregated all costed readmission episodes up by year since primary arthroplasty to obtain data on the costs per year for each patient. To ensure that patients who were never readmitted were included in the analysis, we then matched the costed and aggregated readmission data to the dataset described in the previous paragraph, which provided revision indicators and contained one row per year of follow-up for all patients. The cost of readmissions was assumed to be zero for any entries without a match, since the patient had no relevant readmissions in that specific year.

We used a similar procedure to create a dataset for readmissions after revision surgery. For this dataset, the year variable was created using the date of admission for the revision arthroplasty episode.

In a final step, we linked all datasets on primary TJR, revision TJR and relevant readmissions to baseline information from the relevant NHS PROMs record.

Distribution of patients by Oxford score

The distribution of patients by age/sex was based on the distribution of patients in the full PROMs/HES extract (Table *159*). The distribution of Oxford score was also based on the same PROMs/HES extract and is shown in *Online Supplement 12, Table 103.*

TABLE 159 Age and sex distribution for patients undergoing primary arthroplasty, based on the full PROMs/HES extract 2009-2015

Age used in the model	Age range	Number[a] (percentage) of patients undergoing hip replacement		Number (percentage) of patients undergoing knee replacement	
		Men	Women	Men	Women
50	Under 55	16,447 (5.7%)	17,989 (6.2%)	8,127 (2.6%)	12,016 (3.8%)
60	55 to 64	28,245 (9.8%)	35,659 (12.3%)	31,189 (10.0%)	40,680 (13.0%)
70	65 to 74	41,817 (14.4%)	63,258 (21.8%)	54,899 (17.6%)	69,750 (22.3%)
80	75 to 84	27,032 (9.3%)	47,300 (16.3%)	34,208 (11.0%)	49,647 (15.9%)
90	85+	3,313 (1.1%)	8,619 (3.0%)	4,563 (1.5%)	7,193 (2.3%)

Revision rates

The regression models estimated by Pennington et al[127, 129] were used to estimate revision rates, as described in *Online Supplement 12, Revision Rates*.

Mortality

The regression models estimated by Pennington et al[127, 129] were used to estimate the probability of perioperative mortality and mortality in the year of revision surgery, and the healthy patient effect, as described in *Online Supplement 12, Mortality*. However, as described in *Chapter 7, Method* the analyses described in *Chapter 7* allowed for mortality associated with all revision procedures.

For THA, the probability of death in the year of revision surgery was based on the logistic regression model predicting death in the year of revision in 65-95-year-olds undergoing hip revision surgery.[129] For TKA, we followed Pennington et al[127] in using the model that they estimated for 30-day mortality associated with primary arthroplasty for both primary and revision surgery. However, when estimating mortality for revision surgery, we used age at the time of revision, rather than age at primary surgery. Mortality in the year of revision surgery was calculated from the 30-day mortality and the annual mortality that would have applied in the absence of revision surgery in the same way as for primary arthroplasty. We followed Pennington et al by capping mortality in the year of revision at a maximum of 10% above all-cause mortality to avoid extrapolating very high mortality rates to very old patients who were generally outside the sample used to estimate mortality rates.

In the model of hip arthroplasty (where mortality for revision surgery is estimated over a 12-month period), mortality in year 1 was assumed to equal mortality in the year of revision surgery for the proportion of patients undergoing revision surgery in year 1 and was assumed to equal mortality in the year of primary surgery for those patients who were not revised in year 1. In the model of knee arthroplasty (where mortality for revision surgery is estimated over a 30 day period), the 30-day mortality for primary TJA was applied for all patients, the 30-day mortality for revision arthroplasty was applied for the proportion of patients who were revised in the first year (x) and all-cause mortality allowing for the healthy patient effect was applied to those patients who did not die in the first 30 days for the remaining 365.24-30-30x days of the year.

Mapping baseline clinical tool scores onto EQ-5D utility

Methods

Models mapping from OKS and OHS onto EQ-5D utility were required to estimate pre-operative EQ-5D utility for each hypothetical individual considered in the model. Only models mapping from total OKS and total OHS were considered due to the way in which clinical tool scores were considered in the model structure.

The models considered for *Chapter 7* superseded the published mapping algorithms used for the analysis in *Chapter 5* (*Online Supplement 12*). The full PROMs/HES abstract included more recent data and a sample size 2-20 times larger than the datasets used in the published algorithms.[134, 184] Moreover, estimating mapping models using the model selection procedure below allowed us to consider nonlinearities in the relationship between OKS/OHS and EQ-5D utility. Finally, including age and sex into the model allowed us to more accurately assess how economic thresholds vary with age and sex. The model selection procedure was broadly similar to the procedure used for the mapping models in *Chapter 5*:

- EQ-5D utility comprised the dependent variable
- We only used pre-operative data, i.e. we did not consider pooling baseline and follow-up data. The large sample size of >200,000 baseline observations means that interaction effects between baseline measurement and OKS/OHS, age and sex would most likely be highly significant, and any potential gains in precision by including follow-up data could likely be offset by nonlinearities in the interaction effects between baseline measurement and covariates.
- Exploratory data analysis was conducted solely on baseline data.
- The "simple model" used in step 1 comprised Oxford score, age and sex.
- Steps 1, 2 and 3 selected the functional form for the model, score and age/sex variables as described in *Chapter 5, Regression Analyses*

Mapping OKS on to EQ-5D utility in TKA

This model was estimated using linked data from PROMs/HES. The dataset was chosen, since it offered the largest sample size, encompassing approximately 67% of all TKA procedures conducted in England between April 2009 and October 2015. Linking the PROMs record to HES data was necessary, since our PROMs extract did not include age of the patient. We conducted no external validation. The model selection procedure, measures of model performance (MSE) and 10-fold cross-validation are described in *Chapter 5, Regression Analyses*.

PROMs/HES included up to two measurements (baseline and six-month follow-up) for 312,535 TKA patients. As described above, we only included baseline data in the analysis, since the large sample size meant that any potential gains in statistical precision are likely offset by systematic differences in the relationship between EQ-5D utility and covariates between baseline and follow-up measurement. We conducted a complete-case analysis on 290,893 baseline observations with complete data on EQ-5D utility, OKS, age and sex.

Exploratory data analysis demonstrated that the distribution of pre-operative EQ-5D utilities had two peaks around 0 and between 0.5 and 0.8; 0.3% of observations had a utility of 1. We therefore explored OLS, Tobit and two-part models using an OLS regression for the second part. We plotted the mean EQ-5D utility at each OKS score and compared it against different fitted functions. On the basis of such graphs, we evaluated quadratic and cubic, fourth- and fifth-order polynomials as well as log-linear functions for the relationship between EQ-5D utility and OKS. We considered linear, quadratic and cubic functions, fourth- and fifth-order polynomials as well as five-year age bands for age. We also considered whether excluding age would increase model performance. Finally, we considered whether to exclude sex from the model.

A Tobit model censored from below at -0.594 and from above at 1 and estimated on 290,893 observations gave best predictions (Table *160*). The model included a fifth-order polynomial for OKS, a fourth-order polynomial for age as well as an indicator for sex. Within 10-fold cross-validation, the MSE for this model was 0.0471549. The variance-covariance matrix is available at http://www.herc.ox.ac.uk/downloads/downloads-supporting-material-1/ACHE.

TABLE 160 Tobit model censored at -0.594 and 1 mapping from OKS to EQ-5D in TKA patients from PROMs/HES (290,893 observations)[a]

Variable	**Mean (SE)**
Female sex	0.01039880 (0.00083510)*
Age	-0.02942770 (0.01046270)*
Squared age	0.0007750 (0.00025410)*
Cubic age	-0.000008360 (0.00000270)*
Age power 4	0.000000033 (0.000000011)*
Baseline OKS	0.01000790 (0.00240270)*
Squared OKS	0.00215030 (0.00029970)*
Cubic OKS	-0.00003140 (0.00001660)
OKS power 4	-0.000001650 (0.000000419)*
OKS power 5	0.000000032 (0.000000004)*
Constant term	0.17905660 (0.15916530)
Sigma (Tobit)	0.21773650 (0.00028950)*

* p<0.05

[a] The Tobit model censored values at -0.594 and 1. To calculate predicted EQ-5D utility for the Tobit models, it is necessary to first calculate the linear predictor (XB) by multiplying the values for the individual patient by the coefficients shown and summing over all coefficients. The predicted utility can then be calculated as

$$\widehat{eq5d} = -0.594 * \Phi\left(\frac{-0.594 - XB}{\sigma}\right) + 1 * \Phi\left(-\frac{1 - XB}{\sigma}\right)$$

$$+\left(\Phi\left(\frac{1-XB}{\sigma}\right) - \Phi\left(\frac{-0.594-XB}{\sigma}\right)\right) * (Xb - \sigma * \frac{\phi\left(\frac{1-Xb}{\sigma}\right)-\phi\left(\frac{-0.594-Xb}{\sigma}\right)}{\Phi\left(\frac{1-Xb}{\sigma}\right)-\Phi\left(\frac{-0.594-Xb}{\sigma}\right)}).$$

Mapping OHS onto EQ-5D in THA

This model was also estimated using linked data from PROMs/HES. The dataset was chosen, since it offered the largest sample size, encompassing approximately 67% of all THA procedures conducted in England between April 2009 and October 2015. Linking the PROMs record to HES data was necessary, since our PROMs extract did not include age of the patient. We conducted no external validation. The model selection procedure, measures of model performance (MSE) and 10-fold cross-validation are described in *Chapter 5, Regression Analyses*.

PROMs/HES included up to two measurements (baseline and six-month follow-up) for 289,867 THA patients. As described above, we only included baseline data in the analysis. We conducted a complete-case analysis on 271,045 baseline observations with complete data on EQ-5D utility, OHS, age and sex.

Exploratory data analysis demonstrated that the distribution of EQ-5D utilities had two peaks around 0 and between 0.5 and 0.8; 0.2% of observations had a utility of 1. We therefore explored OLS, Tobit and two-part models using an OLS regression for the second part. We plotted the mean EQ-5D utility at each OHS score and compared it against different fitted functions. Based on such graphs, we evaluated quadratic and cubic, fourth- and fifth-order polynomials as well as log-linear functions for the relationship between EQ-5D utility and OHS. We considered linear, quadratic and cubic functions, fourth- and fifth-order polynomials as well as five-year age bands for age. We also considered whether excluding age would increase model performance. Finally, we considered whether to exclude sex of the patient from the model.

A Tobit model censored from below at -0.594 and from above at 1 and estimated on 271,045 observations gave best predictions (Table *161*). The model included a fifth-order polynomial for OHS as well as a fourth-order polynomial for age. Sex was excluded from the model.

Within 10-fold cross validation, the MSE for this model was 0.0450653. The variance-covariance matrix is available at http://www.herc.ox.ac.uk/downloads/downloads-supporting-material-1/ACHE.

TABLE 161 Tobit model censored at -0.594 and 1 mapping from OHS to EQ-5D in TKA patients from PROMs/HES (271,045 observations)[a]

Variable	**Mean (SE)**
Age	-0.00874150 (0.00386580)*
Squared age	0.00037420 (0.00010620)*
Cubic age	-0.000005190 (0.000001240)*
Age power 4	0.000000023 (0.000000005)*
Baseline OHS	0.00571870 (0.00203970)*
Squared OHS	0.00238470 (0.00026410)*
Cubic OHS	-0.0000380 (0.0000150)*
OHS Power 4	-0.000001480 (0.000000385)*
OHS power 5	0.000000030 (0.000000004)*
Constant term	-0.16485810 (0.05079150)*
Sigma (Tobit)	0.21283210 (0.00030220)*

* p<0.05

[a] The Tobit model censored values at -0.594 and 1. To calculate predicted EQ-5D utility for the Tobit models, it is necessary to first calculate the linear predictor (XB) by multiplying the values for the individual patient by the coefficients shown and summing over all coefficients. The predicted utility can then be calculated as

$$\widehat{eq5d} = -0.594 * \Phi\left(\frac{-0.594 - XB}{\sigma}\right) + 1 * \Phi\left(-\frac{1 - XB}{\sigma}\right)$$

$$+\left(\Phi\left(\frac{1-XB}{\sigma}\right) - \Phi\left(\frac{-0.594-XB}{\sigma}\right)\right) * \left(Xb - \sigma * \frac{\phi\left(\frac{1-Xb}{\sigma}\right)-\phi\left(\frac{-0.594-Xb}{\sigma}\right)}{\Phi\left(\frac{1-Xb}{\sigma}\right)-\Phi\left(\frac{-0.594-Xb}{\sigma}\right)}\right).$$

Post-operative EQ-5D utility six months after arthroplasty

Analysis plan

- The explanatory variable comprised EQ-5D utility six months after primary arthroplasty.
- This analysis excluded patients who died before six months, since they have no utility data.
- Since it is difficult to identify which PROMs respondents had revisions within 12 months of arthroplasty and we have a shortage of data to assess how revision rates vary with clinical tool, we combined together patients who had a revision before 12 months and patients who have not been revised in this period.

Post-operative EQ-5D utility six months after TKA: OKS

This model was estimated using 223,836 observations from PROMs/HES. We considered OLS, Tobit and two-part models with a linear second part. For the functional form of OKS, we considered quadratic, cubic, fourth-order and fifth-order polynomials as well as log-linear functions. For age, we considered linear, quadratic and cubic functions, fourth- and fifth-order polynomials, five-year age bands as well as a linear spline with a spline point at 65. We also considered whether excluding age from the model would improve model performance. Finally, we considered whether to exclude sex from the model.

The final model was a Tobit model censored at -0.594 and 1. The model was estimated using 223,836 observations. The model included a fourth-order polynomial for OKS as well as age bands (ten-year bands between 30 and 50, five-year bands between 50 and 95). Sex was excluded from the model. The estimation results are shown in Table *162*.

TABLE 162 Tobit model censored at -0.594 and 1 predicting EQ-5D utility six months after knee arthroplasty as a function of OKS

Variable	**Mean (SE)**
Age <30	-0.14669210 (0.06180950)*
Age 30-39	-0.04302510 (0.02371350)
Age 40-49	-0.02315660 (0.00678670)*
Age 55-59	0.01138180 (0.00447040)*
Age 60-64	0.04653980 (0.00409360)*
Age 65-69	0.08937710 (0.00397960)*

Age 70-74	0.0899050 (0.00396640)*
Age 75-79	0.08561110 (0.00399990)*
Age 80-84	0.08467470 (0.0042080)*
Age 85-89	0.0770580 (0.00509870)*
Age 90-94	0.07987230 (0.01066470)*
Age ≥95	0.09355830 (0.04858090)
Baseline OKS	0.05724670 (0.00248220)*
Squared OKS	-0.00235630 (0.00020080)*
Cubic OKS	0.00005390 (0.00000660)*
OKS power 4	-0.00000047 (0.00000008)*
Constant term	0.17409740 (0.01105080)*
Sigma (Tobit)	0.29971790 (0.00071090)*

* $p<0.05$

Post-operative EQ-5D utility six months after THA: OHS

This model was estimated on 208,344 observations from PROMs/HES. During the model selection process, we considered OLS, Tobit and two-part models with a linear second part. For OHS, we considered quadratic and cubic trends, fourth- and fifth-order polynomials as well as log-linear functions. We considered linear, quadratic and cubic trends, fourth- and fifth-order polynomials as well as five-year bands for age. We also considered whether excluding age would improve model performance. Finally, we considered excluding sex from the model.

The final model was chosen as a Tobit model censored at -0.594 and 1. The model was estimated using 208,344 observations. We included a fifth-order polynomial for OHS, an indicator for sex as well as age bands (ten-year bands between 30 and 50, five-year bands between 50 and 95). The estimation results are shown in Table *163*.

TABLE 163 Tobit model censored at -0.594 and 1 predicting EQ-5D utility six months after hip arthroplasty as a function of OHS

Variable	**Mean (SE)**
Age <30	-0.09038720 (0.01717380)*

Age 30-39	-0.0442320 (0.01046950)*
Age 40-49	-0.01239970 (0.00612810)*
Age 55-59	0.00320430 (0.00501190)
Age 60-64	0.02120470 (0.00459240)*
Age 65-69	0.03234740 (0.00442240)*
Age 70-74	0.00383120 (0.00437720)
Age 75-79	-0.02072520 (0.00439990)*
Age 80-84	-0.04606640 (0.00462860)*
Age 85-90	-0.06785520 (0.00555820)*
Age 90-94	-0.0698370 (0.01027090)*
Age ≥95	-0.10718110 (0.04129650)*
Female sex	-0.0309910 (0.00169110)*
Baseline OHS	0.05839120 (0.00433690)*
Squared OHS	-0.00331240 (0.000540)*
Cubic OHS	0.00011820 (0.00002990)*
OHS power 4	-0.000002110 (0.000000752)*
OHS power5	0.000000015 (0.000000007)*
Constant term	0.44512830 (0.01296520)*
Sigma	0.34419480 (0.00089040)*

* $p<0.05$

Long-term annual change in EQ-5D utility beyond six months – Without surgery

As described in *Chapter 5*, we used Ara and Brazier's Model 1[121] to predict the rate at which EQ-5D utility decreases with age. The variance-covariance matrix was obtained from the authors. We used only the age (β1) and age-squared β2) coefficients from this model and calculated utility in year t as:

$$utility_t = utility_{t-1} + (\beta 1 \cdot age_t + \beta 2 \cdot age_t^2) - (\beta 1 \cdot age_{t-1} + \beta 2 \cdot age_{t-1}^2)$$

Long-term annual change in EQ-5D utility beyond six months after surgery

The regression models described in *Online Supplement 12, Long-Term Annual Change In EQ-5D Utility Beyond Six Months After Surgery* were also used in the analyses described in *Chapter 7.*

EQ-5D utility before or after revision surgery

Methods

- EQ-5D utility before and after revision surgery was estimated using the 2009-2015 PROMs/HES extract. PROMs questionnaires relating to revision procedures were linked to the questionnaires relating to the same patient's primary operation (matched on patient ID, procedure and side of the body information from HES). Revisions that could not be linked to a PROMs questionnaire for a primary operation on the same joint were excluded from this analysis.
- Revisions occurring <1 year after primary arthroplasty were excluded, since quality of life for all patients (including those who have had revisions) was included in the model of six-month EQ-5D. Furthermore, for revisions occurring in year 1, the pre-revision utility may be measured either before or after the questionnaire completed six months after the primary operation.
- All linked revisions occurring >1 year after primary arthroplasty were included in the analysis, regardless of whether they were the patient's first revision or how many previous revisions of patient had had. Data were analysed in long format, with one row per revision, and clustering was used to adjust standard errors for repeated observations of patients with more than one revision. When sorting observations into 10 groups for K-fold cross-validation, patients were divided between the 10 groups and all observations for the same patient were included in the same part of the dataset.
- We estimated regression models predicting EQ-5D utility immediately before and six months after revision surgery as a function of the Oxford score before the primary operation, age, sex and time since primary arthroplasty.
- Separate regression analyses were conducted on utilities before and after revision and predictions were averaged to estimate the number of QALYs accrued in the year of revision surgery.

EQ-5D utility before knee revision

EQ-5D utility before knee revision surgery was estimated on 2,227 observations of 2,073 patients within the PROMs/HES data, who had complete data on age and sex and for whom PROMs questionnaires conducted before revision surgery could be linked to a PROMs questionnaire conducted before primary knee arthroplasty.

Based on the exploratory data analysis, we compared prediction accuracy for OLS and Tobit models. Two-part models were not considered since exploratory data analysis demonstrated that very few patients had a utility of 1. Tobit models censoring utility at 1 and -0.594 gave best prediction accuracy. We then compared models with linear, log-linear, quadratic and cubic functions for the time since primary arthroplasty against a model dropping the time variable. For OKS, we considered first, second, third and fourth order polynomials, a logarithmic function and a linear spline at a score of 30. We compared prediction accuracy between a model controlling for age at the time of primary arthroplasty and a model controlling for age at the time of revision surgery and found that the former gave best predictions. Linear, quadratic and cubic functions for age at the time of primary arthroplasty were considered, as well as a model dropping age and a model with a linear spline at age 70. Finally, we evaluated whether dropping the gender variable improved prediction accuracy. The model with best prediction accuracy was a Tobit model censored at 1 and -0.594 that predicted EQ-5D utility before revision as a function of a third order polynomials for OKS, a linear spline for age, male gender and the natural log of the timing of revision surgery (Table *164*).

TABLE 164 Tobit[a] model predicting utility before knee revision surgery

Variable	**Mean (SE)[b]**
OKS measured before primary arthroplasty	0.0263075 (0.0082707)*
OKS (before primary arthroplasty) squared	0.0002356 (0.0004623)
OKS (before primary arthroplasty) cubed	-0.0000151 (0.0000077)
Age at the time of primary arthroplasty operation	0.0044719 (0.0009990)*
Equal to 0 if the patient is aged under 70 years at the time of primary arthroplasty and equal to age at primary minus 70 years if the patient is 70 years or over	-0.0056068 (0.0028785)
Male sex	-0.0235770 (0.0136819)
Natural log of the year of revision, where year of revision is recorded as 1 if the revision took place within 12 months of primary procedure, as 2 if the revision took place 12-24 months after primary and 3 if the revision took place 24-36 months after, etc	-0.0360110 (0.0188177)

Constant	-0.3498149 (0.0753372)*
Sigma	0.2998682 (0.0036758)*

* $p<0.05$

[a] The Tobit model censored values at -0.594 and 1.To calculate predicted EQ-5D utility for the Tobit model, it is necessary to first calculate the linear predictor (XB) by multiplying the values for the individual patient by the coefficients shown and summing over all coefficients. The predicted utility can then be calculated as

$$\widehat{eq5d} = -0.594 * \Phi\left(\frac{-0.594 - XB}{\sigma}\right) + 1 * \Phi\left(-\frac{1 - XB}{\sigma}\right)$$
$$+ \left(\Phi\left(\frac{1-XB}{\sigma}\right) - \Phi\left(\frac{-0.594-XB}{\sigma}\right)\right) * (Xb - \sigma * \frac{\phi\left(\frac{1-Xb}{\sigma}\right)-\phi\left(\frac{-0.594-Xb}{\sigma}\right)}{\Phi\left(\frac{1-Xb}{\sigma}\right)-\Phi\left(\frac{-0.594-Xb}{\sigma}\right)}).$$

[b] Standard errors were adjusted for clustering

EQ-5D utility six months after knee revision

EQ-5D utility six months after knee revision surgery was estimated on the 1,398 observations of 1,331 patients in PROMs/HES for whom PROMs questionnaires completed after revision surgery could be linked to those completed before primary arthroplasty.

Based on exploratory data analysis, we compared OLS, Tobit and two-part models. We then compared models with linear, quadratic, cubic and log-linear functions for time since primary arthroplasty and a model dropping the time variable. Linear, quadratic, cubic and logarithmic functions for OKS were then compared. We compared a model controlling for age at the time of revision surgery against a model controlling for age at the time of primary surgery and found the former to have better prediction accuracy. Linear, quadratic and cubic functions for age at the time of revision were compared against a model dropping age and a model with a linear spline at age 65. Finally, we evaluated whether dropping the gender variable improved prediction accuracy.

The model with best prediction accuracy was a Tobit model censoring utility at 1 and -0.594 that predicted EQ-5D utility six months after knee revision surgery as a function of the natural log of OKS, a linear spline functions for age at the time of revision surgery and gender (Table *165*). Dropping time since primary arthroplasty improved prediction accuracy.

TABLE 165 Tobit[a] model predicting utility after knee revision surgery as a function of OKS

Variable	**Mean (SE[b])**
Natural log of OKS measured before primary arthroplasty (equal to 0 if OKS equals 0)	0.2556 (0.0195)*
Age at the time of revision surgery	0.0135 (0.0026)*
Equal to 0 if the patient is aged under 65 years at the time of revision surgery and equal to age at revision minus 65 years if the patient is 65 years or over	-0.0153 (0.0037)*
Male sex	-0.0887 (0.0198)*
Constant	-0.9426 (0.1623)*
Sigma	0.3441 (0.0076)*

* p<0.05

[a] The Tobit model censored values at -0.594 and 1.To calculate predicted EQ-5D utility for the Tobit model, it is necessary to first calculate the linear predictor (XB) by multiplying the values for the individual patient by the coefficients shown and summing over all coefficients. The predicted utility can then be calculated as

$$\widehat{eq5d} = -0.594 * \Phi\left(\frac{-0.594 - XB}{\sigma}\right) + 1 * \Phi\left(-\frac{1 - XB}{\sigma}\right)$$

$$+ \left(\Phi\left(\frac{1-XB}{\sigma}\right) - \Phi\left(\frac{-0.594-XB}{\sigma}\right)\right) * \left(Xb - \sigma * \frac{\phi\left(\frac{1-Xb}{\sigma}\right)-\phi\left(\frac{-0.594-Xb}{\sigma}\right)}{\Phi\left(\frac{1-Xb}{\sigma}\right)-\Phi\left(\frac{-0.594-Xb}{\sigma}\right)}\right).$$

[b] Standard errors were adjusted for clustering

EQ-5D utility before hip revision

EQ-5D utility before hip revision surgery was estimated on 1,391 observations of 1,331 patients in PROMs/HES for whom utility measured before revision surgery could be linked to pre-operative OHS. We first compared prediction accuracy between OLS and Tobit models. Since exploratory data analysis showed that the relationship between time since primary surgery and EQ-5D utility was very weak, we simply compared a linear model for time since primary surgery against a model dropping the time variable. We considered linear, quadratic, cubic and logarithmic functions for OHS. Age at the time of revision surgery was then found to have better prediction accuracy than age at the time of primary arthroplasty. We considered linear, quadratic and cubic functions for age at the time of revision surgery, as well as a model dropping the age variable. Finally, we considered the impact of dropping the gender variable.

The final model was a Tobit model censored at 1 and -0.594, which predicted EQ-5D utility before revision as a function of OHS before primary arthroplasty, OHS-squared and age at the time of revision surgery (Table *166*).

TABLE 166 Tobit[a] model predicting utility before hip revision surgery

Variable	**Mean (SE[b])**
OHS before primary arthroplasty surgery	0.02665 (0.00419)*
OHS (before primary operation) squared	-0.00029 (0.00010)*
Age in years at the time of revision surgery	0.00212 (0.00076)*
Constant	-0.14437 (0.06087)*
Sigma	0.31777 (0.00475)*

* p<0.05

[a] The Tobit model censored values at -0.594 and 1.To calculate predicted EQ-5D utility for the Tobit model, it is necessary to first calculate the linear predictor (XB) by multiplying the values for the individual patient by the coefficients shown and summing over all coefficients. The predicted utility can then be calculated as

$$\widehat{eq5d} = -0.594 * \Phi\left(\frac{-0.594 - XB}{\sigma}\right) + 1 * \Phi\left(-\frac{1 - XB}{\sigma}\right)$$

$$+ \left(\Phi\left(\frac{1-XB}{\sigma}\right) - \Phi\left(\frac{-0.594-XB}{\sigma}\right)\right) * (Xb - \sigma * \frac{\phi\left(\frac{1-Xb}{\sigma}\right)-\phi\left(\frac{-0.594-Xb}{\sigma}\right)}{\Phi\left(\frac{1-Xb}{\sigma}\right)-\Phi\left(\frac{-0.594-Xb}{\sigma}\right)}).$$

[b] Standard errors were adjusted for clustering

EQ-5D utility six months after hip revision

PROMs/HES data on 880 for observations of 860 patients were used to predict EQ-5D utility six months after hip revision surgery. OLS, two-part and Tobit models were compared with respect to prediction accuracy. Since there was only a weak relationship between EQ-5D and time since primary surgery, we simply compared linear functions of time against a model dropping the time variable. Linear, quadratic, cubic and logarithmic functions of OHS were compared. Age of the time of revision surgery was found to give better predictions than age at the time of primary surgery. Linear, quadratic and cubic functions of age at revision surgery were compared against a model dropping age. Finally, the impact of dropping gender was evaluated.

The final model comprised a Tobit model predicting EQ-5D utility six months after hip revision surgery as a function of log-OHS, male gender and a cubic function of age at the time of revision surgery (Table *167*).

TABLE 167 Tobit[a] model predicting utility after hip revision surgery

Variable	**Mean (SE[b])**
Natural log of OHS before primary arthroplasty surgery (set to 0 if OHS is 0)	0.220105 (0.025802)*
Age in years at the time of revision surgery	-0.081808 (0.069536)
Square of age in years at the time of revision surgery	0.001755 (0.001099)
Cube of age in years at the time of revision surgery	-0.000011 (0.000006)
Male gender	-0.059074 (0.026963)*
Constant	1.120423 (1.445414)
Sigma	0.363348 (0.011838)*

* $p<0.05$

[a] The Tobit model censored values at -0.594 and 1.To calculate predicted EQ-5D utility for the Tobit model, it is necessary to first calculate the linear predictor (XB) by multiplying the values for the individual patient by the coefficients shown and summing over all coefficients. The predicted utility can then be calculated as

$$\widehat{eq5d} = -0.594 * \Phi\left(\frac{-0.594 - XB}{\sigma}\right) + 1 * \Phi\left(-\frac{1 - XB}{\sigma}\right)$$

$$+\left(\Phi\left(\frac{1-XB}{\sigma}\right) - \Phi\left(\frac{-0.594-XB}{\sigma}\right)\right) * (Xb - \sigma * \frac{\phi\left(\frac{1-Xb}{\sigma}\right)-\phi\left(\frac{-0.594-Xb}{\sigma}\right)}{\Phi\left(\frac{1-Xb}{\sigma}\right)-\Phi\left(\frac{-0.594-Xb}{\sigma}\right)}).$$

[b] Standard errors were adjusted for clustering

Cost of the primary arthroplasty procedure and hospital stay

Methods

- Cost of the primary arthroplasty procedure was estimated using the 2009-2015 PROMs/HES extract. HES episodes were identified as primary arthroplasty procedures if they could be linked to a PROMs questionnaires that was not marked as a revision procedure and if the patient did not have a previous arthroplasty procedure conducted on the same joint and the same side.
- Arthroplasty episodes were valued using the NHS Payment Grouper for 2014/15[153] and the National Tariff 2014/15,[154] see *Online Supplement 15, Valuing Admissions Using The Payment Grouper*. The cost included the base cost of the HRG, excess bed day costs for bed days exceeding the relevant trim point as well as costs for unbundled procedures (e.g. diagnostic imaging). Episodes that could not be valued after data cleaning or with missing data on length of stay were excluded from the analyses.
- We estimated regression models predicting cost of primary arthroplasty as a function of the Oxford score before the primary operation, age at admission and sex.

Cost of primary TKA: OKS

This parameter was estimated based on 308,638 observations from PROMs/HES. During the model selection process, we considered OLS models, gamma-GLM models with a canonical (i.e. inverse) and a log-link function as well as Gaussian-GLMs with a log-link function. We did not consider Tobit or two-part models, since the data did not seem to be censored or truncated from below. For OKS, we considered linear and cubic trends, fourth- and fifth-order polynomials as well as log-linear functional forms. For patients with OKS of zero, we set the logarithm of OKS to zero. For age, we considered linear, quadratic and cubic trends, five- and ten-year age bands as well as excluding age from the model. Finally, we considered whether excluding sex would improve model performance.

The final model was estimated as a gamma-GLM with an inverse (canonical) link function based on 308,638 observations. The model included a fifth-order polynomial for OKS, a quadratic age trend as well as an indicator for sex (Table *168*).

TABLE 168 Gamma-GLM with an inverse link function[a] predicting the cost of primary TKA

Variable	**Mean (SE)**
Age at operation	0.0000007640 (0.00000006090)*
Squared age	-0.000000007760 (0.0000000004460)*
Female sex	-0.0000002470 (0.0000001110)*
Baseline OKS	0.000002670 (0.0000002920)*
Squared OKS	-0.0000002260 (0.00000003580)*
Cubic OKS	0.00000000970 (0.000000001960)*
OKS power 4	-0.0000000002020 (0.0000000000487)*
OKS power 5	0.0000000000016 (0.0000000000004)*
Constant term	0.00013770 (0.000002210)*

* $p<0.05$

[a] To calculate predicted the costs for the GLM with inverse link function, it is necessary to first calculate the linear predictor (XB) by multiplying the values for the individual patient by the coefficients shown and summing over all coefficients. The predicted cost can then be calculated as $1/XB$. Costs predicted to be <0 were set to 0.

Cost of primary THA: OHS

This parameter was estimated based on 286,507 observations from PROMs/HES. During the model selection process, we considered OLS models, gamma-GLM models with a canonical (i.e. inverse) and a log-link function as well as Gaussian-GLMs with a log-link function. We did not consider Tobit or two-part models, since very few patients had cost below £4,000. For OHS, we considered linear and cubic trends, fourth- and fifth-order polynomials as well as log-linear functional forms. For patients with OHS of zero, we set the logarithm of OHS to zero as well. For age, we considered linear, quadratic and cubic trends, fourth- and fifth-order polynomials, five-year age bands as well as excluding age from the model. Finally, we considered whether excluding sex would improve model performance.

The final model was estimated as a gamma-GLM with an inverse (canonical) link function using 286,507 observations. The model included a fifth-order polynomial for both OHS and age as well as an indicator for sex (Table *169*).

TABLE 169 Gamma-GLM with an inverse link function[a] predicting the cost of primary THA

Variable	**Mean (SE)**
Age	-0.0000008280 (0.000001220)
Age squared	0.00000004310 (0.00000004730)
Cubic age	-0.0000000008870 (0.0000000008730)
Age power 4	0.000000000008530 (0.000000000007740)
Age power 5	-0.000000000000035 (0.000000000000027)
Female sex	0.0000007440 (0.00000009180)*
Baseline OHS	0.00000310 (0.0000001970)*
OHS squared	-0.0000002580 (0.0000000250)*
Cubic OHS	0.00000001070 (0.00000000140)*
OHS power 4	-0.0000000002080 (0.0000000000350)*
OHS power 5	0.00000000000150 (0.000000000000322)*
Constant term	0.00017170 (0.00001190)*

* p<0.05

[a] To calculate predicted the costs for the GLM with inverse link function, it is necessary to first calculate the linear predictor (XB) by multiplying the values for the individual patient by the coefficients shown and summing over all coefficients. The predicted cost can then be calculated as $1/XB$. Costs predicted to be <0 were set to 0.

Readmission costs beyond the initial hospital stay for arthroplasty: Year 1

Methods

- As described in *Online Supplement 15, Methods For Identifying Arthroplasty-Related Readmissions*, admission episodes in the HES data were identified as readmissions attributable to primary arthroplasty if they could be linked to a primary arthroplasty episode and fulfilled one of the following criteria:
    - The episode occurred within 30 days of primary arthroplasty surgery; or
    - The primary diagnosis of the episode was M.16X (hip arthritis) or M.17X (knee arthritis); or
    - The procedure codes indicated a surgical procedure conducted on the hip or knee joint; or
    - The diagnosis codes indicated an infection attributable to a joint implant.
- Readmission episodes were valued using the NHS Payment Grouper[153] and the National Tariff 2014/15[154] (see *Online Supplement 15, Valuing Admissions Using The Payment Grouper*). We distinguished between the elective and non-elective tariff for each HRG. For episodes with missing data, we imputed data on cost per bed-day (if length of stay information was available) or on cost per admission (if length of stay data were missing) by using the average value for episodes retained within the same category (see above).
- Readmissions were aggregated by year since primary arthroplasty to create a dataset in long format (i.e. one row per year and per primary arthroplasty episode). If no readmissions were observed for a patient in a given year, we assigned cost of zero to this observation.
- We created indicators for whether a patient was revised in any given year and whether they had any revision in the past.
- If a patient died in hospital, we excluded all observations for subsequent years from the analysis.
- For the analysis of readmission cost in the first year after primary arthroplasty, we included patients who had a revision within the same year.
- We estimated regression models predicting total readmission cost based on clinical tool score, age and sex at the time of primary arthroplasty.
- We randomly allocated observations to one of 10 groups for K-fold cross-validation; for simplicity, observations were allocated to groups independently, such that observations for the same patient could be allocated to different groups.

Readmission costs Year 1 after primary knee arthroplasty: OKS

This model was estimated based on 255,194 observations from PROMs/HES. For the functional form of the model, we considered OLS regressions, Tobit models, gamma-GLM models with an inverse or log-link function, a Gaussian-GLM with a log-link function as well as two-part models. Two-part models predicted whether the cost was £0 and then predicting costs for patients with non-zero costs; for the second part, we explored OLS models, gamma-

GLM models with an inverse or log-link function, or Gaussian-GLMs with a log-link function. For the functional form of OKS, we considered quadratic and cubic trends, fourth- and fifth-order polynomials as well as a linear spline with a spline point at 10. For age, we considered linear, quadratic and cubic trends, a linear spline at age 70 as well as excluding age from the model. Finally, we considered whether to exclude sex from the model.

The final model was estimated as a Gaussian-GLM with a log-link function and clustered standard errors (clustered by patient ID, since some patients have several primary arthroplasty procedures) on 255,194 observations from PROMs/HES. The model included a cubic trend for OKS, a quadratic age trend and an indicator for sex of the patient (Table *170*).

TABLE 170 Gaussian-GLM with a log-link function[a] predicting the cost of readmissions in the first year after primary TKA

Variable	**Mean (SE)**
Age at operation	-0.081136 (0.009237)*
Squared age	0.000710 (0.000067)*
Female sex	-0.250019 (0.020704)*
Baseline OKS	-0.117701 (0.013419)*
Squared OKS	0.003638 (0.000742)*
Cubic OKS	-0.000044 (0.000012)*
Constant term	9.687001 (0.300810)*

* p<0.05

[a] To calculate predicted the costs for the GLM with log-link function, it is necessary to first calculate the linear predictor (XB) by multiplying the values for the individual patient by the coefficients shown and summing over all coefficients. The predicted cost can then be calculated as $\exp(XB)$. Costs predicted to be <0 were set to 0.

Readmission costs Year 1 after primary hip arthroplasty: OHS

This parameter was estimated using 236,514 observations from PROMs/HES. For the functional form of the model, we considered OLS regressions, Tobit models, gamma-GLM models with an inverse or log-link function, a Gaussian-GLM with a log-link function as well as two-part models with the second part as an OLS model, gamma-GLM models with an inverse or log-link function, or Gaussian-GLMs with a log-link function. For the functional form of OHS, we considered quadratic and cubic trends, fourth- and fifth-order polynomials as well as a linear spline with a spline point at 10. For age, we considered linear, quadratic and cubic trends, a linear spline at age 70 as well as excluding age from the model. Finally, we considered whether to exclude sex from the model.

The final model was estimated as a Gaussian-GLM with a log-link function and clustered standard errors by patient ID on 236,514 observations. The model included a fifth-order polynomial for OHS, a linear spline for age with a spline point at age 70, and an indicator for sex of the patient (Table *171*).

TABLE 171 Gaussian-GLM with a log-link function[a] predicting the cost of readmissions in the first year after primary TKA

Variable	**Mean (SE)**
Age	0.00531760 (0.00167050)*
Age trend for patients over 70: Equals age minus 70 if the patient is aged 70 years or over	0.03447590 (0.00335950)*
Female sex	-0.17847820 (0.02143660)*
Baseline OHS	-0.17271450 (0.03718920)*
Squared OHS	0.01325340 (0.00505960)*
Cubic OHS	-0.00061220 (0.00029550)*
OHS power 4	0.00001370 (0.00000764)
OHS power 5	-0.00000011 (0.00000007)
Constant term	6.788150 (0.14758930)*

* $p<0.05$

[a] To calculate predicted the costs for the GLM with log-link function, it is necessary to first calculate the linear predictor (XB) by multiplying the values for the individual patient by the coefficients shown and summing over all coefficients. The predicted cost can then be calculated as $\exp(XB)$. Costs predicted to be <0 were set to 0.

Community and outpatient costs beyond the initial hospital stay for arthroplasty: Year 1

Methods

Included all ambulatory consultations within 12 months of primary arthroplasty, regardless of whether patients had had a revision within 12 months of primary arthroplasty. Patients who died were excluded.

Community and outpatient costs Year 1 after primary knee arthroplasty: OKS

This parameter was estimated using 1,841 observations from the KAT trial. For the functional form of the model, we considered OLS regressions, Tobit models, gamma-GLM models with an inverse or log-link function, a Gaussian-GLM with a log-link function as well as two-part models with the second part as an OLS model, gamma-GLM models with an inverse or log-link function, or Gaussian-GLMs with a log-link function. For OKS, we considered linear and cubic trends as well as a linear spline with a spline point at 25. For age, we considered linear, quadratic, cubic and log-linear functional forms as well as excluding age from the model. Finally, we considered whether excluding sex from the model would improve model performance.

The final model was estimated as a gamma-GLM with a log-link function. The model included a linear trend for OKS and age. Sex was excluded from the model (Table *172*).

TABLE 172 Gamma-GLM using a log-link function[a] predicting ambulatory costs in year 1 after primary knee arthroplasty as a function of OKS

Variable	**Mean (SE)**
Age at operation	-0.029 (0.003)*
Baseline OKS	-0.016 (0.003)*
Constant term	8.170 (0.220)*

* $p<0.05$

[a] To calculate predicted the costs for the GLM with log-link function, it is necessary to first calculate the linear predictor (XB) by multiplying the values for the individual patient by the coefficients shown and summing over all coefficients. The predicted cost can then be calculated as $\exp(XB)$. Costs predicted to be <0 were set to 0.

Community and outpatient costs Year 1 after primary hip arthroplasty: OHS

This parameter was estimated using 548 observations from the COASt study. For the functional form of the model, we considered OLS regressions, Tobit models, gamma-GLM models with an inverse or log-link function, a Gaussian-GLM with a log-link function as well as two-part models with the second part as an OLS model, gamma-GLM models with an inverse or log-link function, or Gaussian-GLMs with a log-link function. For OHS, we considered linear, quadratic and cubic trends as well as a linear spline with a spline point at 20. For age, we considered linear, quadratic and cubic functional forms as well as excluding age from the model. Finally, we considered whether excluding sex from the model would improve model performance.

The final model was estimated as an OLS regression. The model included a cubic trend for OHS and a linear trend for age at operation. Sex was excluded from the model (Table *173*).

TABLE 173 OLS model predicting costs in year 1 after primary hip arthroplasty as a function of OHS

Variable	**Mean (SE)**
Age	-2.67 (1.13)*
Baseline OHS	28.81 (8.64)*
Squared OHS	-1.40 (0.44)*
Cubic OHS	0.02 (0.01)*
Constant term	137.07 (93.42)

* p<0.05

Readmission costs beyond the initial hospital stay for arthroplasty: Year 2 onwards

Methods

- This was estimated on data in long format with one row for each year and patient (i.e. primary arthroplasty episode) (see *Readmission Costs Beyond The Initial Hospital Stay For Arthroplasty: Year 1* within this appendix).
- Observations for year 1 were excluded from the analysis.
- We excluded years in which a revision occurred as well as all subsequent years for revised patients and any years occurring after patients had died.

- Standard errors were adjusted for clustering to allow for multiple years of data for individual participants. When sorting observations into 10 groups for 10-fold cross-validation, we randomised on the observation level, i.e. observations referring to the same patient could be sorted into different groups.
- We estimated regression models predicting cost based on time since primary arthroplasty, baseline clinical tool score, age and sex of the patient. Before choosing the functional form for age, we checked whether age at operation or current age provides the best model fit.

Readmission costs beyond the initial hospital stay for arthroplasty: OKS

This parameter was estimated using 514,047 observations from HES/PROMs. For the functional form of the model, we considered OLS regressions, Tobit models, gamma-GLM models with an inverse or log-link function, a Gaussian-GLM with a log-link function as well as two-part models with the second part as an OLS model, gamma-GLM models with an inverse or log-link function, or Gaussian-GLMs with a log-link function. Then, we considered whether to include a linear trend for time since primary TKA, a quadratic trend, a binary indicator for year 2 since primary TKA, binary indicators for each year since primary TKA, or whether to exclude time since primary TKA from the model. For OKS, we considered linear, quadratic and cubic trends, fourth- and fifth-order polynomials as well as log-linear functional forms. For patients with OKS of zero, we set the natural logarithm of OKS to zero. Before considering the functional form for age, we checked whether age at operation or current age would provide the best model fit. For age at operation, we considered linear, quadratic and cubic functional forms, fourth- and fifth-order polynomials, five-year age bands as well as excluding age from the model. Finally, we considered whether excluding sex from the model would improve model performance.

The final model was estimated as a gamma-GLM with an inverse link function and standard errors clustered on the patient level using 514,047 observations. The model included a linear trend for time since primary arthroplasty, OKS and age at operation as well as an indicator for sex of the patient (Table *174*).

TABLE 174 Gamma-GLM with an inverse link function predicting the cost of readmissions from year 2 onwards after primary TKA

Variable	**Mean (SE)**
Age at primary arthroplasty	0.00005 (0.00001)*
Female sex	0.00043 (0.00011)*
Baseline OKS	0.00017 (0.00001)*
Years since primary operation	0.00123 (0.00007)*
Constant term	-0.00396 (0.00037)*

* p<0.05

Readmission costs beyond the initial hospital stay for arthroplasty: OHS

This parameter was estimated based on 476,514 observations from PROMs/HES. For the functional form of the model, we considered OLS regressions, Tobit models, gamma-GLM models with an inverse or log-link function, a Gaussian-GLM with a log-link function as well as two-part models with the second part as an OLS model, gamma-GLM models with an inverse or log-link function, or Gaussian-GLMs with a log-link function. Then, we considered whether to include a linear trend for time since primary THA, a quadratic trend, a binary indicator for year 2 since primary THA, binary indicators for each year since primary THA, or whether to exclude time since primary THA from the model. For OHS, we considered linear, quadratic and cubic trends, fourth- and fifth-order polynomials as well as log-linear functional forms. For patients with OHS of zero, we set the natural logarithm of OHS to zero. Before considering the functional form for age, we checked whether age at operation or current age would provide the best model fit. For age, we considered linear, quadratic and cubic functional forms, five-year age bands as well as excluding age from the model. Finally, we considered whether excluding sex from the model would improve model performance.

The final model was estimated as a gamma-GLM with an inverse link function and standard errors clustered on the patient-level using 476,514 observations from PROMs/HES. The model included a linear trend for OHS and current age as well as a binary indicator for year 2 since primary THA. Sex was excluded from the model (Table *175*).

TABLE 175 Gamma-GLM with an inverse link function predicting the cost of readmissions from year 2 onwards after primary THA

Variable	**Mean (SE)**
Current age	0.000042 (0.000009)*
Baseline OHS	0.00020 (0.000017)*
Year 2 after primary operation	-0.002446 (0.000226)*
Constant term	0.003432 (0.000711)*

* p<0.05

Community and outpatient costs beyond the initial hospital stay for arthroplasty: Year 2 onwards

Community and outpatient costs >1 year after primary knee arthroplasty: OKS

- This analysis included only ambulatory consultations (GP, physiotherapy or outpatient consultation).
- This was estimated on long-format data (one row per patient per year), excluding data on the first year after joint replacement.
- This was estimated on patients who have not yet had a revision and don’t have revision surgery in the year in question.
- Patients who died were excluded.
- Standard errors were adjusted for clustering to allow for multiple years of data for individual participants.
- When sorting observations into 10 groups for 10-fold cross-validation, we randomised on the observation level, i.e. observations referring to the same patient could be sorted into different groups.
- Indicators of time since primary surgery were included if they improve MSE.

Community and outpatient costs were estimated using 13,271 observations from the KAT trial in long format. For the functional form of the model, we considered OLS regressions, linear mixed models, Tobit models, gamma-GLM models with an inverse or log-link function, a Gaussian-GLM with a log-link function as well as two-part models with the second part as an OLS model or a gamma-GLM model with a log-link function. Then, we considered whether to include a linear trend for time since primary TKA, a quadratic trend, a cubic trend, a binary indicator for year 2 since primary TKA, a binary indicator for year 2 since primary TKA in combination with a linear trend, or whether to exclude time since primary TKA from the model. For OKS, we considered linear, quadratic and cubic trends. Before considering the functional form for age, we checked whether age at operation or current age would provide the best model fit. For age at operation, we considered linear, quadratic and cubic functional forms as well as excluding age from the model. Finally, we considered whether excluding sex from the model would improve model performance.

The final model was estimated as a Gaussian-GLM with a log-link function and standard errors clustered on the patient-level using 13,271 observations. The model included a quadratic trend for OKS, a cubic trend for time since primary TKA, a cubic trend for age as well as an indicator for sex of the patient (Table *176*).

TABLE 176 Gaussian-GLM with a log-link function predicting ambulatory cost from year 2 onwards following primary TKA

Variable	**Mean (SE)**
Age at operation	0.3672 (0.2467)
Age squared	-0.0072 (0.0040)
Cubic age	0.0 (0.0)
Female sex	-0.3197 (0.1363)*
Baseline OKS	-0.0779 (0.0367)*
OKS squared	0.0011 (0.0009)
Year since primary operation	-0.5597 (0.2420)*
Year squared	0.0529 (0.0410)
Cubic year	-0.0018 (0.0021)
Constant term	1.2124 (4.8011)

* p<0.05

Community and outpatient costs >1 year after primary hip arthroplasty

The cost of consultations in years 2 to 10 after THA were based on the values presented in Appendices 40 and 41 of Pinedo Villanueva 2013,[114] using the methods described in *Online Supplement 12, Costs >1 year after primary hip arthroplasty*.

Cost of revision arthroplasty procedure and hospital stay

Methods

- Admissions were identified as a revision episode if they were indicated as revisions in the PROMs record, or if the patient previously had primary TKA on the same joint and the same side.
- Revision episodes were valued using the NHS Payment Grouper 2014/15[153] and the National Tariff 2014/15,[154] see *Online Supplement 15, Valuing Admissions Using The Payment Grouper*.
- Since it was not possible to identify two-stage revisions without NJR data, we did not distinguish between one- and two-stage revisions in the estimations. We assumed that the second-stage of the revision would be identified as a relevant readmission and increase the costs of readmissions in the year of revision correspondingly.
- Revision episodes with missing data were excluded.
- We estimated regression models predicting cost of primary arthroplasty as a function of the Oxford score before the primary operation, age at admission and sex.

Cost of knee revision surgery

This parameter was estimated using 3,416 observations from PROMs/HES. For the functional form of the model, we considered OLS models, gamma-GLM models with an inverse or log-link function as well as Gaussian-GLM models with a log-link function. We did not consider Tobit or two-part models, since very few patients had cost close to or exactly zero. For OKS, we considered linear and cubic trends, fourth-order polynomials as well as log-linear functional forms. For patients with OKS of zero, we set the natural logarithm of OKS to zero. We considered linear, quadratic and cubic trends for age as well as whether excluding age would improve model performance. Finally, we considered whether excluding sex would improve model performance.

The final model was estimated as an OLS regression with standard errors clustered by the primary TKA episode. The model included linear trends for age and OKS as well as an indicator for sex of the patient (Table *177*).

TABLE 177 OLS model predicting the cost of revision surgery after TKA

Variable	Mean (SE)
Age at operation	-21.01 (4.85)*
Female sex	74.58 (95.51)
Baseline OKS	-1.40 (6.82)
Constant term	9110.91 (327.48)*

* p<0.05

Cost of hip revision surgery

This parameter was estimated using 2,359 observations from PROMs/HES. For the functional form of the model, we considered OLS models, gamma-GLM models with an inverse or log-link function as well as Gaussian-GLM models with a log-link function. We did not consider Tobit or two-part models, since very few patients had cost close to or exactly zero. For OHS, we considered linear and cubic trends as well as log-linear functional forms. For patients with OHS of zero, we set the natural logarithm of OHS to zero. We considered linear, quadratic and cubic trends for age as well as whether excluding age would improve model performance. Finally, we considered whether excluding sex would improve model performance.

The final model was estimated as a gamma-GLM with an inverse link function and standard errors clustered on the primary THA episode. The model included a linear trend for OHS, a quadratic age trend as well as an indicator for sex of the patient (Table *178*).

TABLE 178 Gamma-GLM with inverse link function predicting the cost of revision surgery after THA

Variable	**Mean (SE)**
Age	0.000000906 (0.000000350)*
Squared age	-0.000000007 (0.000000003)*
Female sex	0.00000670 (0.000001570)*
Baseline OHS	-0.000000237 (0.000000098)*
Constant term	0.00009570 (0.000010)*

* p<0.05

Readmission costs during the year of revision

Methods

- The cost of readmissions was calculated using the methods described above and in *Online Supplement 12, Methods For Identifying Arthroplasty-Related Readmissions* and *Valuing Admissions Using The Payment Grouper*.
- We merged data on readmissions attributable to joint replacement surgery with the dates of revision surgery. Consequently, the dataset includes readmissions within 30 days of primary arthroplasty, but not necessarily those within 30 days of revision arthroplasty.
- If a patient had several revisions, we matched readmissions to the most recent revision procedure.
- Standard errors were adjusted for clustering by patient ID to allow for patients with more than one revision. We randomly allocated observations to one of 10 groups for K-fold cross-validation; for simplicity, observations were allocated to groups independently, such that observations for the same patient could be allocated to different groups.
- Readmissions were aggregated by year since revision surgery.
- For this analysis, we only included readmissions in the 12 months following revision surgery.
- We estimated regression models predicting cost based on time since primary arthroplasty, baseline clinical tool score, age and sex of the patient. Before choosing the functional form for age, we checked whether age at primary operation or current age provides the best model fit.

Readmission costs during the year of knee revision surgery: OKS

This parameter was estimated using 2,258 observations from PROMs/HES. For the functional form of the model, we considered OLS regressions, Tobit models, gamma-GLM models with an inverse or log-link function, a Gaussian-GLM with a log-link function as well as two-part models with the second part as an OLS model, gamma-GLM models with an inverse or log-link function, or Gaussian-GLMs with a log-link function. Then, we considered whether to include a linear trend for time since primary TKA, a quadratic trend, or a cubic trend. For OKS, we considered linear, quadratic and cubic trends. Before considering the functional form for age, we checked whether age at primary operation or current age would provide the best model fit. For age, we considered linear, quadratic and cubic functional forms, five-year age bands as well as excluding age from the model. Finally, we considered whether excluding sex from the model would improve model performance.

The final model was estimated as a two-part model with a gamma-GLM with a log-link function for the second-stage and clustered standard errors on the patient-level. The model included a linear trend for OKS and age at primary operation, an indicator for sex of the patient as well as a cubic trend for time since primary TKA (Table *179*). Since we only observed patients up to seven years following their primary TKA episode, we set the maximum value of time since primary TKA to seven in the Markov model in order to avoid extreme out-of-sample predictions in later years.

TABLE 179 Two-part model predicting the cost of readmissions in the year of knee revision surgery

Variable	**Mean (SE)** **Part 1:** Logit model predicting the probability of zero cost	**Mean (SE)** **Part 2:** Gamma-GLM with a log-link function predicting the cost of readmissions in the year of knee revision surgery for patients with non-zero cost
Age at primary	0.00051 (0.00672)	0.010 (0.006)
Female Sex	0.23859 (0.12346)	-0.091 (0.123)
Baseline OKS	0.00379 (0.00856)	-0.013 (0.008)
Year since primary operation	-2.48811 (1.43819)	-0.317 (1.725)
Squared year	0.61571 (0.39329)	0.147 (0.482)
Cubic year	-0.04586 (0.03340)	-0.016 (0.042)
Constant term	4.62219 (1.69869)*	8.352 (1.982)*

* p<0.05

Readmission costs during the year of knee revision surgery: OHS

This parameter was estimated using 1,669 observations from PROMs/HES. For the functional form of the model, we considered OLS regressions, Tobit models, gamma-GLM models with an inverse or log-link function, a Gaussian-GLM with a log-link function as well as two-part models with the second part as an OLS model, gamma-GLM models with an inverse or log-link function, or Gaussian-GLMs with a log-link function. Then, we considered whether to include a binary indicator for year 2 since primary THA or whether to exclude time since primary THA from the model. For OHS, we considered linear, quadratic and cubic trends. Before considering the functional form for age, we checked whether age at primary operation or current age would provide the best model fit. For age at primary operation, we considered linear, quadratic and cubic functional forms, five-year age bands as well as excluding age from the model. Finally, we considered whether excluding sex from the model would improve model performance.

The final model was estimated as a two-part model with a gamma-GLM with an inverse link function for the second-stage and clustered standard errors on the patient-level. The model included a linear trend for OHS, a quadratic trend for age at primary operation, an indicator for sex of the patient as well as an indicator for year 2 since primary THA (Table *180*).

TABLE 180 Two-part model predicting the cost of readmissions in the year of knee revision surgery

Variable	**Mean (SE) Part 1:** Logit model predicting the probability of zero cost	**Mean (SE) Part 2:** Gamma-GLM with an inverse link function predicting the cost of readmissions in the year of knee revision surgery for patients with non-zero cost
Female sex	0.172391 (0.162359)	0.000052 (0.000020)*
Age at operation	0.095892 (0.044183)*	-0.000001 (0.000005)
Quadratic age	-0.000823 (0.000362)*	0.0 (0.0)
Baseline OHS	0.008407 (0.010933)	-0.000001 (0.000001)
Indicator for second year since primary	0.315322 (0.167522)	0.000048 (0.000018)*
Constant term	-0.820222 (1.353384)	0.000208 (0.000176)

* $p<0.05$

Community and outpatient costs during the year of revision

Methods for TKA

- This was estimated on all patients who had a revision in the year leading up to the relevant resource use questionnaire (regardless of how many revisions they have in that year, how many previous revisions they have had or how long ago the revision occurred).
- This was estimated on long-format data (one row per patient per year), with clustering.
- Patients who died were by default be excluded because they did not return resource use questionnaires.
- The dependent variable excluded the cost of revision surgery and readmissions to hospital but included outpatient care.
- Standard errors were adjusted for clustering by patient ID to allow for patients with more than one revision. We randomly allocated observations to one of 10 groups for

K-fold cross-validation; for simplicity, observations were allocated to groups independently, such that observations for the same patient could be allocated to different groups.

Community and outpatient costs in the year of knee revision surgery: OKS

This parameter was estimated using 88 observations from the KAT trial. For the functional form of the model, we considered OLS regressions, Tobit models, gamma-GLM models with an inverse or log-link function, a Gaussian-GLM with a log-link function as well as two-part models with the second part as an OLS model, gamma-GLM models with an inverse or log-link function, or Gaussian-GLMs with a log-link function. For OKS, we considered linear, quadratic and cubic trends. For age at primary operation, we considered linear, quadratic and cubic functional forms as well as excluding age from the model. Finally, we considered whether excluding sex from the model would improve model performance.

The final model was estimated as a gamma-GLM model with a log-link function and standard errors clustered on the patient-level. The model included a linear trend for OKS and a quadratic trend for age at primary operation. Sex was excluded from the model (Table *181*).

TABLE 181 Gamma-GLM with a log-link function predicting ambulatory cost in the year of knee revision surgery

Variable	**Mean (SE)**
Age at operation	0.2062 (0.0887)*
Age squared	-0.0018 (0.0007)*
Baseline OKS	-0.0327 (0.0181)
Constant term	1.1453 (2.8606)

* p<0.05

Community and outpatient costs in the year of hip revision surgery

The cost of consultations in the year of hip revision surgery were based on the values presented by Pinedo Villanueva 2013,[114] using the methods described in *Online Supplement 12, Costs >1 year after primary hip arthroplasty*..

Readmission costs >1 year after revision

Methods

- For this analysis, we only included readmissions occurring >12 months following revision surgery.
- Regressions were estimated on data in long format, with one row per year and per primary arthroplasty episode.
- Standard errors were adjusted for clustering by patient ID to allow for patients with more than one revision. When sorting observations into 10 groups for 10-fold cross-validation, we randomised on the observation level, i.e. observations referring to the same patient could be sorted into different groups.
- We estimated regression models predicting cost based on time since primary arthroplasty, baseline clinical tool score, age and sex of the patient. Before choosing the functional form for age, we checked whether age at primary operation or current age provides the best model fit.

Readmission costs >1 year after knee revision surgery: OKS

This parameter was estimated based on 3,153 observations from PROMs/HES. For the functional form of the model, we considered OLS regressions, Tobit models, gamma-GLM models with an inverse or log-link function, a Gaussian-GLM with a log-link function as well as two-part models with the second part as an OLS model, gamma-GLM models with an inverse or log-link function, or Gaussian-GLMs with a log-link function. Then, we considered whether to include a linear, quadratic or cubic trend for time since primary TKA or whether to exclude time since primary TKA from the model. For OKS, we considered linear, quadratic and cubic trends. Before considering the functional form for age, we checked whether age at primary operation or current age provided the best model fit. For current age, we considered linear, quadratic and cubic functional forms as well as excluding age from the model. Finally, we considered whether excluding sex from the model would improve model performance.

The final model was estimated as a Tobit model censored at zero and with standard errors clustered on the patient-level using 3,153 observations. The model included a linear trend for time since primary TKA, a linear trend for OKS and a cubic trend for current age (Table *182*).

TABLE 182 Tobit model censored at zero predicting the cost of readmissions >12 months after knee revision surgery

Variable	Mean (SE)
Current age	-11716.94 (4526.61)*
Age squared	177.25 (70.58)*
Cubic age	-0.89 (0.36)*
Baseline OKS	-197.21 (99.61)*
Years since primary operation	-1934.66 (497.30)*
Constant term	245531.30 (93855.78)*
Sigma (Tobit)	13897.05 (2139.03)*

* p<0.05

Readmission costs >1 year after hip revision surgery: OHS

This parameter was estimated using 2,406 observations from PROMs/HES. For the functional form of the model, we considered OLS regressions, Tobit models, gamma-GLM models with an inverse or log-link function, a Gaussian-GLM with a log-link function as well as two-part models with the second part as an OLS model, gamma-GLM models with an inverse or log-link function, or Gaussian-GLMs with a log-link function. Then, we considered whether to include a linear or quadratic trend for time since primary THA or whether to exclude time since primary THA from the model. For OHS, we considered linear, quadratic and cubic trends. Before considering the functional form for age, we checked whether age at primary operation or current age provided the best model fit. For age at primary operation, we considered linear, quadratic and cubic functional forms, five-year age bands as well as excluding age from the model. Finally, we considered whether excluding sex from the model would improve model performance.

The final model was estimated as a Tobit model censored at zero and with standard errors clustered on the patient-level using 2,406 observations. The model included only a linear trend for OHS. Time since primary THA, age and sex were excluded from the model (Table *183*).

TABLE 183 Tobit model censored at zero predicting the cost of readmissions >12 months after hip revision surgery

Variable	**Mean (SE)**
Baseline OHS	-242.38 (107.37)*
Constant term	-24538.27 (3656.86)*
Sigma (Tobit model)	14718.08 (1858.63)*

* p<0.05

Community and outpatient costs >1 year after revision

Methods for TKA

- The cost of GP, physiotherapy and outpatient visits related to the knee was estimated separately from the cost of any readmissions.
- This was estimated on long-format data (one row per patient per year).
- This was estimated on patients who have had at least one revision and did not have revision surgery in the year in question.
- No distinction was made between one and two-stage revisions, how many revisions the patient has had or how long has elapsed since the last revision due to the Markovian assumption implicit within the model.
- Patients who died were excluded.
- Standard errors were adjusted for clustering by patient ID to allow for patients with more than one revision. When sorting observations into 10 groups for 10-fold cross-validation, we randomised on the observation level, i.e. observations referring to the same patient could be sorted into different groups.

Community and outpatient costs >1 year after knee revision surgery: OKS

This parameter was estimated based on 329 observations from the KAT trial. For the functional form of the model, we considered OLS regressions, Tobit models, gamma-GLM models with an inverse or log-link function, a Gaussian-GLM with a log-link function as well as two-part models with the second part as an OLS model, gamma-GLM models with an inverse or log-link function, or Gaussian-GLMs with a log-link function. For OKS, we considered linear, quadratic and cubic trends. For age at primary operation, we considered linear, quadratic and cubic functional forms as well as excluding age from the model. Finally, we considered whether excluding sex from the model would improve model performance.

The final model was estimated as a gamma-GLM with an inverse link function and standard errors clustered on the patient-level using 329 observations. The model included a cubic trend for OKS as well as an indicator for sex of the patient (Table *184*).

TABLE 184 Gamma-GLM with an inverse link function predicting ambulatory costs >1 year after knee revision surgery

Variable	**Mean (SE)**
Female sex	0.0017263 (0.0020680)
Baseline OKS	0.0016366 (0.0009185)
Squared OKS	-0.0001439 (0.0000793)
Cubic OKS	0.0000039 (0.0000019)*
Constant term	0.0003737 (0.0018593)

* p<0.05

Community and outpatient costs >1 year after hip revision surgery

The cost of ambulatory consultations >1 year after hip revision surgery were based on the values presented in Appendix 49 of Pinedo Villanueva 2013,[114] using the methods described in *Online Supplement 12, Costs >1 year after primary hip arthroplasty*.

Community, outpatient and inpatient costs without joint replacement

The regression models described in *Online Supplement 12,*

Community, Outpatient And Inpatient Costs Without Joint Replacement were also used in the analyses described in *Chapter 7*.

Online Supplement 16 - Additional results of the economic analyses described in Chapter 7

Cost-effectiveness acceptability curves

Cost-effectiveness acceptability curves showed that there is relatively little uncertainty around the conclusions, except at OKS/OHS immediately around the economic threshold (*Figures 133-140*).

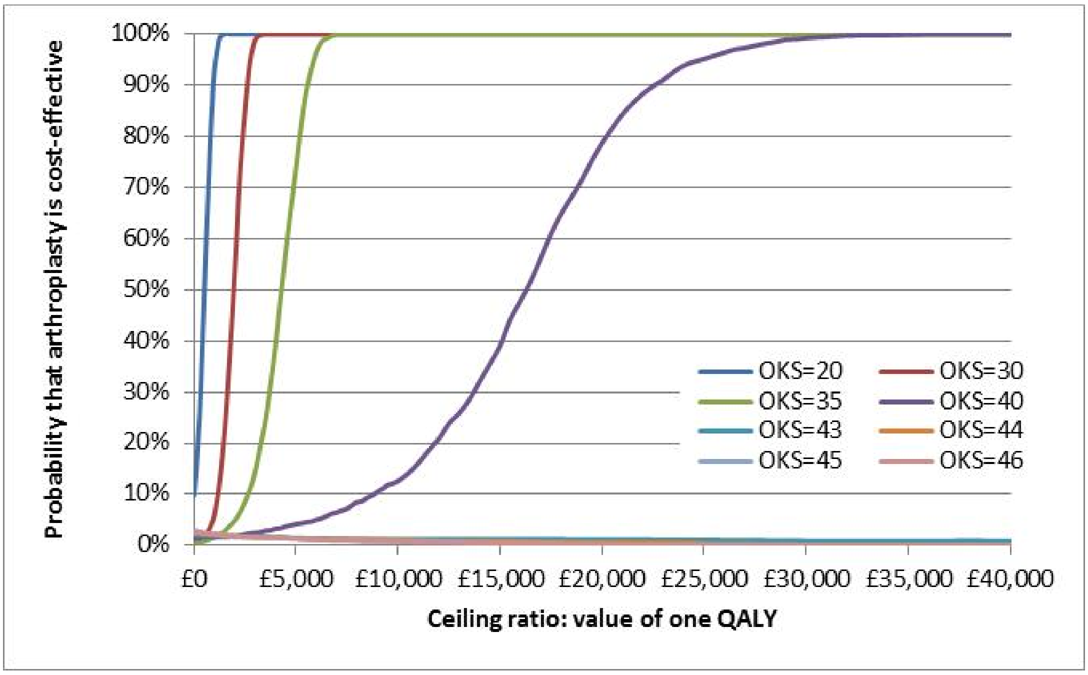


FIGURE 133 Cost-effectiveness acceptability curve showing PSA results for 70-year-old women at different OKS

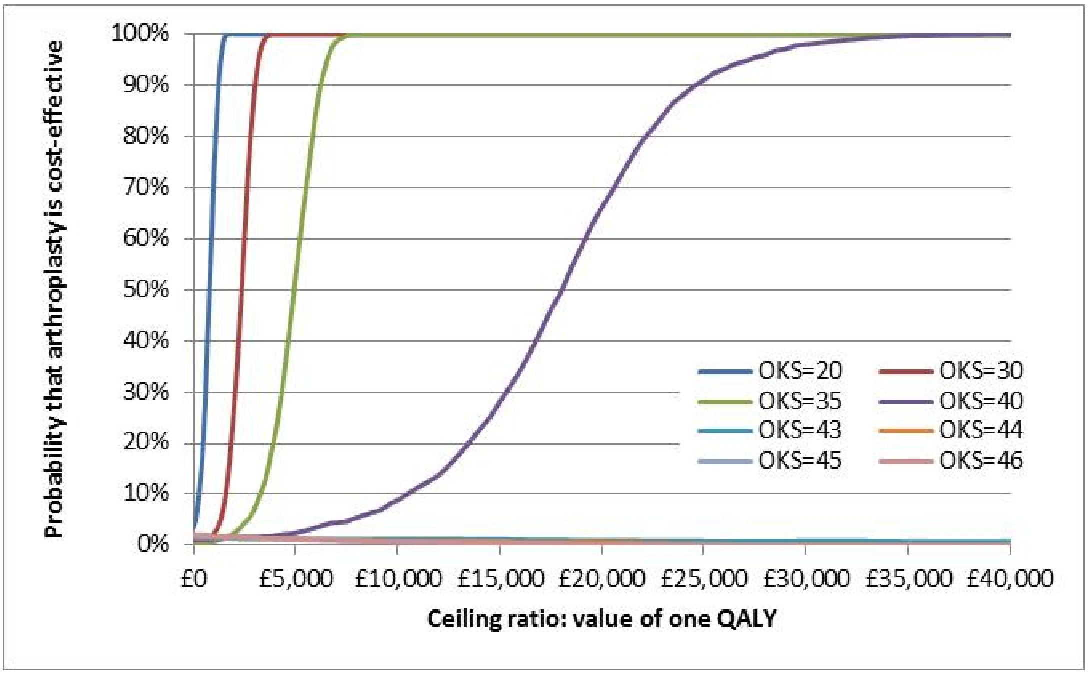


FIGURE 134 Cost-effectiveness acceptability curve showing PSA results for 70-year-old men at different OKS

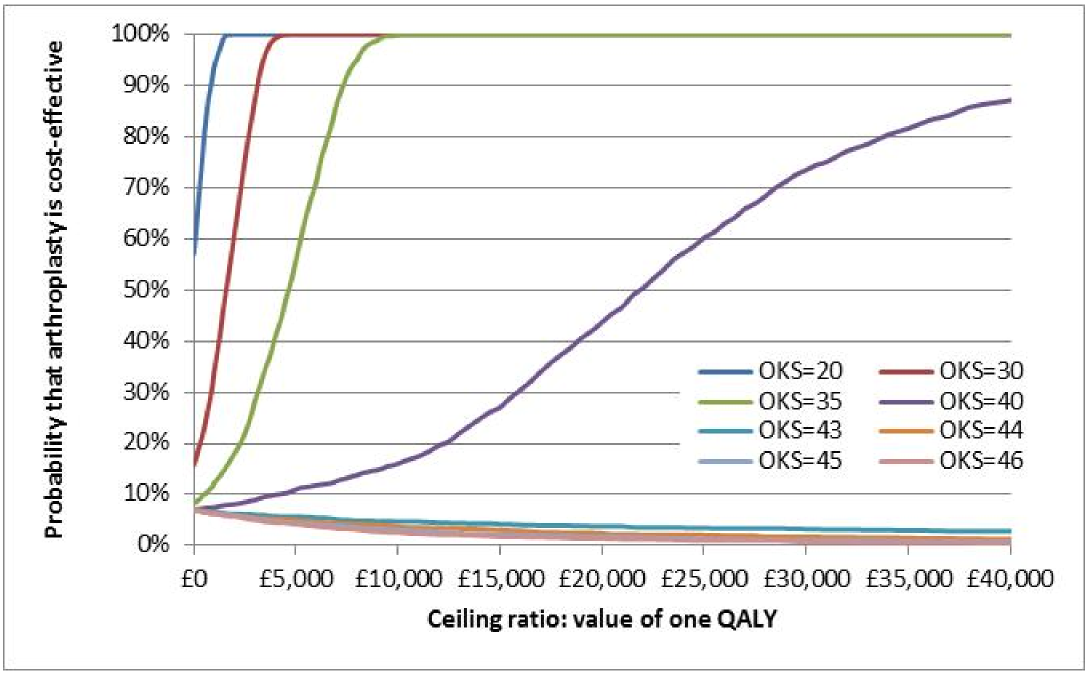


FIGURE 135 Cost-effectiveness acceptability curve showing PSA results for 50-year-old women at different OKS

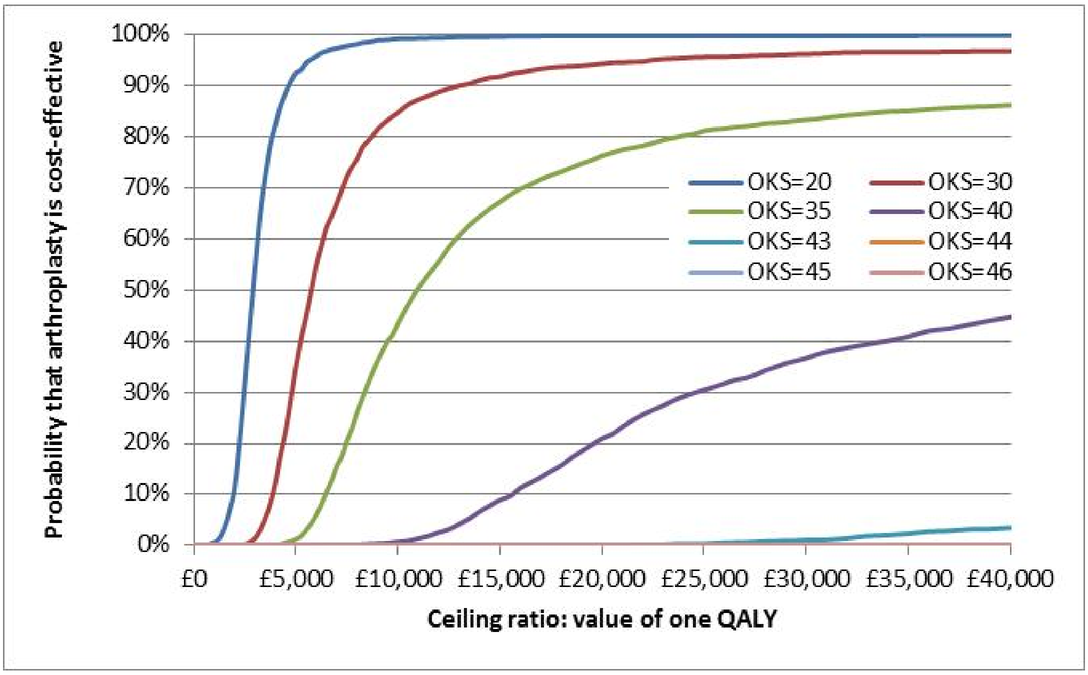


FIGURE 136 Cost-effectiveness acceptability curve showing PSA results for 90-year-old women at different OKS

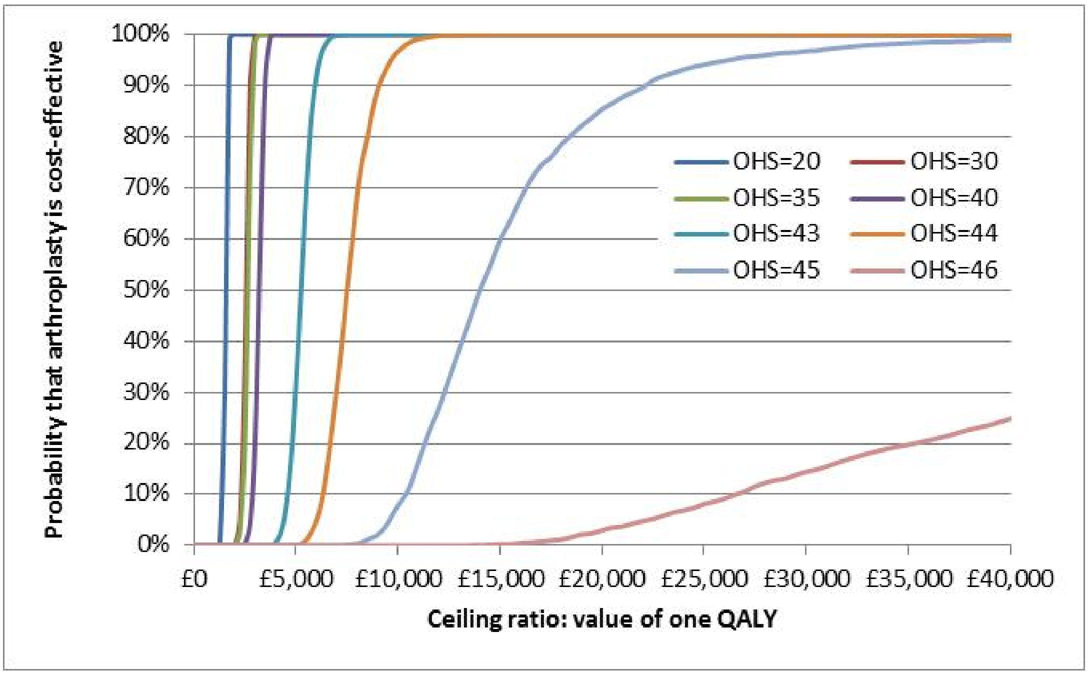


FIGURE 137 Cost-effectiveness acceptability curve showing PSA results for 70-year-old women at different OHS

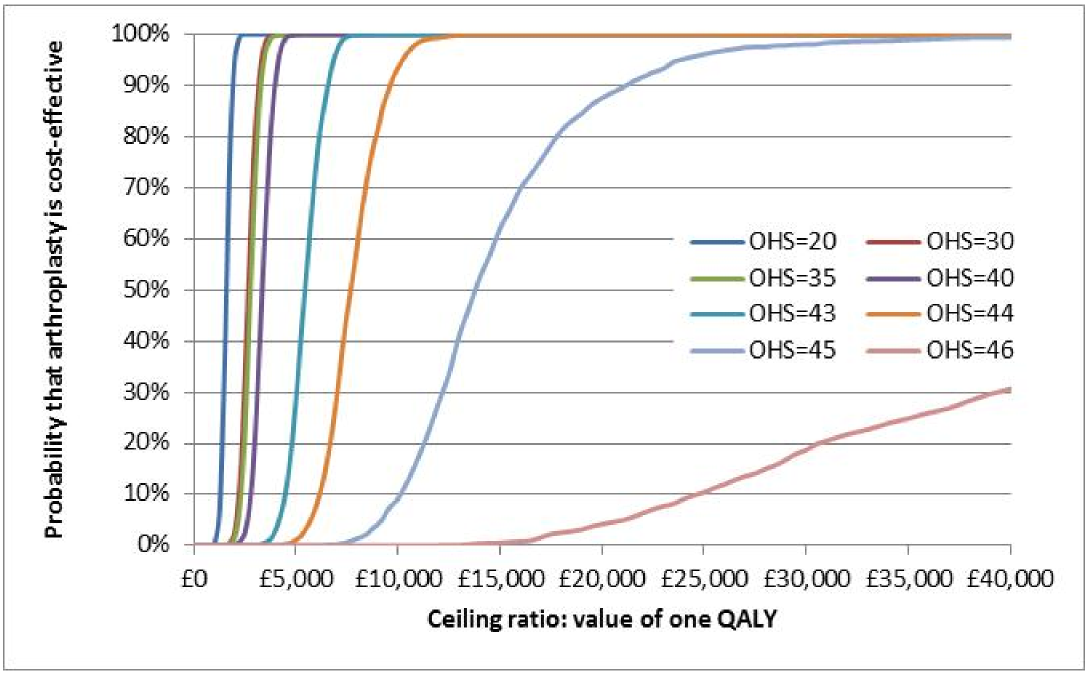


FIGURE 138 Cost-effectiveness acceptability curve showing PSA results for 70-year-old men at different OHS

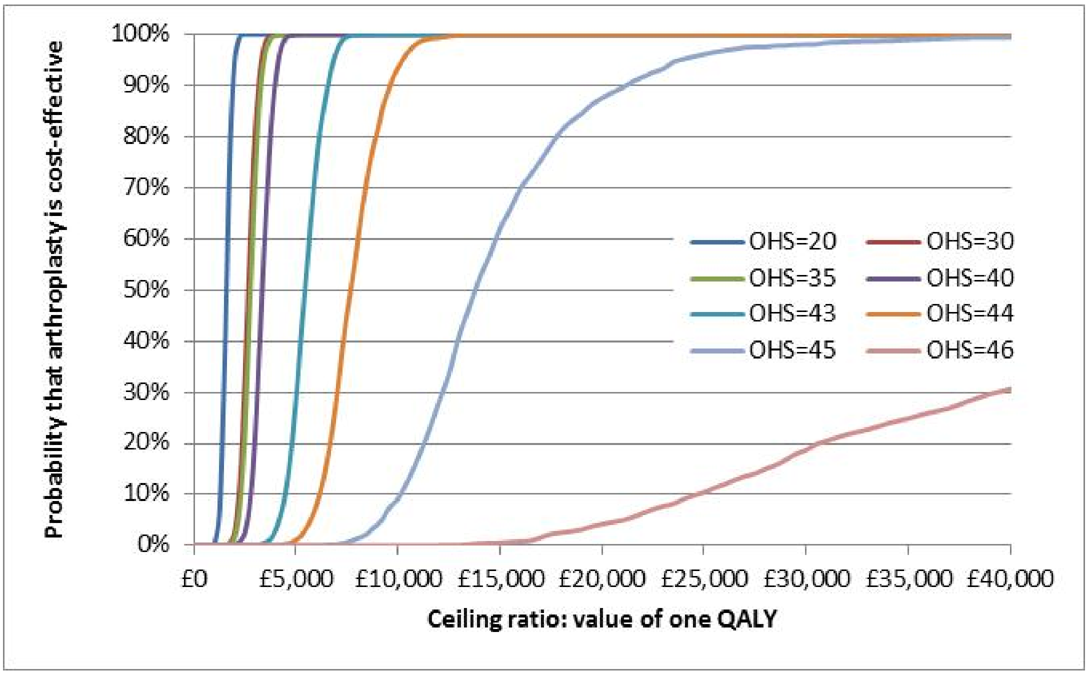


FIGURE 139 Cost-effectiveness acceptability curve showing PSA results for 50-year-old women at different OHS

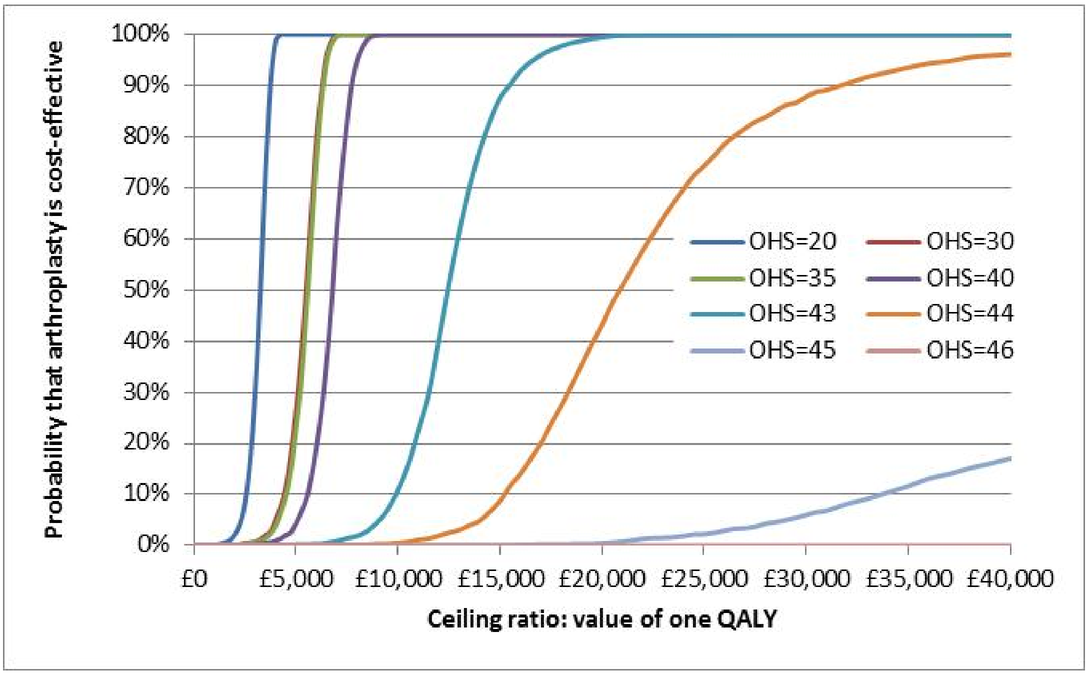
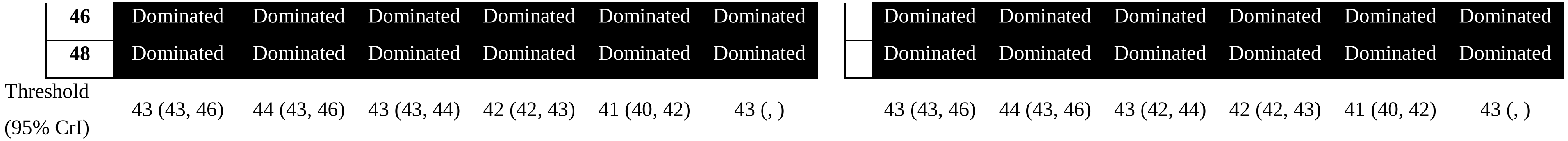


FIGURE 140 Cost-effectiveness acceptability curve showing PSA results for 90-year-old women at different OHS

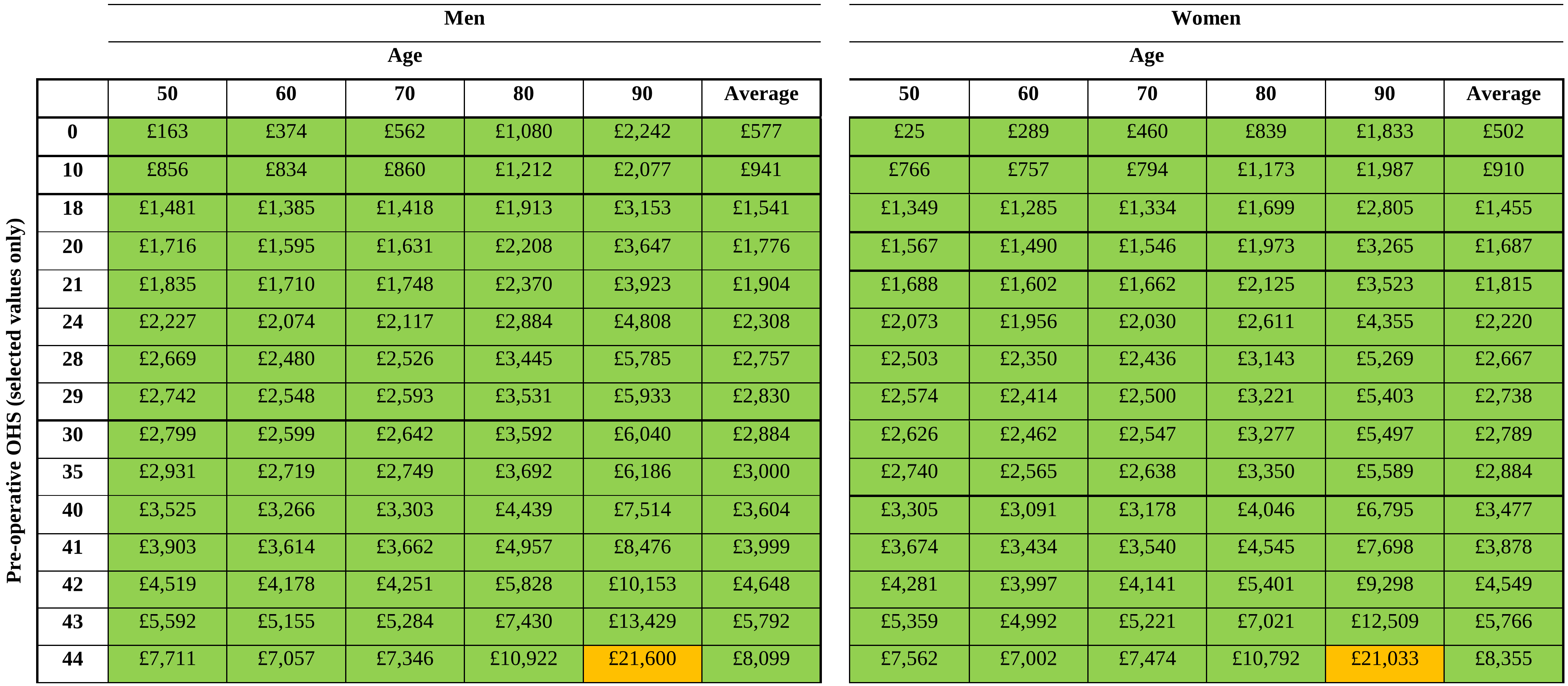
Additional decision grids separated by gender

Preoperative OKS (selected values only)	Men						Women					
	Age						Age					
	50	60	70	80	90	Average	50	60	70	80	90	Average
0	£2,471	£1,960	£2,158	£3,113	£5,839	£2,409	£1,647	£1,488	£1,768	£2,607	£4,910	£1,971
10	£185	£338	£664	£1,337	£2,946	£739	Dominant	£177	£509	£1,101	£2,485	£578
20	£69	£405	£1,033	£2,296	£5,436	£1,141	Dominant	£180	£814	£1,958	£4,717	£921
21	£147	£488	£1,163	£2,536	£6,003	£1,280	Dominant	£252	£935	£2,182	£5,235	£1,052
24	£550	£858	£1,682	£3,422	£8,044	£1,833	£106	£597	£1,432	£3,032	£7,128	£1,586
29	£1,677	£1,738	£2,717	£4,847	£10,898	£2,910	£1,214	£1,484	£2,485	£4,471	£9,859	£2,685
30	£1,909	£1,908	£2,888	£5,017	£11,105	£3,083	£1,458	£1,663	£2,666	£4,653	£10,067	£2,869
35	£2,898	£2,632	£3,539	£5,470	£11,095	£3,729	£2,521	£2,437	£3,370	£5,162	£10,117	£3,566
36	£3,104	£2,788	£3,693	£5,609	£11,224	£3,884	£2,737	£2,601	£3,534	£5,312	£10,251	£3,729
37	£3,346	£2,973	£3,894	£5,829	£11,546	£4,086	£2,983	£2,791	£3,744	£5,541	£10,567	£3,940
38	£3,652	£3,208	£4,173	£6,177	£12,171	£4,368	£3,288	£3,031	£4,033	£5,901	£11,170	£4,232
39	£4,066	£3,525	£4,579	£6,736	£13,294	£4,780	£3,694	£3,351	£4,453	£6,476	£12,248	£4,657
40	£4,671	£3,982	£5,205	£7,657	£15,313	£5,413	£4,278	£3,810	£5,099	£7,429	£14,190	£5,313
41	£5,631	£4,685	£6,239	£9,285	£19,233	£6,458	£5,201	£4,516	£6,178	£9,138	£17,990	£6,403
42	£7,355	£5,876	£8,165	£12,578	£28,488	£8,382	£6,856	£5,716	£8,223	£12,707	£27,158	£8,451
43	£11,182	£8,219	£12,637	£21,594	£67,491	£12,755	£10,554	£8,109	£13,187	£23,362	£69,200	£13,307
44	£25,501	£14,412	£31,478	£106,490	Dominated	£29,784	£24,774	£14,640	£38,061	£307,750	Dominated	£35,396
45	Dominated	£60,403	Dominated	Dominated	Dominated	Dominated	Dominated	£74,777	Dominated	Dominated	Dominated	Dominated



46	Dominated	Dominated	Dominated	Dominated	Dominated	Dominated	Dominated	Dominated	Dominated	Dominated	Dominated	Dominated
48	Dominated	Dominated	Dominated	Dominated	Dominated	Dominated	Dominated	Dominated	Dominated	Dominated	Dominated	Dominated
Threshold (95% CrI)	43 (43, 46)	44 (43, 46)	43 (43, 44)	42 (42, 43)	41 (40, 42)	43 (,)	43 (43, 46)	44 (43, 46)	43 (42, 44)	42 (42, 43)	41 (40, 42)	43 (,)

FIGURE 141 Cost-effectiveness of TKA in patients of different age and baseline OKS for men and women separately

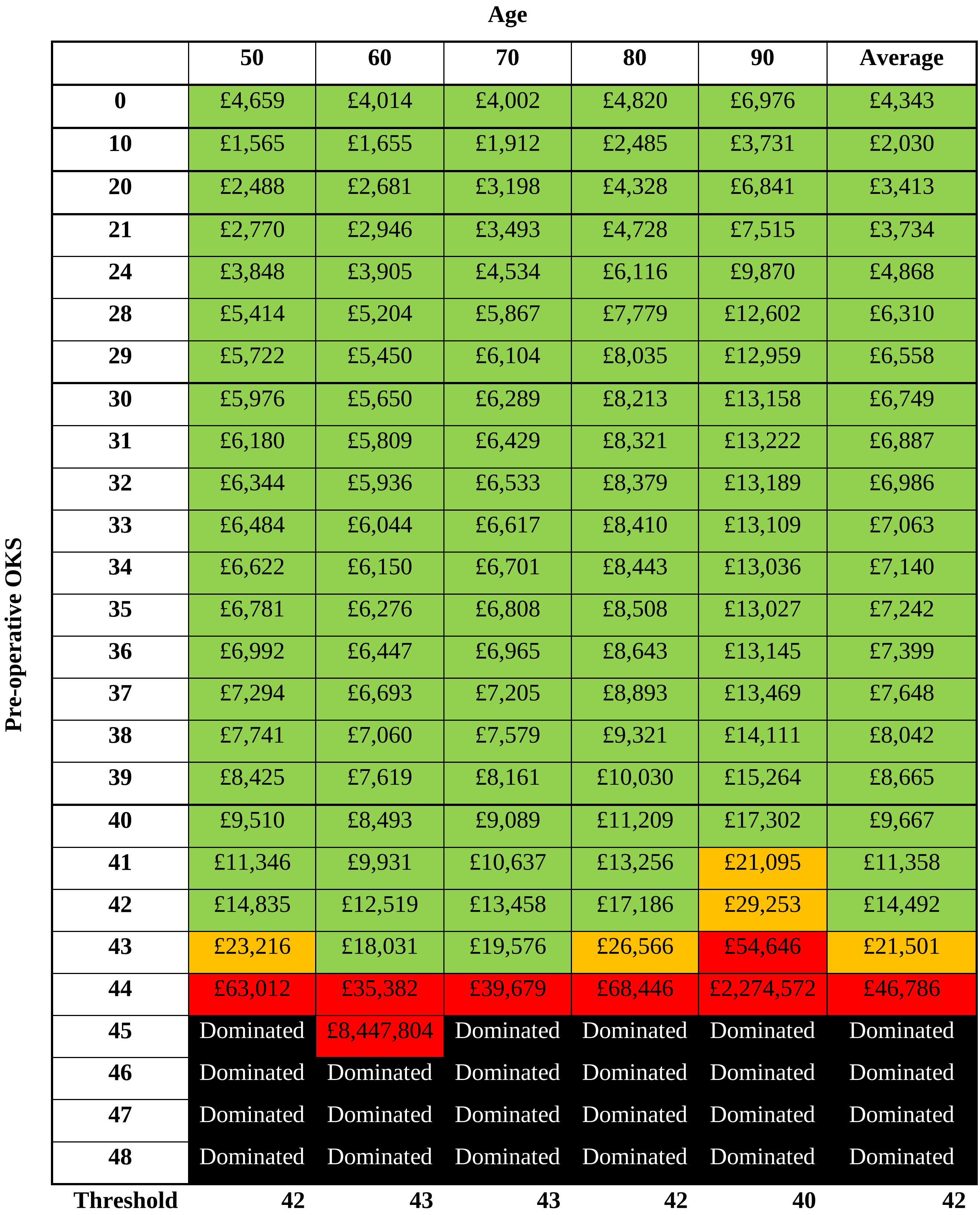


Pre-operative OHS (selected values only)	Men						Women					
	Age						Age					
	50	**60**	**70**	**80**	**90**	**Average**	**50**	**60**	**70**	**80**	**90**	**Average**
0	£163	£374	£562	£1,080	£2,242	£577	£25	£289	£460	£839	£1,833	£502
10	£856	£834	£860	£1,212	£2,077	£941	£766	£757	£794	£1,173	£1,987	£910
18	£1,481	£1,385	£1,418	£1,913	£3,153	£1,541	£1,349	£1,285	£1,334	£1,699	£2,805	£1,455
20	£1,716	£1,595	£1,631	£2,208	£3,647	£1,776	£1,567	£1,490	£1,546	£1,973	£3,265	£1,687
21	£1,835	£1,710	£1,748	£2,370	£3,923	£1,904	£1,688	£1,602	£1,662	£2,125	£3,523	£1,815
24	£2,227	£2,074	£2,117	£2,884	£4,808	£2,308	£2,073	£1,956	£2,030	£2,611	£4,355	£2,220
28	£2,669	£2,480	£2,526	£3,445	£5,785	£2,757	£2,503	£2,350	£2,436	£3,143	£5,269	£2,667
29	£2,742	£2,548	£2,593	£3,531	£5,933	£2,830	£2,574	£2,414	£2,500	£3,221	£5,403	£2,738
30	£2,799	£2,599	£2,642	£3,592	£6,040	£2,884	£2,626	£2,462	£2,547	£3,277	£5,497	£2,789
35	£2,931	£2,719	£2,749	£3,692	£6,186	£3,000	£2,740	£2,565	£2,638	£3,350	£5,589	£2,884
40	£3,525	£3,266	£3,303	£4,439	£7,514	£3,604	£3,305	£3,091	£3,178	£4,046	£6,795	£3,477
41	£3,903	£3,614	£3,662	£4,957	£8,476	£3,999	£3,674	£3,434	£3,540	£4,545	£7,698	£3,878
42	£4,519	£4,178	£4,251	£5,828	£10,153	£4,648	£4,281	£3,997	£4,141	£5,401	£9,298	£4,549
43	£5,592	£5,155	£5,284	£7,430	£13,429	£5,792	£5,359	£4,992	£5,221	£7,021	£12,509	£5,766
44	£7,711	£7,057	£7,346	£10,922	£21,600	£8,099	£7,562	£7,002	£7,474	£10,792	£21,033	£8,355

45	£13,075	£11,721	£12,698	£22,348	£64,618	£14,233	£13,626	£12,368	£13,991	£25,935	£82,570	£16,248
46	£41,476	£33,123	£44,342	Dominated	Dominated	£55,505	£64,364	£49,169	£95,198	Dominated	Dominated	£221,568
47	Dominated	Dominated	Dominated	Dominated	Dominated	Dominated	Dominated	Dominated	Dominated	Dominated	Dominated	Dominated
48	Dominated	Dominated	Dominated	Dominated	Dominated	Dominated	Dominated	Dominated	Dominated	Dominated	Dominated	Dominated
Threshold (95% CrI)	45 (44, 46)	45 (45, 46)	45 (44, 46)	44 (44, 45)	43 (43, 44)	45	45 (44, 46)	45 (44, 46)	45 (44, 46)	44 (44, 45)	43 (43, 44)	45

FIGURE 142 Cost-effectiveness of THA in patients of different age and baseline OHS for men and women separately

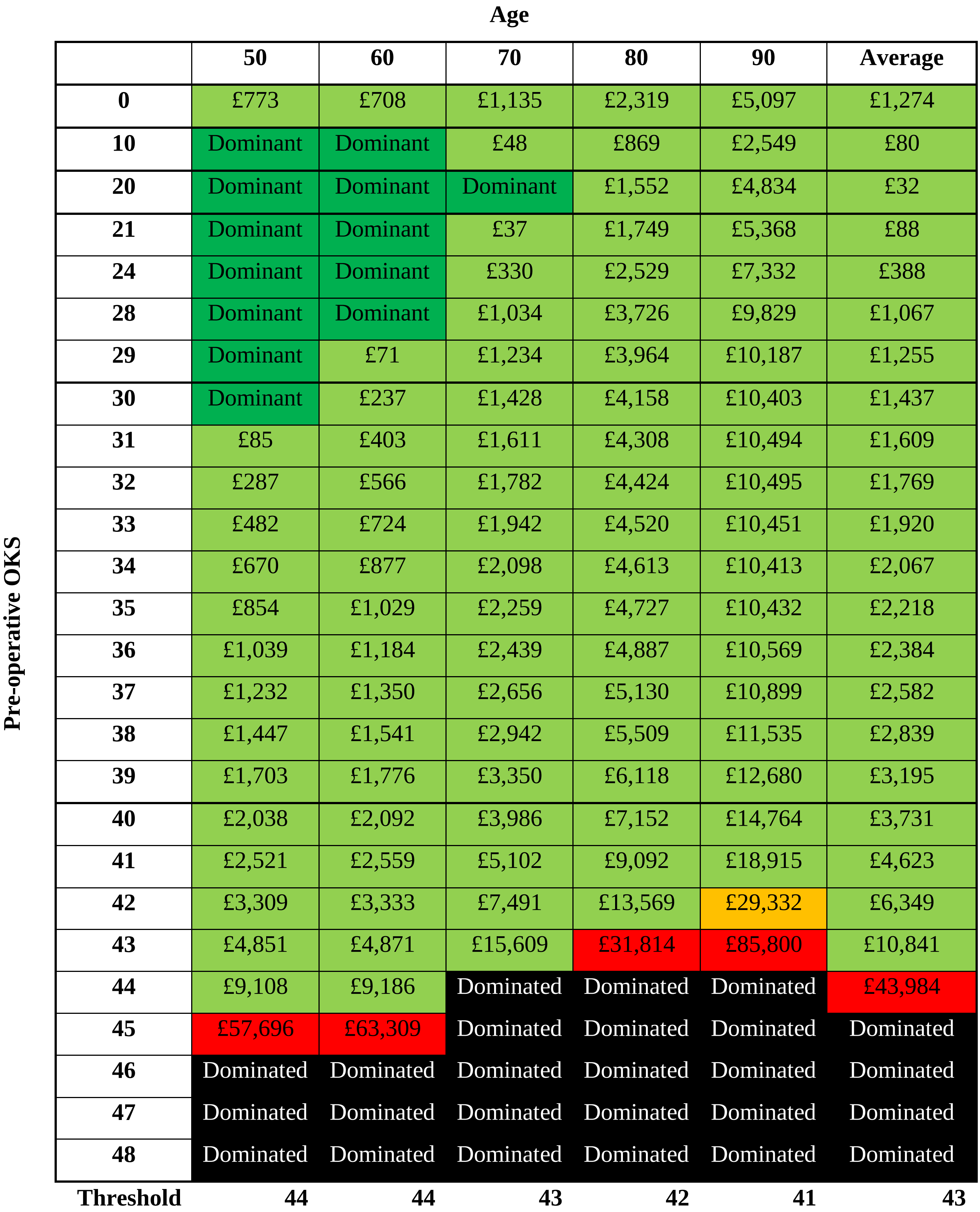
Results of sensitivity analysis



Age

Pre-operative OKS	50	60	70	80	90	Average
0	£4,659	£4,014	£4,002	£4,820	£6,976	£4,343
10	£1,565	£1,655	£1,912	£2,485	£3,731	£2,030
20	£2,488	£2,681	£3,198	£4,328	£6,841	£3,413
21	£2,770	£2,946	£3,493	£4,728	£7,515	£3,734
24	£3,848	£3,905	£4,534	£6,116	£9,870	£4,868
28	£5,414	£5,204	£5,867	£7,779	£12,602	£6,310
29	£5,722	£5,450	£6,104	£8,035	£12,959	£6,558
30	£5,976	£5,650	£6,289	£8,213	£13,158	£6,749
31	£6,180	£5,809	£6,429	£8,321	£13,222	£6,887
32	£6,344	£5,936	£6,533	£8,379	£13,189	£6,986
33	£6,484	£6,044	£6,617	£8,410	£13,109	£7,063
34	£6,622	£6,150	£6,701	£8,443	£13,036	£7,140
35	£6,781	£6,276	£6,808	£8,508	£13,027	£7,242
36	£6,992	£6,447	£6,965	£8,643	£13,145	£7,399
37	£7,294	£6,693	£7,205	£8,893	£13,469	£7,648
38	£7,741	£7,060	£7,579	£9,321	£14,111	£8,042
39	£8,425	£7,619	£8,161	£10,030	£15,264	£8,665
40	£9,510	£8,493	£9,089	£11,209	£17,302	£9,667
41	£11,346	£9,931	£10,637	£13,256	£21,095	£11,358
42	£14,835	£12,519	£13,458	£17,186	£29,253	£14,492
43	£23,216	£18,031	£19,576	£26,566	£54,646	£21,501
44	£63,012	£35,382	£39,679	£68,446	£2,274,572	£46,786
45	Dominated	£8,447,804	Dominated	Dominated	Dominated	Dominated
46	Dominated	Dominated	Dominated	Dominated	Dominated	Dominated
47	Dominated	Dominated	Dominated	Dominated	Dominated	Dominated
48	Dominated	Dominated	Dominated	Dominated	Dominated	Dominated
Threshold	42	43	43	42	40	42

FIGURE 143 Cost-effectiveness of TKA in patients of different age and baseline OKS (averaged over men and women): 5 year time horizon

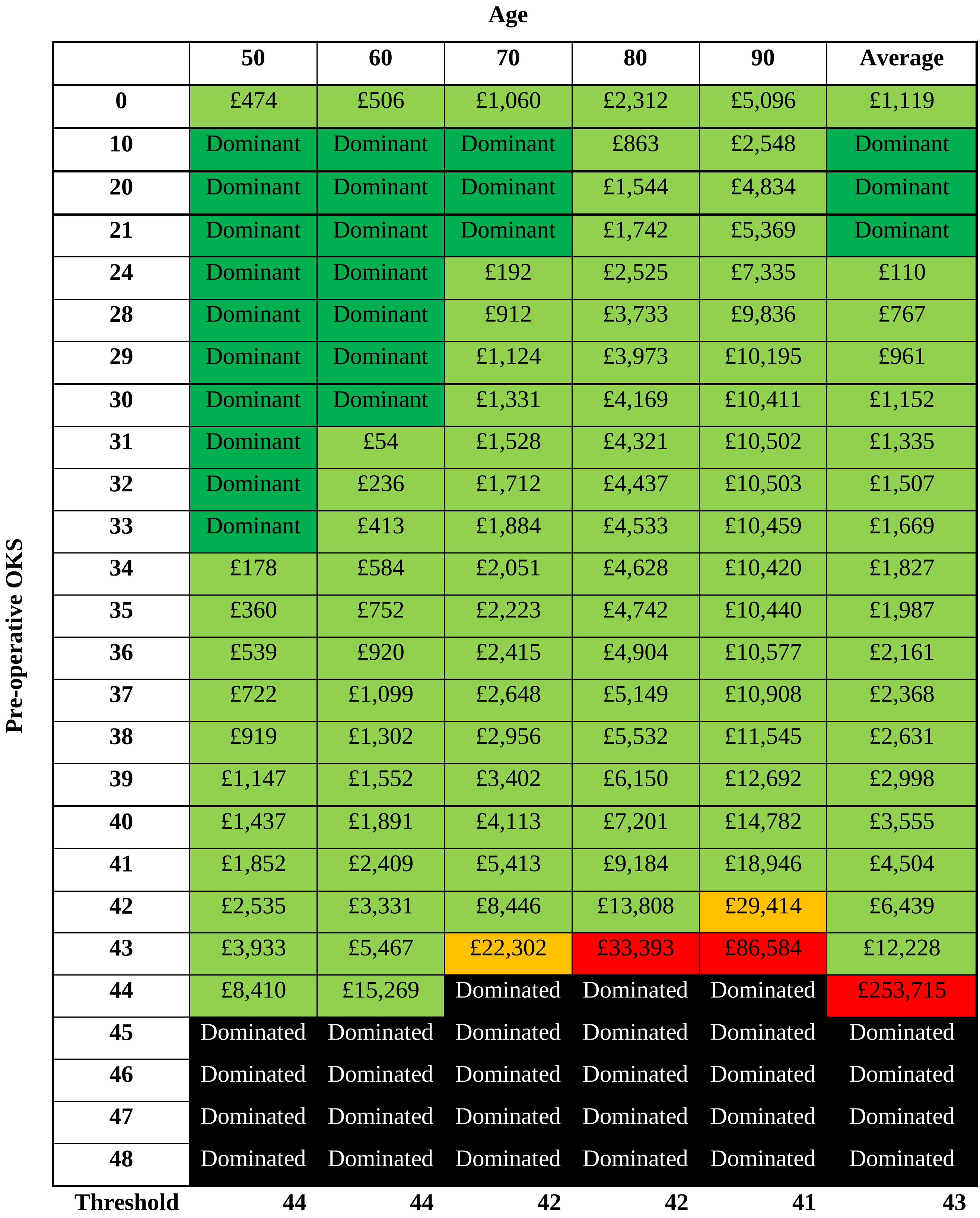


Age

Pre-operative OKS

	50	60	70	80	90	Average
0	£773	£708	£1,135	£2,319	£5,097	£1,274
10	Dominant	Dominant	£48	£869	£2,549	£80
20	Dominant	Dominant	Dominant	£1,552	£4,834	£32
21	Dominant	Dominant	£37	£1,749	£5,368	£88
24	Dominant	Dominant	£330	£2,529	£7,332	£388
28	Dominant	Dominant	£1,034	£3,726	£9,829	£1,067
29	Dominant	£71	£1,234	£3,964	£10,187	£1,255
30	Dominant	£237	£1,428	£4,158	£10,403	£1,437
31	£85	£403	£1,611	£4,308	£10,494	£1,609
32	£287	£566	£1,782	£4,424	£10,495	£1,769
33	£482	£724	£1,942	£4,520	£10,451	£1,920
34	£670	£877	£2,098	£4,613	£10,413	£2,067
35	£854	£1,029	£2,259	£4,727	£10,432	£2,218
36	£1,039	£1,184	£2,439	£4,887	£10,569	£2,384
37	£1,232	£1,350	£2,656	£5,130	£10,899	£2,582
38	£1,447	£1,541	£2,942	£5,509	£11,535	£2,839
39	£1,703	£1,776	£3,350	£6,118	£12,680	£3,195
40	£2,038	£2,092	£3,986	£7,152	£14,764	£3,731
41	£2,521	£2,559	£5,102	£9,092	£18,915	£4,623
42	£3,309	£3,333	£7,491	£13,569	£29,332	£6,349
43	£4,851	£4,871	£15,609	£31,814	£85,800	£10,841
44	£9,108	£9,186	Dominated	Dominated	Dominated	£43,984
45	£57,696	£63,309	Dominated	Dominated	Dominated	Dominated
46	Dominated	Dominated	Dominated	Dominated	Dominated	Dominated
47	Dominated	Dominated	Dominated	Dominated	Dominated	Dominated
48	Dominated	Dominated	Dominated	Dominated	Dominated	Dominated
Threshold	44	44	43	42	41	43

FIGURE 144 Cost-effectiveness of TKA in patients of different age and baseline OKS (averaged over men and women): 20 year time horizon

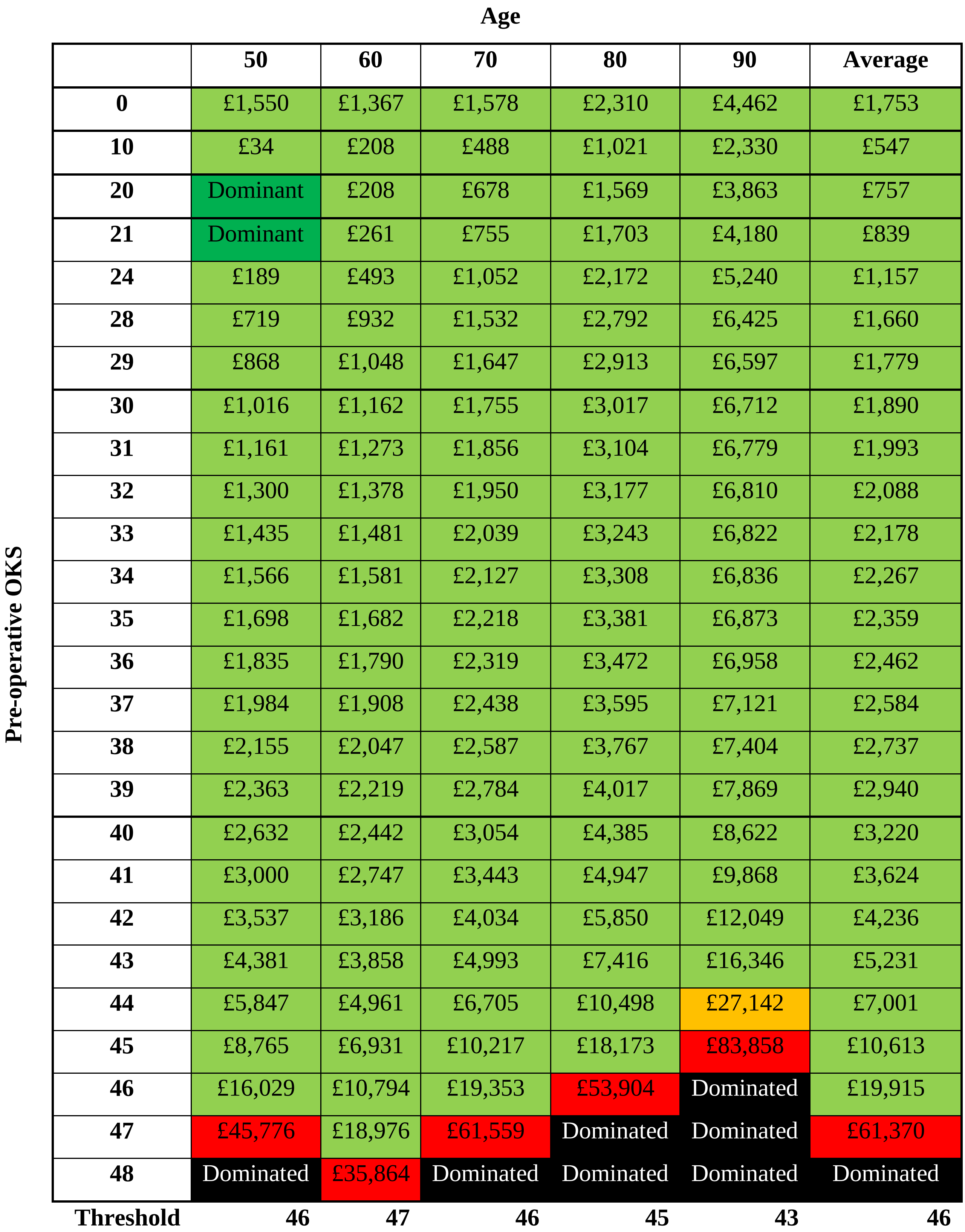


Age

Pre-operative OKS

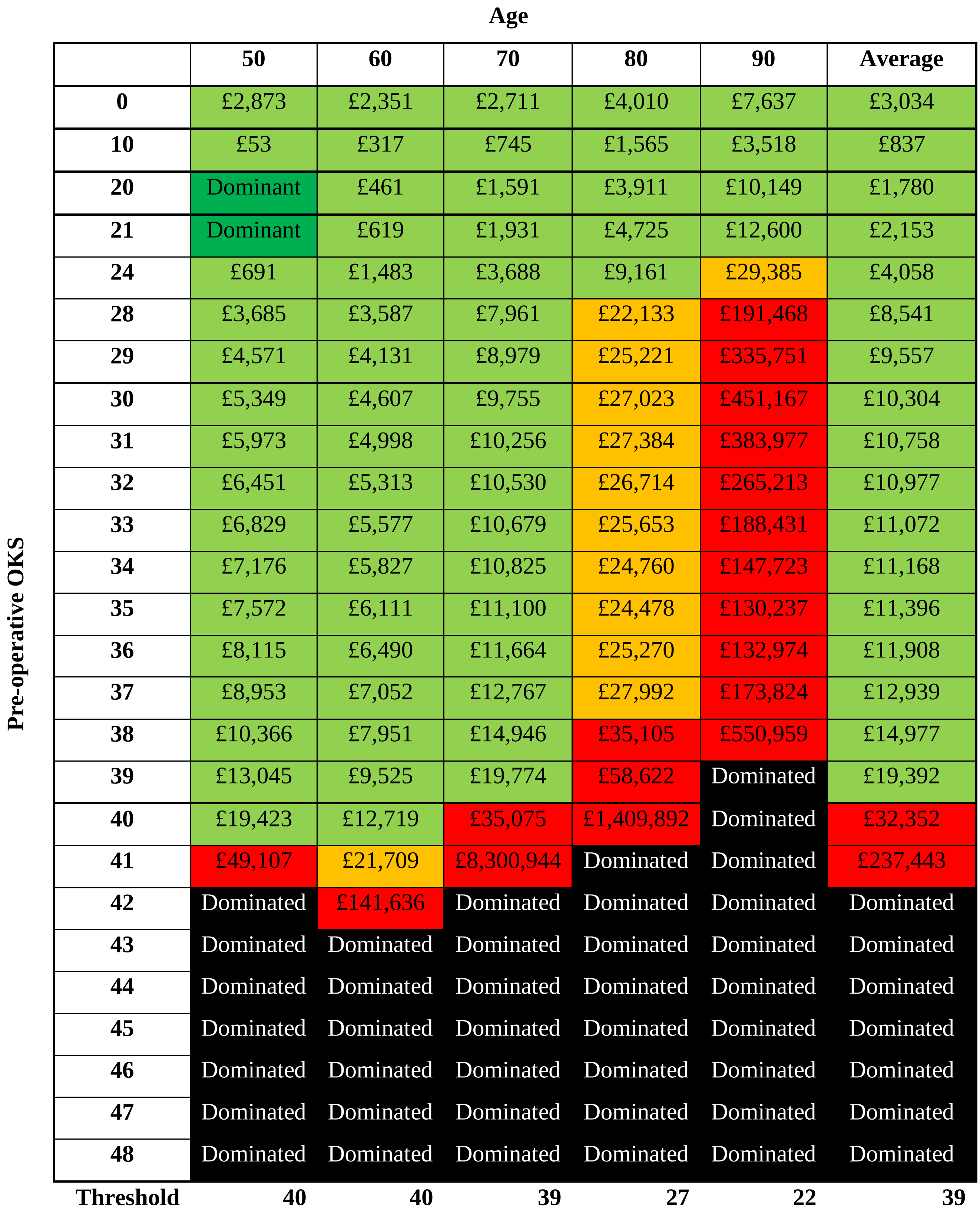
	50	60	70	80	90	Average
0	£474	£506	£1,060	£2,312	£5,096	£1,119
10	Dominant	Dominant	Dominant	£863	£2,548	Dominant
20	Dominant	Dominant	Dominant	£1,544	£4,834	Dominant
21	Dominant	Dominant	Dominant	£1,742	£5,369	Dominant
24	Dominant	Dominant	£192	£2,525	£7,335	£110
28	Dominant	Dominant	£912	£3,733	£9,836	£767
29	Dominant	Dominant	£1,124	£3,973	£10,195	£961
30	Dominant	Dominant	£1,331	£4,169	£10,411	£1,152
31	Dominant	£54	£1,528	£4,321	£10,502	£1,335
32	Dominant	£236	£1,712	£4,437	£10,503	£1,507
33	Dominant	£413	£1,884	£4,533	£10,459	£1,669
34	£178	£584	£2,051	£4,628	£10,420	£1,827
35	£360	£752	£2,223	£4,742	£10,440	£1,987
36	£539	£920	£2,415	£4,904	£10,577	£2,161
37	£722	£1,099	£2,648	£5,149	£10,908	£2,368
38	£919	£1,302	£2,956	£5,532	£11,545	£2,631
39	£1,147	£1,552	£3,402	£6,150	£12,692	£2,998
40	£1,437	£1,891	£4,113	£7,201	£14,782	£3,555
41	£1,852	£2,409	£5,413	£9,184	£18,946	£4,504
42	£2,535	£3,331	£8,446	£13,808	£29,414	£6,439
43	£3,933	£5,467	£22,302	£33,393	£86,584	£12,228
44	£8,410	£15,269	Dominated	Dominated	Dominated	£253,715
45	Dominated	Dominated	Dominated	Dominated	Dominated	Dominated
46	Dominated	Dominated	Dominated	Dominated	Dominated	Dominated
47	Dominated	Dominated	Dominated	Dominated	Dominated	Dominated
48	Dominated	Dominated	Dominated	Dominated	Dominated	Dominated
Threshold	**44**	**44**	**42**	**42**	**41**	**43**

FIGURE 145 Cost-effectiveness of TKA in patients of different age and baseline OKS (averaged over men and women): 60 year time horizon



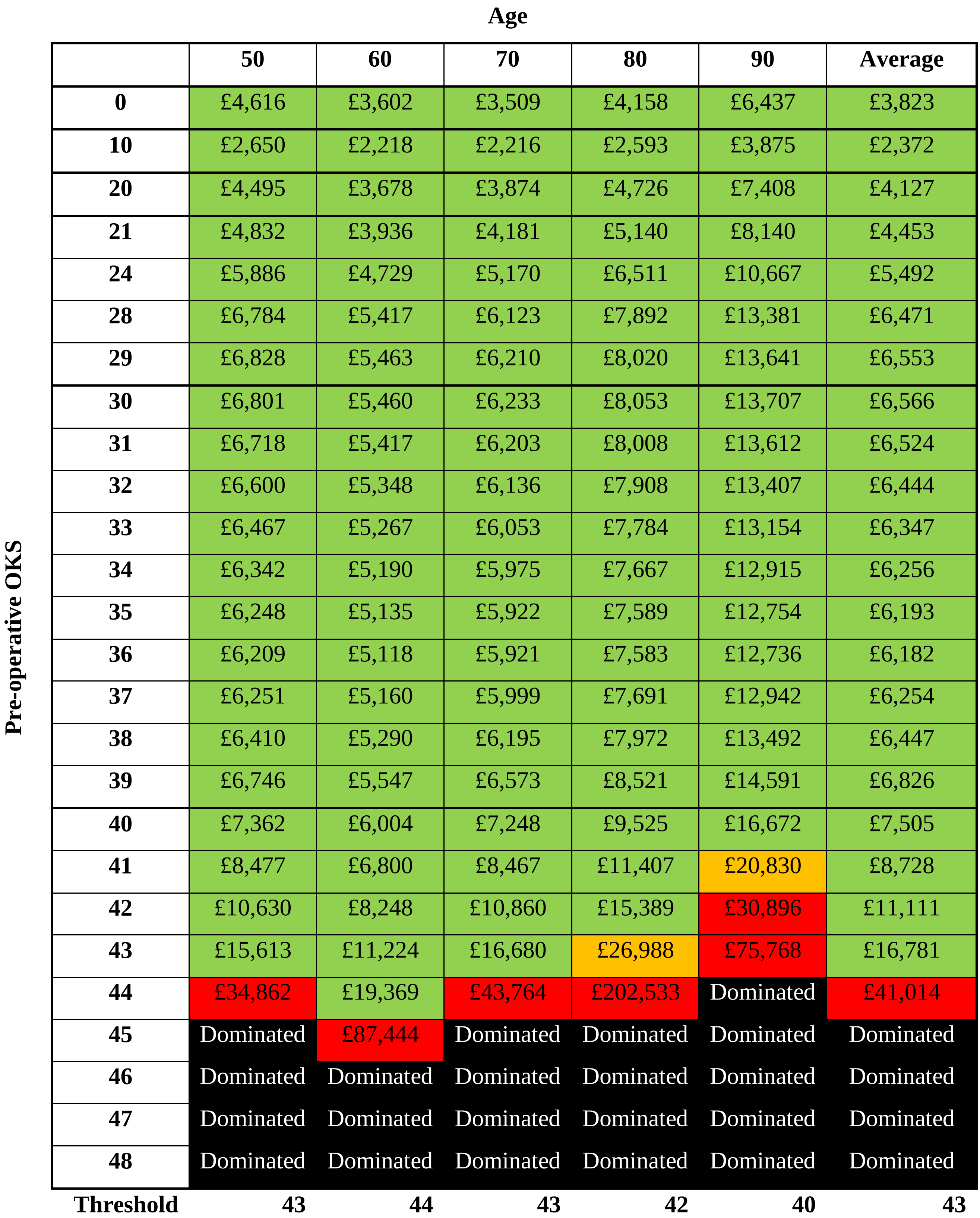
Pre-operative OKS	Age					
	50	**60**	**70**	**80**	**90**	**Average**
0	£1,550	£1,367	£1,578	£2,310	£4,462	£1,753
10	£34	£208	£488	£1,021	£2,330	£547
20	Dominant	£208	£678	£1,569	£3,863	£757
21	Dominant	£261	£755	£1,703	£4,180	£839
24	£189	£493	£1,052	£2,172	£5,240	£1,157
28	£719	£932	£1,532	£2,792	£6,425	£1,660
29	£868	£1,048	£1,647	£2,913	£6,597	£1,779
30	£1,016	£1,162	£1,755	£3,017	£6,712	£1,890
31	£1,161	£1,273	£1,856	£3,104	£6,779	£1,993
32	£1,300	£1,378	£1,950	£3,177	£6,810	£2,088
33	£1,435	£1,481	£2,039	£3,243	£6,822	£2,178
34	£1,566	£1,581	£2,127	£3,308	£6,836	£2,267
35	£1,698	£1,682	£2,218	£3,381	£6,873	£2,359
36	£1,835	£1,790	£2,319	£3,472	£6,958	£2,462
37	£1,984	£1,908	£2,438	£3,595	£7,121	£2,584
38	£2,155	£2,047	£2,587	£3,767	£7,404	£2,737
39	£2,363	£2,219	£2,784	£4,017	£7,869	£2,940
40	£2,632	£2,442	£3,054	£4,385	£8,622	£3,220
41	£3,000	£2,747	£3,443	£4,947	£9,868	£3,624
42	£3,537	£3,186	£4,034	£5,850	£12,049	£4,236
43	£4,381	£3,858	£4,993	£7,416	£16,346	£5,231
44	£5,847	£4,961	£6,705	£10,498	£27,142	£7,001
45	£8,765	£6,931	£10,217	£18,173	£83,858	£10,613
46	£16,029	£10,794	£19,353	£53,904	Dominated	£19,915
47	£45,776	£18,976	£61,559	Dominated	Dominated	£61,370
48	Dominated	£35,864	Dominated	Dominated	Dominated	Dominated
Threshold	46	47	46	45	43	46

FIGURE 146 Cost-effectiveness of TKA in patients of different age and baseline OKS (averaged over men and women): Assuming that EQ-5D utility without TJA worsens by 0.025 per year



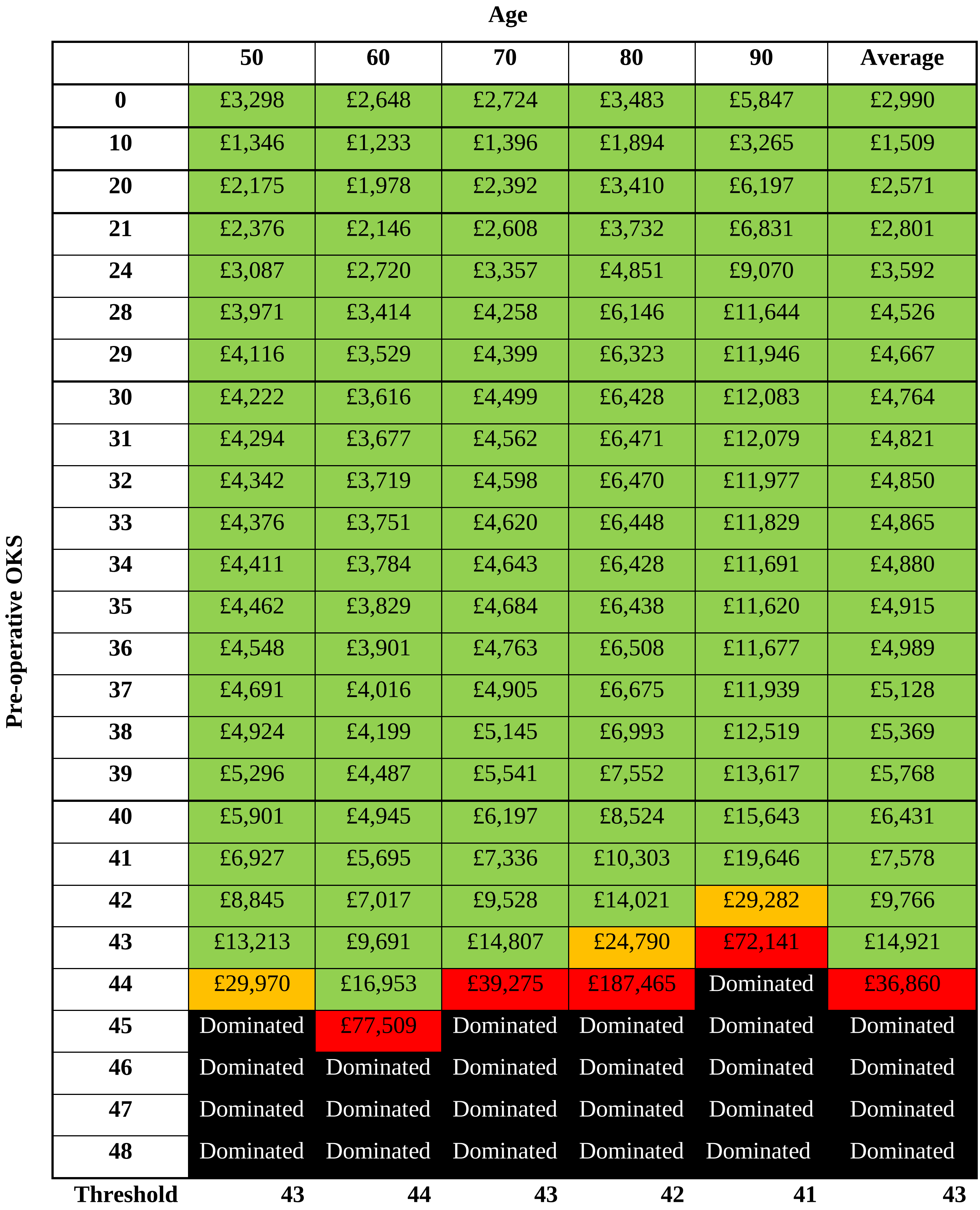
Pre-operative OKS	Age: 50	60	70	80	90	Average
0	£2,873	£2,351	£2,711	£4,010	£7,637	£3,034
10	£53	£317	£745	£1,565	£3,518	£837
20	Dominant	£461	£1,591	£3,911	£10,149	£1,780
21	Dominant	£619	£1,931	£4,725	£12,600	£2,153
24	£691	£1,483	£3,688	£9,161	£29,385	£4,058
28	£3,685	£3,587	£7,961	£22,133	£191,468	£8,541
29	£4,571	£4,131	£8,979	£25,221	£335,751	£9,557
30	£5,349	£4,607	£9,755	£27,023	£451,167	£10,304
31	£5,973	£4,998	£10,256	£27,384	£383,977	£10,758
32	£6,451	£5,313	£10,530	£26,714	£265,213	£10,977
33	£6,829	£5,577	£10,679	£25,653	£188,431	£11,072
34	£7,176	£5,827	£10,825	£24,760	£147,723	£11,168
35	£7,572	£6,111	£11,100	£24,478	£130,237	£11,396
36	£8,115	£6,490	£11,664	£25,270	£132,974	£11,908
37	£8,953	£7,052	£12,767	£27,992	£173,824	£12,939
38	£10,366	£7,951	£14,946	£35,105	£550,959	£14,977
39	£13,045	£9,525	£19,774	£58,622	Dominated	£19,392
40	£19,423	£12,719	£35,075	£1,409,892	Dominated	£32,352
41	£49,107	£21,709	£8,300,944	Dominated	Dominated	£237,443
42	Dominated	£141,636	Dominated	Dominated	Dominated	Dominated
43	Dominated	Dominated	Dominated	Dominated	Dominated	Dominated
44	Dominated	Dominated	Dominated	Dominated	Dominated	Dominated
45	Dominated	Dominated	Dominated	Dominated	Dominated	Dominated
46	Dominated	Dominated	Dominated	Dominated	Dominated	Dominated
47	Dominated	Dominated	Dominated	Dominated	Dominated	Dominated
48	Dominated	Dominated	Dominated	Dominated	Dominated	Dominated
Threshold	40	40	39	27	22	39

FIGURE 147 Cost-effectiveness of TKA in patients of different age and baseline OKS (averaged over men and women): Assuming that EQ-5D utility without TJA increases by 0.115 in the first year and follows age-related decline thereafter



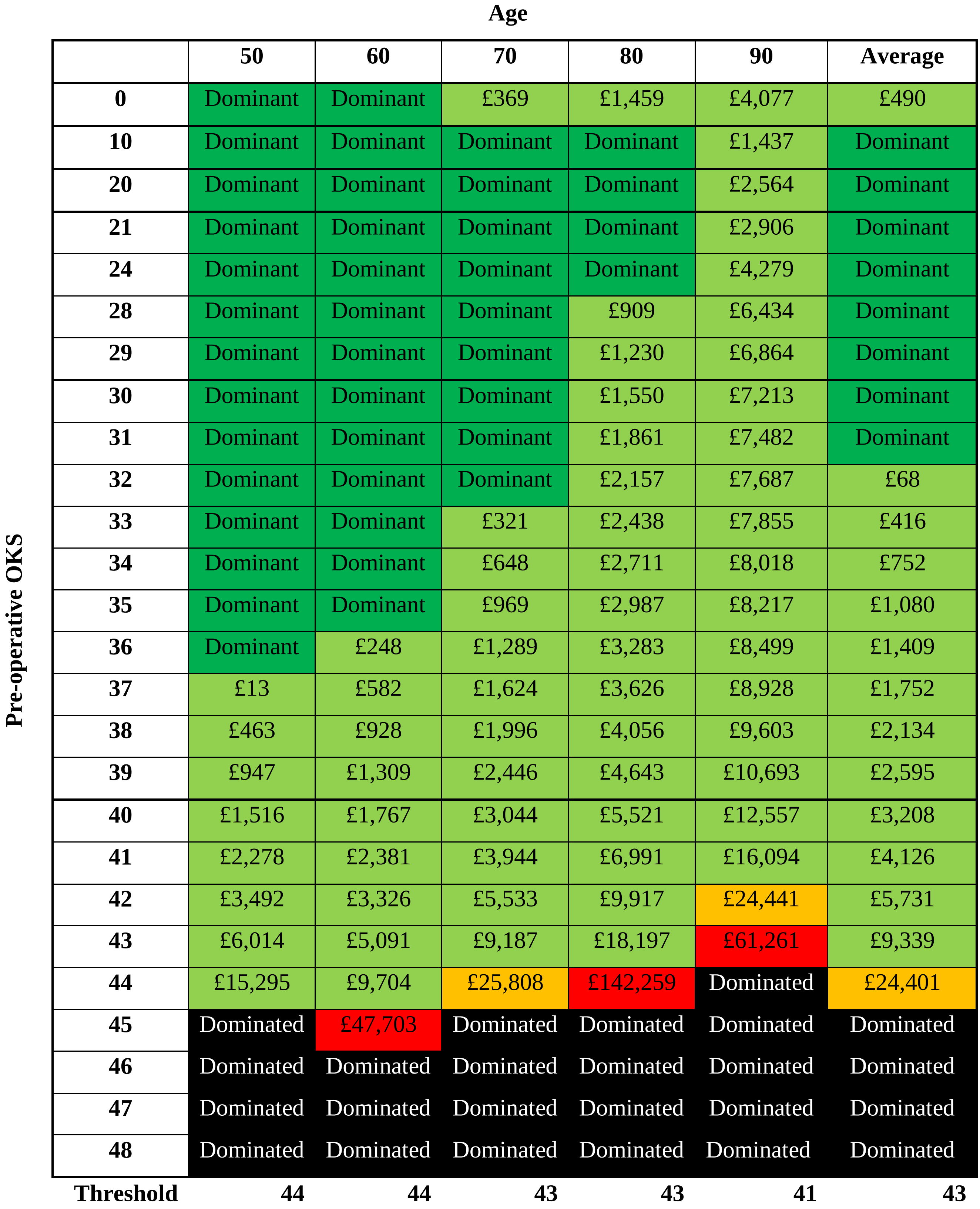
	Age					
Pre-operative OKS	50	60	70	80	90	Average
0	£4,616	£3,602	£3,509	£4,158	£6,437	£3,823
10	£2,650	£2,218	£2,216	£2,593	£3,875	£2,372
20	£4,495	£3,678	£3,874	£4,726	£7,408	£4,127
21	£4,832	£3,936	£4,181	£5,140	£8,140	£4,453
24	£5,886	£4,729	£5,170	£6,511	£10,667	£5,492
28	£6,784	£5,417	£6,123	£7,892	£13,381	£6,471
29	£6,828	£5,463	£6,210	£8,020	£13,641	£6,553
30	£6,801	£5,460	£6,233	£8,053	£13,707	£6,566
31	£6,718	£5,417	£6,203	£8,008	£13,612	£6,524
32	£6,600	£5,348	£6,136	£7,908	£13,407	£6,444
33	£6,467	£5,267	£6,053	£7,784	£13,154	£6,347
34	£6,342	£5,190	£5,975	£7,667	£12,915	£6,256
35	£6,248	£5,135	£5,922	£7,589	£12,754	£6,193
36	£6,209	£5,118	£5,921	£7,583	£12,736	£6,182
37	£6,251	£5,160	£5,999	£7,691	£12,942	£6,254
38	£6,410	£5,290	£6,195	£7,972	£13,492	£6,447
39	£6,746	£5,547	£6,573	£8,521	£14,591	£6,826
40	£7,362	£6,004	£7,248	£9,525	£16,672	£7,505
41	£8,477	£6,800	£8,467	£11,407	£20,830	£8,728
42	£10,630	£8,248	£10,860	£15,389	£30,896	£11,111
43	£15,613	£11,224	£16,680	£26,988	£75,768	£16,781
44	£34,862	£19,369	£43,764	£202,533	Dominated	£41,014
45	Dominated	£87,444	Dominated	Dominated	Dominated	Dominated
46	Dominated	Dominated	Dominated	Dominated	Dominated	Dominated
47	Dominated	Dominated	Dominated	Dominated	Dominated	Dominated
48	Dominated	Dominated	Dominated	Dominated	Dominated	Dominated
Threshold	43	44	43	42	40	43

FIGURE 148 Cost-effectiveness of TKA in patients of different age and baseline OKS (averaged over men and women): Assuming that patients accrued no costs in the absence of joint replacement



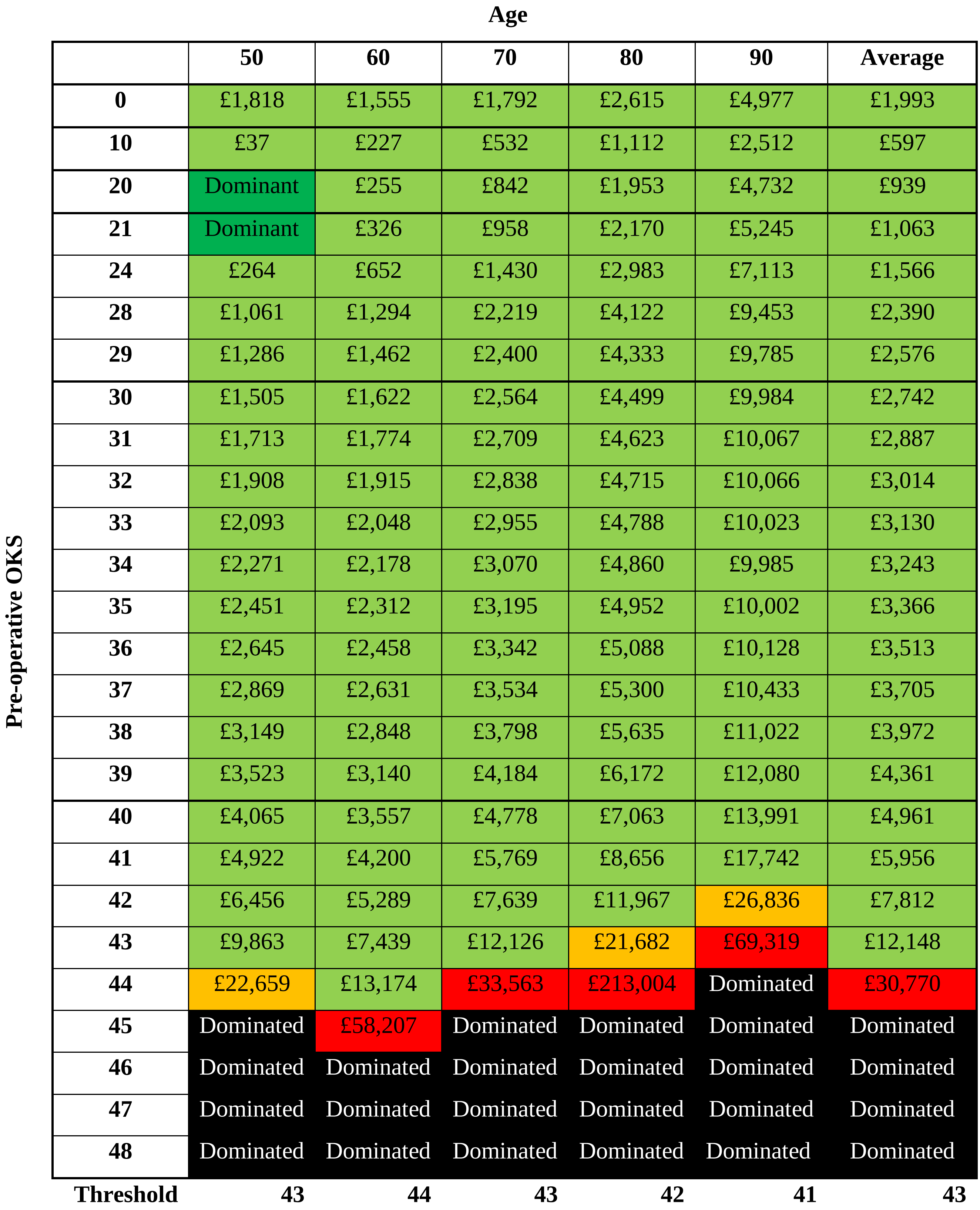
Pre-operative OKS	Age					
	50	**60**	**70**	**80**	**90**	**Average**
0	£3,298	£2,648	£2,724	£3,483	£5,847	£2,990
10	£1,346	£1,233	£1,396	£1,894	£3,265	£1,509
20	£2,175	£1,978	£2,392	£3,410	£6,197	£2,571
21	£2,376	£2,146	£2,608	£3,732	£6,831	£2,801
24	£3,087	£2,720	£3,357	£4,851	£9,070	£3,592
28	£3,971	£3,414	£4,258	£6,146	£11,644	£4,526
29	£4,116	£3,529	£4,399	£6,323	£11,946	£4,667
30	£4,222	£3,616	£4,499	£6,428	£12,083	£4,764
31	£4,294	£3,677	£4,562	£6,471	£12,079	£4,821
32	£4,342	£3,719	£4,598	£6,470	£11,977	£4,850
33	£4,376	£3,751	£4,620	£6,448	£11,829	£4,865
34	£4,411	£3,784	£4,643	£6,428	£11,691	£4,880
35	£4,462	£3,829	£4,684	£6,438	£11,620	£4,915
36	£4,548	£3,901	£4,763	£6,508	£11,677	£4,989
37	£4,691	£4,016	£4,905	£6,675	£11,939	£5,128
38	£4,924	£4,199	£5,145	£6,993	£12,519	£5,369
39	£5,296	£4,487	£5,541	£7,552	£13,617	£5,768
40	£5,901	£4,945	£6,197	£8,524	£15,643	£6,431
41	£6,927	£5,695	£7,336	£10,303	£19,646	£7,578
42	£8,845	£7,017	£9,528	£14,021	£29,282	£9,766
43	£13,213	£9,691	£14,807	£24,790	£72,141	£14,921
44	£29,970	£16,953	£39,275	£187,465	Dominated	£36,860
45	Dominated	£77,509	Dominated	Dominated	Dominated	Dominated
46	Dominated	Dominated	Dominated	Dominated	Dominated	Dominated
47	Dominated	Dominated	Dominated	Dominated	Dominated	Dominated
48	Dominated	Dominated	Dominated	Dominated	Dominated	Dominated
Threshold	**43**	**44**	**43**	**42**	**41**	**43**

FIGURE 149 Cost-effectiveness of TKA in patients of different age and baseline OKS (averaged over men and women): Halving the cost in the absence of joint replacement



	Age					
Pre-operative OKS	**50**	**60**	**70**	**80**	**90**	**Average**
0	Dominant	Dominant	£369	£1,459	£4,077	£490
10	Dominant	Dominant	Dominant	Dominant	£1,437	Dominant
20	Dominant	Dominant	Dominant	Dominant	£2,564	Dominant
21	Dominant	Dominant	Dominant	Dominant	£2,906	Dominant
24	Dominant	Dominant	Dominant	Dominant	£4,279	Dominant
28	Dominant	Dominant	Dominant	£909	£6,434	Dominant
29	Dominant	Dominant	Dominant	£1,230	£6,864	Dominant
30	Dominant	Dominant	Dominant	£1,550	£7,213	Dominant
31	Dominant	Dominant	Dominant	£1,861	£7,482	Dominant
32	Dominant	Dominant	Dominant	£2,157	£7,687	£68
33	Dominant	Dominant	£321	£2,438	£7,855	£416
34	Dominant	Dominant	£648	£2,711	£8,018	£752
35	Dominant	Dominant	£969	£2,987	£8,217	£1,080
36	Dominant	£248	£1,289	£3,283	£8,499	£1,409
37	£13	£582	£1,624	£3,626	£8,928	£1,752
38	£463	£928	£1,996	£4,056	£9,603	£2,134
39	£947	£1,309	£2,446	£4,643	£10,693	£2,595
40	£1,516	£1,767	£3,044	£5,521	£12,557	£3,208
41	£2,278	£2,381	£3,944	£6,991	£16,094	£4,126
42	£3,492	£3,326	£5,533	£9,917	£24,441	£5,731
43	£6,014	£5,091	£9,187	£18,197	£61,261	£9,339
44	£15,295	£9,704	£25,808	£142,259	Dominated	£24,401
45	Dominated	£47,703	Dominated	Dominated	Dominated	Dominated
46	Dominated	Dominated	Dominated	Dominated	Dominated	Dominated
47	Dominated	Dominated	Dominated	Dominated	Dominated	Dominated
48	Dominated	Dominated	Dominated	Dominated	Dominated	Dominated
Threshold	**44**	**44**	**43**	**43**	**41**	**43**

FIGURE 150 Cost-effectiveness of TKA in patients of different age and baseline OKS (averaged over men and women): Doubling the cost in the absence of joint replacement

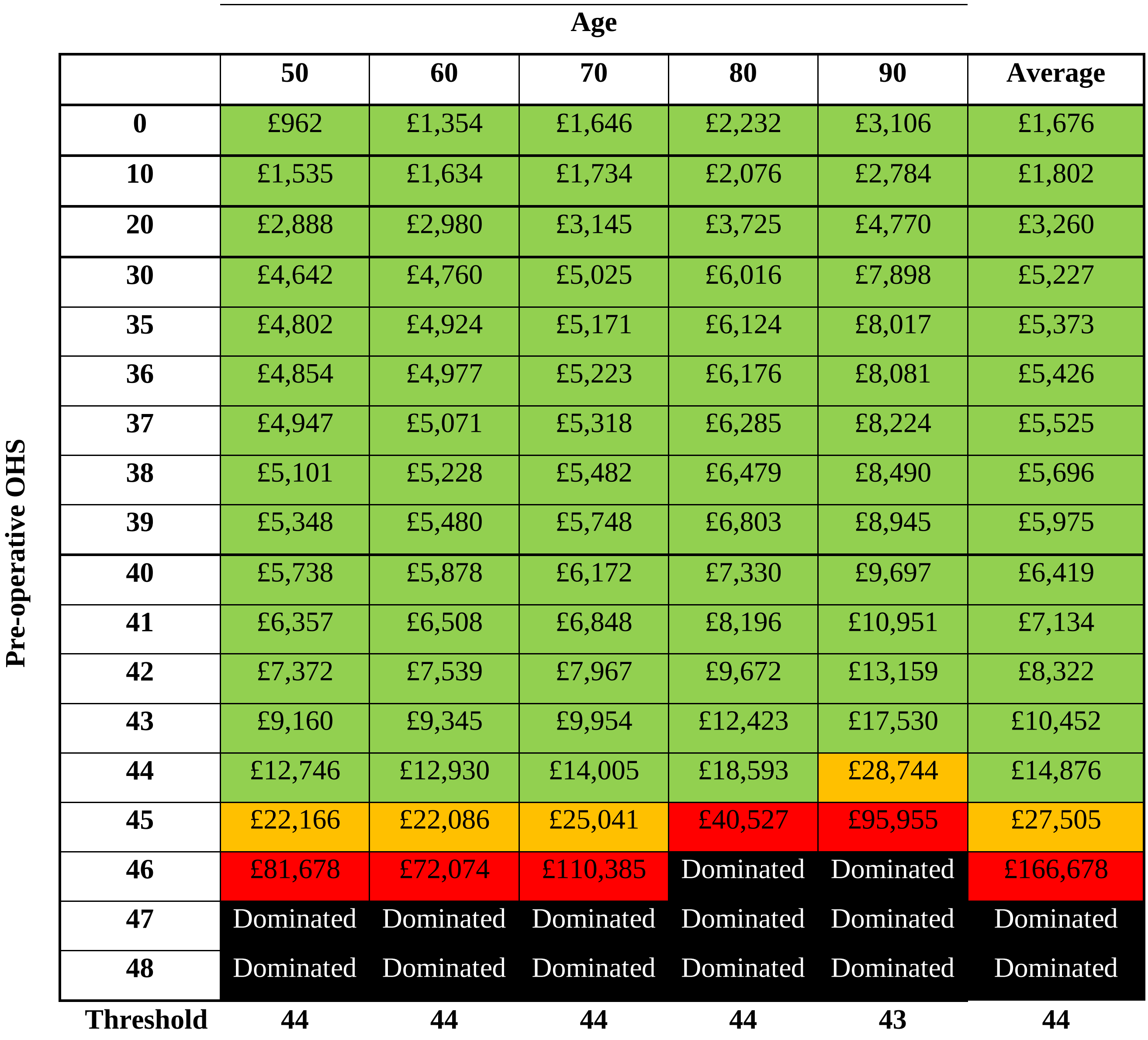


	Age					
Pre-operative OKS	50	60	70	80	90	Average
0	£1,818	£1,555	£1,792	£2,615	£4,977	£1,993
10	£37	£227	£532	£1,112	£2,512	£597
20	Dominant	£255	£842	£1,953	£4,732	£939
21	Dominant	£326	£958	£2,170	£5,245	£1,063
24	£264	£652	£1,430	£2,983	£7,113	£1,566
28	£1,061	£1,294	£2,219	£4,122	£9,453	£2,390
29	£1,286	£1,462	£2,400	£4,333	£9,785	£2,576
30	£1,505	£1,622	£2,564	£4,499	£9,984	£2,742
31	£1,713	£1,774	£2,709	£4,623	£10,067	£2,887
32	£1,908	£1,915	£2,838	£4,715	£10,066	£3,014
33	£2,093	£2,048	£2,955	£4,788	£10,023	£3,130
34	£2,271	£2,178	£3,070	£4,860	£9,985	£3,243
35	£2,451	£2,312	£3,195	£4,952	£10,002	£3,366
36	£2,645	£2,458	£3,342	£5,088	£10,128	£3,513
37	£2,869	£2,631	£3,534	£5,300	£10,433	£3,705
38	£3,149	£2,848	£3,798	£5,635	£11,022	£3,972
39	£3,523	£3,140	£4,184	£6,172	£12,080	£4,361
40	£4,065	£3,557	£4,778	£7,063	£13,991	£4,961
41	£4,922	£4,200	£5,769	£8,656	£17,742	£5,956
42	£6,456	£5,289	£7,639	£11,967	£26,836	£7,812
43	£9,863	£7,439	£12,126	£21,682	£69,319	£12,148
44	£22,659	£13,174	£33,563	£213,004	Dominated	£30,770
45	Dominated	£58,207	Dominated	Dominated	Dominated	Dominated
46	Dominated	Dominated	Dominated	Dominated	Dominated	Dominated
47	Dominated	Dominated	Dominated	Dominated	Dominated	Dominated
48	Dominated	Dominated	Dominated	Dominated	Dominated	Dominated
Threshold	43	44	43	42	41	43

FIGURE 151 Cost-effectiveness of TKA in patients of different age and baseline OKS (averaged over men and women): Discounting QALYs at 1.5% and costs 3.5%

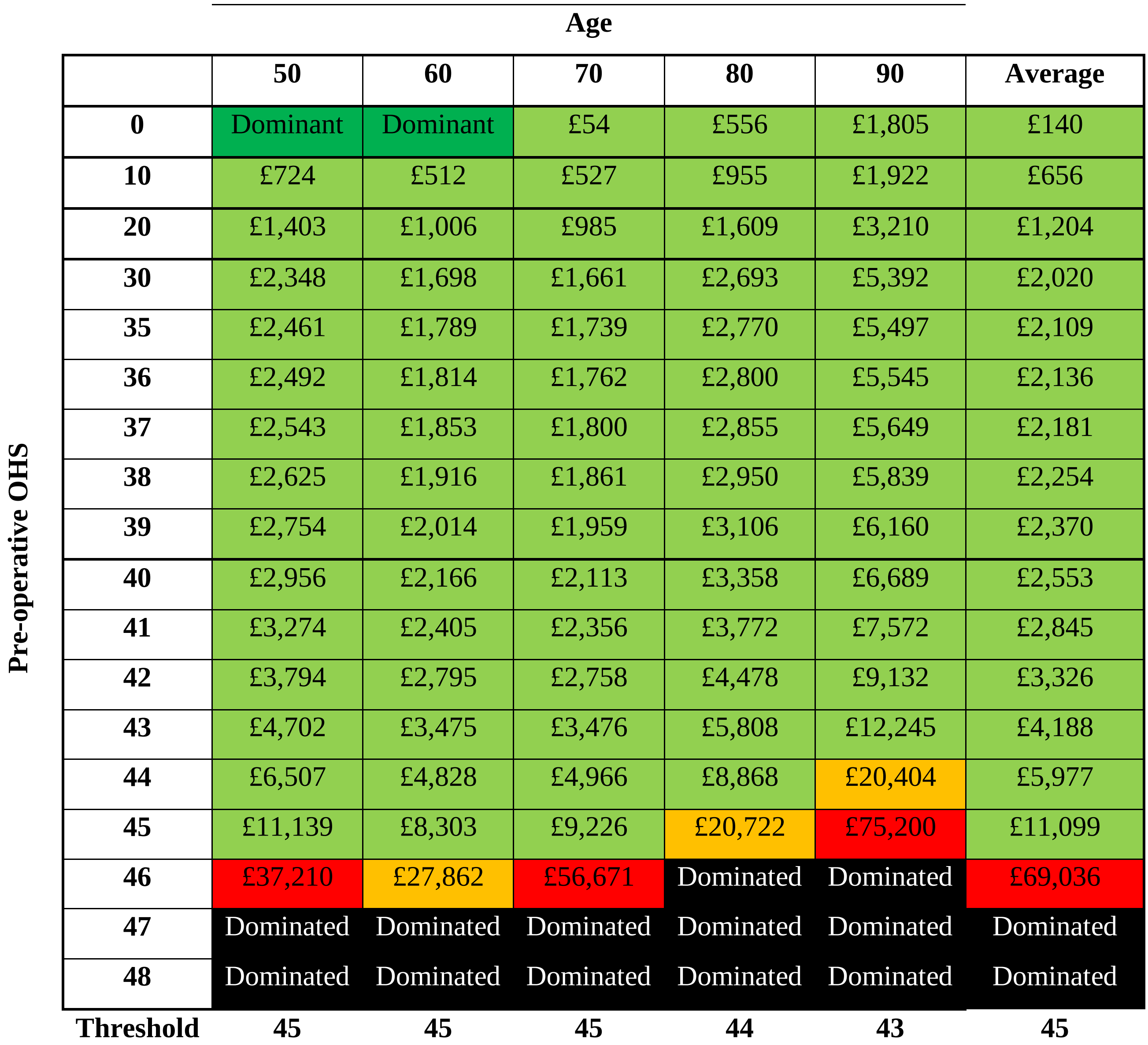
		Age					
		50	60	70	80	90	Average
Pre-operative OKS	0	£1,565	£1,330	£1,572	£2,386	£4,725	£1,764
	10	Dominant	£21	£339	£925	£2,328	£397
	20	Dominant	Dominant	£489	£1,603	£4,375	£574
	21	Dominant	Dominant	£579	£1,792	£4,856	£673
	24	Dominant	£212	£978	£2,520	£6,624	£1,102
	28	£502	£827	£1,722	£3,599	£8,882	£1,881
	29	£739	£1,001	£1,908	£3,812	£9,213	£2,072
	30	£976	£1,174	£2,082	£3,986	£9,418	£2,248
	31	£1,207	£1,340	£2,242	£4,124	£9,513	£2,409
	32	£1,428	£1,498	£2,387	£4,232	£9,528	£2,554
	33	£1,639	£1,649	£2,522	£4,323	£9,502	£2,689
	34	£1,842	£1,797	£2,655	£4,412	£9,481	£2,820
	35	£2,044	£1,946	£2,794	£4,519	£9,511	£2,958
	36	£2,256	£2,104	£2,954	£4,665	£9,646	£3,117
	37	£2,493	£2,285	£3,152	£4,882	£9,954	£3,316
	38	£2,778	£2,504	£3,416	£5,213	£10,535	£3,582
	39	£3,149	£2,790	£3,790	£5,734	£11,570	£3,961
	40	£3,672	£3,190	£4,359	£6,591	£13,438	£4,535
	41	£4,486	£3,795	£5,299	£8,119	£17,113	£5,476
	42	£5,928	£4,809	£7,066	£11,301	£26,111	£7,224
	43	£9,103	£6,794	£11,322	£20,776	£70,012	£11,306
	44	£20,893	£12,040	£32,211	£268,179	Dominated	£29,011
	45	Dominated	£51,549	Dominated	Dominated	Dominated	Dominated
	46	Dominated	Dominated	Dominated	Dominated	Dominated	Dominated
	47	Dominated	Dominated	Dominated	Dominated	Dominated	Dominated
	48	Dominated	Dominated	Dominated	Dominated	Dominated	Dominated
	Threshold	**43**	**44**	**43**	**42**	**41**	**43**

FIGURE 152 Cost-effectiveness of TKA in patients of different age and baseline OKS (averaged over men and women): No discounting



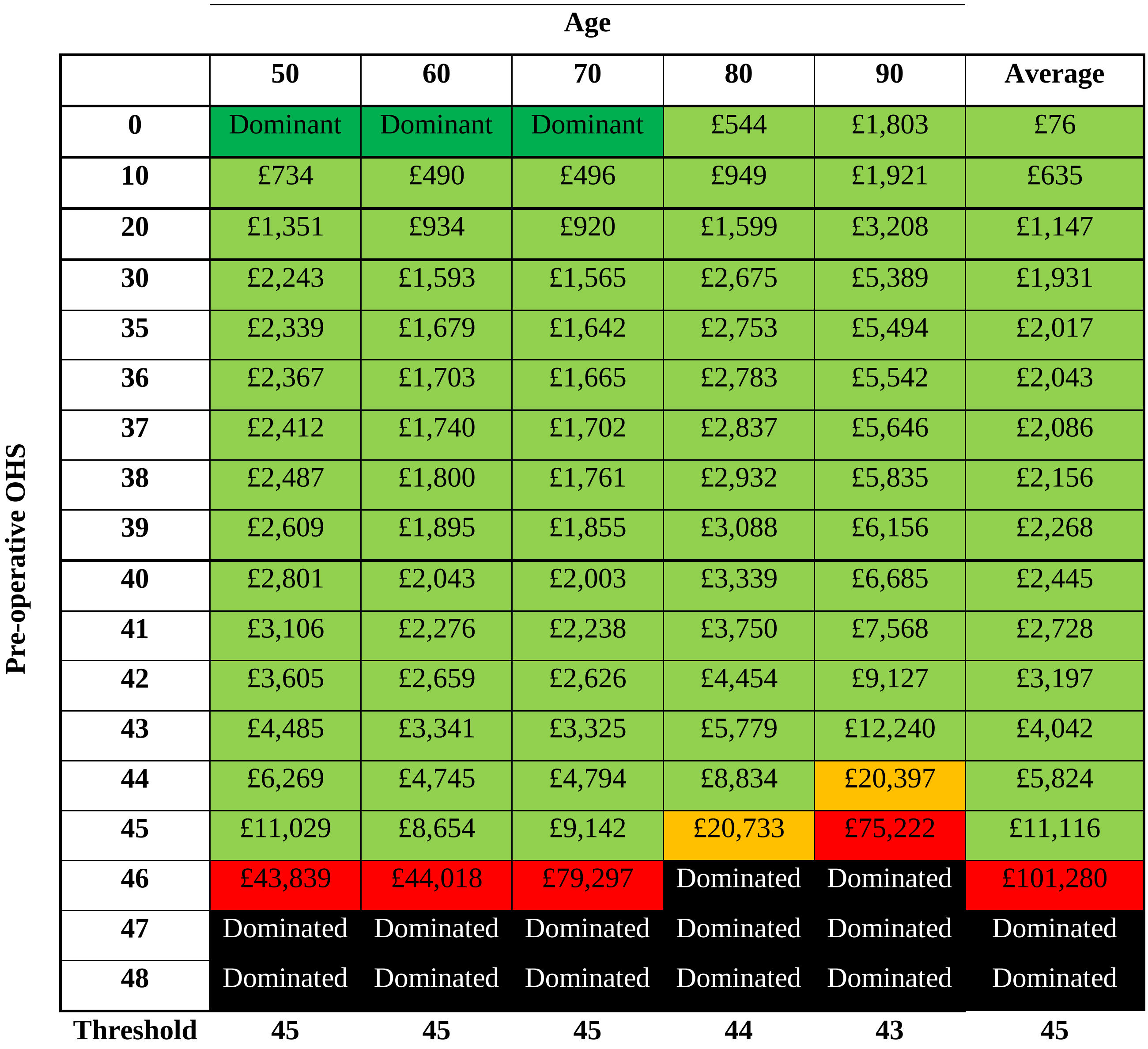
	Age					
Pre-operative OHS	50	60	70	80	90	Average
0	£962	£1,354	£1,646	£2,232	£3,106	£1,676
10	£1,535	£1,634	£1,734	£2,076	£2,784	£1,802
20	£2,888	£2,980	£3,145	£3,725	£4,770	£3,260
30	£4,642	£4,760	£5,025	£6,016	£7,898	£5,227
35	£4,802	£4,924	£5,171	£6,124	£8,017	£5,373
36	£4,854	£4,977	£5,223	£6,176	£8,081	£5,426
37	£4,947	£5,071	£5,318	£6,285	£8,224	£5,525
38	£5,101	£5,228	£5,482	£6,479	£8,490	£5,696
39	£5,348	£5,480	£5,748	£6,803	£8,945	£5,975
40	£5,738	£5,878	£6,172	£7,330	£9,697	£6,419
41	£6,357	£6,508	£6,848	£8,196	£10,951	£7,134
42	£7,372	£7,539	£7,967	£9,672	£13,159	£8,322
43	£9,160	£9,345	£9,954	£12,423	£17,530	£10,452
44	£12,746	£12,930	£14,005	£18,593	£28,744	£14,876
45	£22,166	£22,086	£25,041	£40,527	£95,955	£27,505
46	£81,678	£72,074	£110,385	Dominated	Dominated	£166,678
47	Dominated	Dominated	Dominated	Dominated	Dominated	Dominated
48	Dominated	Dominated	Dominated	Dominated	Dominated	Dominated
Threshold	**44**	**44**	**44**	**44**	**43**	**44**

FIGURE 153 Cost-effectiveness of THA in patients of different age and baseline OHS (averaged over men and women): 5 year time horizon



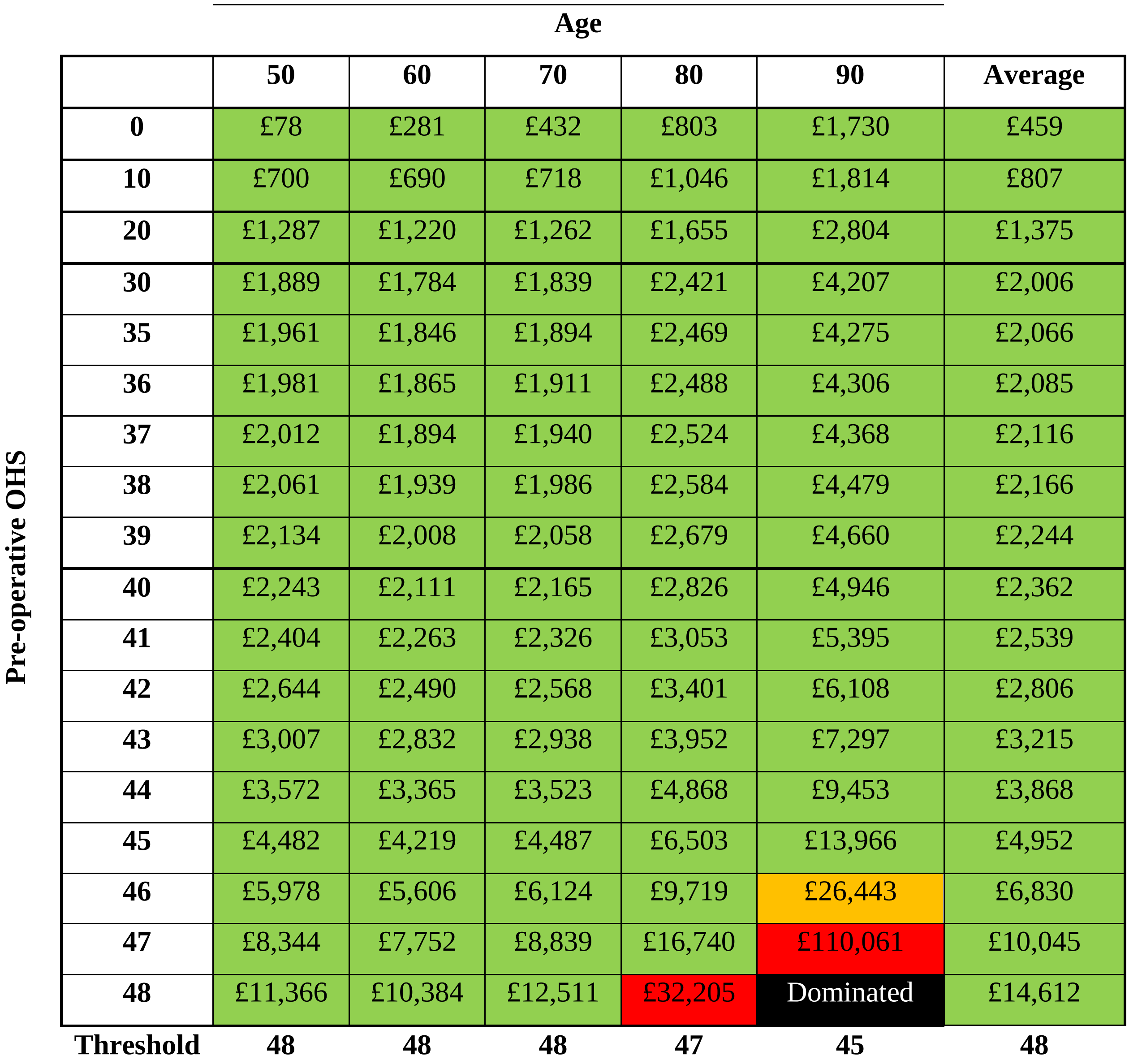
	Age					
Pre-operative OHS	**50**	**60**	**70**	**80**	**90**	**Average**
0	Dominant	Dominant	£54	£556	£1,805	£140
10	£724	£512	£527	£955	£1,922	£656
20	£1,403	£1,006	£985	£1,609	£3,210	£1,204
30	£2,348	£1,698	£1,661	£2,693	£5,392	£2,020
35	£2,461	£1,789	£1,739	£2,770	£5,497	£2,109
36	£2,492	£1,814	£1,762	£2,800	£5,545	£2,136
37	£2,543	£1,853	£1,800	£2,855	£5,649	£2,181
38	£2,625	£1,916	£1,861	£2,950	£5,839	£2,254
39	£2,754	£2,014	£1,959	£3,106	£6,160	£2,370
40	£2,956	£2,166	£2,113	£3,358	£6,689	£2,553
41	£3,274	£2,405	£2,356	£3,772	£7,572	£2,845
42	£3,794	£2,795	£2,758	£4,478	£9,132	£3,326
43	£4,702	£3,475	£3,476	£5,808	£12,245	£4,188
44	£6,507	£4,828	£4,966	£8,868	£20,404	£5,977
45	£11,139	£8,303	£9,226	£20,722	£75,200	£11,099
46	£37,210	£27,862	£56,671	Dominated	Dominated	£69,036
47	Dominated	Dominated	Dominated	Dominated	Dominated	Dominated
48	Dominated	Dominated	Dominated	Dominated	Dominated	Dominated
Threshold	**45**	**45**	**45**	**44**	**43**	**45**

FIGURE 154 Cost-effectiveness of THA in patients of different age and baseline OHS (averaged over men and women): 20 year time horizon



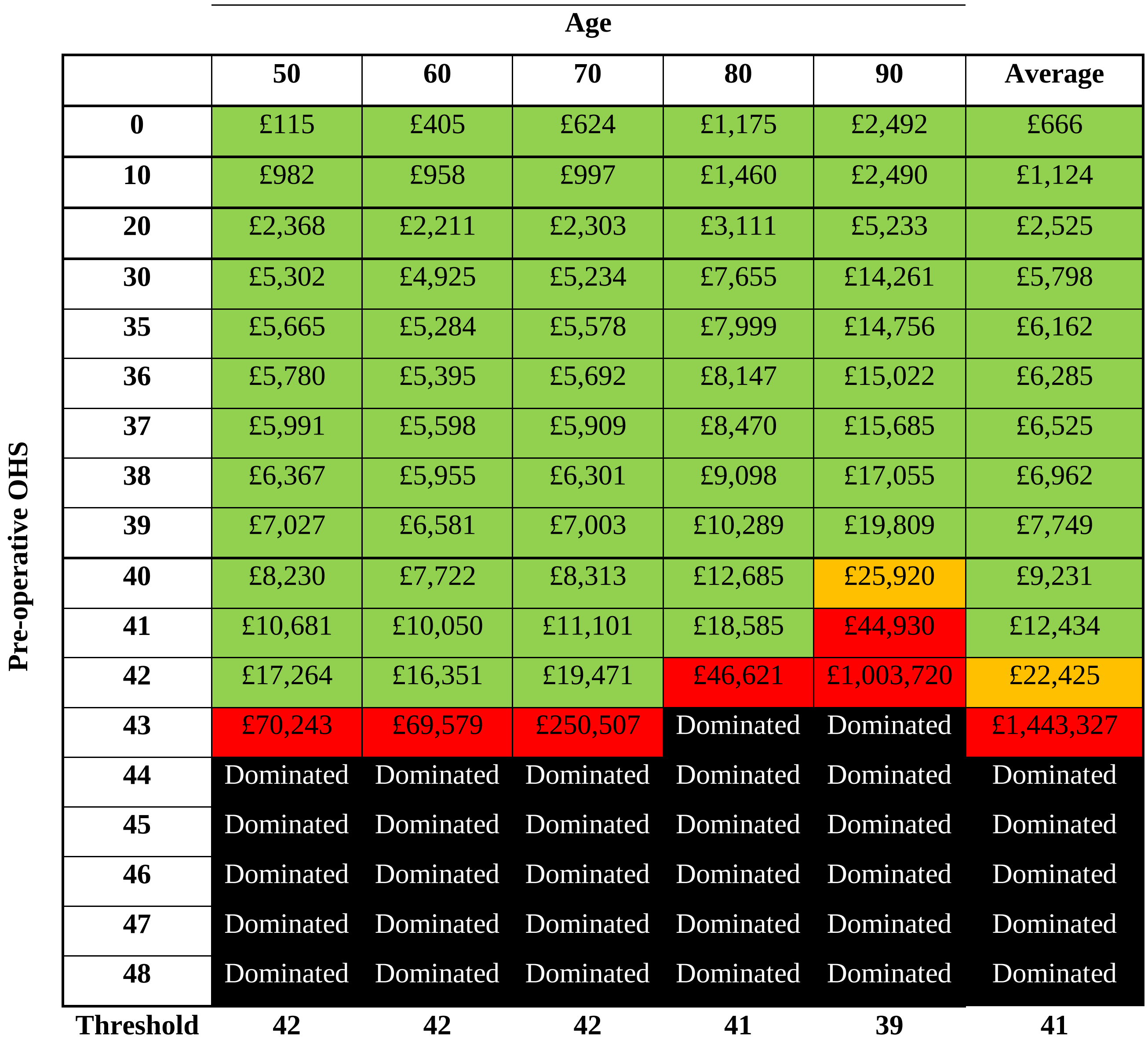
	Age					
Pre-operative OHS	**50**	**60**	**70**	**80**	**90**	**Average**
0	Dominant	Dominant	Dominant	£544	£1,803	£76
10	£734	£490	£496	£949	£1,921	£635
20	£1,351	£934	£920	£1,599	£3,208	£1,147
30	£2,243	£1,593	£1,565	£2,675	£5,389	£1,931
35	£2,339	£1,679	£1,642	£2,753	£5,494	£2,017
36	£2,367	£1,703	£1,665	£2,783	£5,542	£2,043
37	£2,412	£1,740	£1,702	£2,837	£5,646	£2,086
38	£2,487	£1,800	£1,761	£2,932	£5,835	£2,156
39	£2,609	£1,895	£1,855	£3,088	£6,156	£2,268
40	£2,801	£2,043	£2,003	£3,339	£6,685	£2,445
41	£3,106	£2,276	£2,238	£3,750	£7,568	£2,728
42	£3,605	£2,659	£2,626	£4,454	£9,127	£3,197
43	£4,485	£3,341	£3,325	£5,779	£12,240	£4,042
44	£6,269	£4,745	£4,794	£8,834	£20,397	£5,824
45	£11,029	£8,654	£9,142	£20,733	£75,222	£11,116
46	£43,839	£44,018	£79,297	Dominated	Dominated	£101,280
47	Dominated	Dominated	Dominated	Dominated	Dominated	Dominated
48	Dominated	Dominated	Dominated	Dominated	Dominated	Dominated
Threshold	**45**	**45**	**45**	**44**	**43**	**45**

FIGURE 155 Cost-effectiveness of THA in patients of different age and baseline OHS (averaged over men and women): 60 year time horizon



	Age					
Pre-operative OHS	**50**	**60**	**70**	**80**	**90**	**Average**
0	£78	£281	£432	£803	£1,730	£459
10	£700	£690	£718	£1,046	£1,814	£807
20	£1,287	£1,220	£1,262	£1,655	£2,804	£1,375
30	£1,889	£1,784	£1,839	£2,421	£4,207	£2,006
35	£1,961	£1,846	£1,894	£2,469	£4,275	£2,066
36	£1,981	£1,865	£1,911	£2,488	£4,306	£2,085
37	£2,012	£1,894	£1,940	£2,524	£4,368	£2,116
38	£2,061	£1,939	£1,986	£2,584	£4,479	£2,166
39	£2,134	£2,008	£2,058	£2,679	£4,660	£2,244
40	£2,243	£2,111	£2,165	£2,826	£4,946	£2,362
41	£2,404	£2,263	£2,326	£3,053	£5,395	£2,539
42	£2,644	£2,490	£2,568	£3,401	£6,108	£2,806
43	£3,007	£2,832	£2,938	£3,952	£7,297	£3,215
44	£3,572	£3,365	£3,523	£4,868	£9,453	£3,868
45	£4,482	£4,219	£4,487	£6,503	£13,966	£4,952
46	£5,978	£5,606	£6,124	£9,719	£26,443	£6,830
47	£8,344	£7,752	£8,839	£16,740	£110,061	£10,045
48	£11,366	£10,384	£12,511	£32,205	Dominated	£14,612
Threshold	**48**	**48**	**48**	**47**	**45**	**48**

FIGURE 156 Cost-effectiveness of THA in patients of different age and baseline OHS (averaged over men and women): Assuming that EQ-5D utility without TJA worsens by 0.025 per year

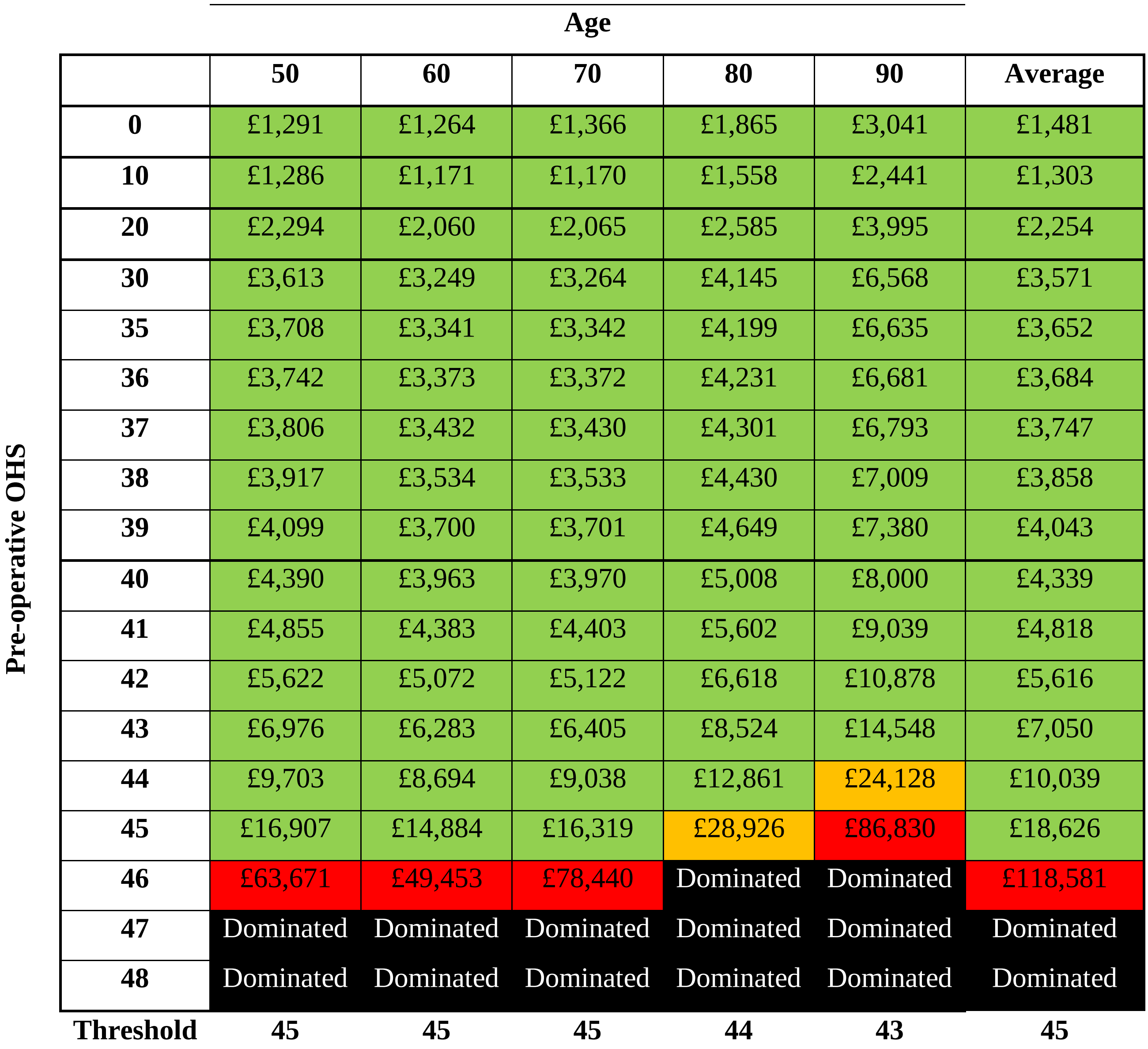


	Age					
Pre-operative OHS	50	60	70	80	90	Average
0	£115	£405	£624	£1,175	£2,492	£666
10	£982	£958	£997	£1,460	£2,490	£1,124
20	£2,368	£2,211	£2,303	£3,111	£5,233	£2,525
30	£5,302	£4,925	£5,234	£7,655	£14,261	£5,798
35	£5,665	£5,284	£5,578	£7,999	£14,756	£6,162
36	£5,780	£5,395	£5,692	£8,147	£15,022	£6,285
37	£5,991	£5,598	£5,909	£8,470	£15,685	£6,525
38	£6,367	£5,955	£6,301	£9,098	£17,055	£6,962
39	£7,027	£6,581	£7,003	£10,289	£19,809	£7,749
40	£8,230	£7,722	£8,313	£12,685	£25,920	£9,231
41	£10,681	£10,050	£11,101	£18,585	£44,930	£12,434
42	£17,264	£16,351	£19,471	£46,621	£1,003,720	£22,425
43	£70,243	£69,579	£250,507	Dominated	Dominated	£1,443,327
44	Dominated	Dominated	Dominated	Dominated	Dominated	Dominated
45	Dominated	Dominated	Dominated	Dominated	Dominated	Dominated
46	Dominated	Dominated	Dominated	Dominated	Dominated	Dominated
47	Dominated	Dominated	Dominated	Dominated	Dominated	Dominated
48	Dominated	Dominated	Dominated	Dominated	Dominated	Dominated
Threshold	**42**	**42**	**42**	**41**	**39**	**41**

FIGURE 157 Cost-effectiveness of THA in patients of different age and baseline OHS (averaged over men and women): Assuming that EQ-5D utility without TJA increases by 0.115 in the first year and follows age-related decline thereafter

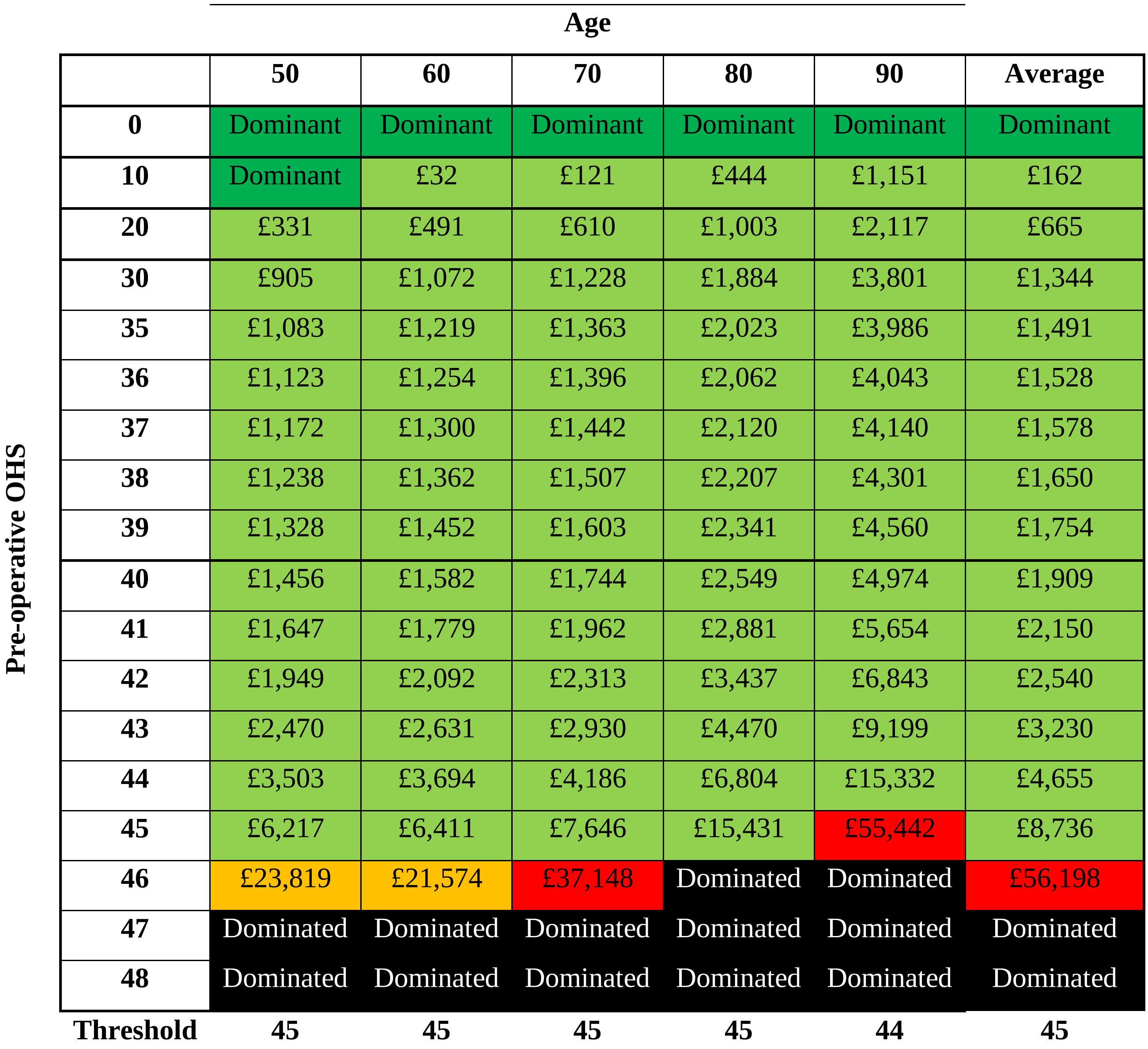
Pre-operative OHS	Age					
	50	**60**	**70**	**80**	**90**	**Average**
0	£2,490	£2,202	£2,231	£2,804	£4,137	£2,429
10	£1,762	£1,551	£1,519	£1,930	£2,872	£1,684
20	£2,948	£2,583	£2,550	£3,113	£4,622	£2,783
30	£4,516	£3,975	£3,943	£4,899	£7,490	£4,313
35	£4,583	£4,049	£4,002	£4,925	£7,517	£4,372
36	£4,614	£4,080	£4,031	£4,955	£7,560	£4,402
37	£4,683	£4,143	£4,093	£5,028	£7,678	£4,470
38	£4,810	£4,258	£4,208	£5,171	£7,911	£4,595
39	£5,023	£4,449	£4,400	£5,419	£8,321	£4,806
40	£5,368	£4,757	£4,712	£5,828	£9,008	£5,149
41	£5,924	£5,251	£5,217	£6,509	£10,167	£5,707
42	£6,846	£6,066	£6,059	£7,678	£12,223	£6,641
43	£8,478	£7,501	£7,563	£9,876	£16,331	£8,324
44	£11,769	£10,361	£10,655	£14,879	£27,060	£11,834
45	£20,470	£17,708	£19,210	£33,424	£97,293	£21,923
46	£76,955	£58,746	£92,205	Dominated	Dominated	£139,376
47	Dominated	Dominated	Dominated	Dominated	Dominated	Dominated
48	Dominated	Dominated	Dominated	Dominated	Dominated	Dominated
Threshold	**44**	**45**	**45**	**44**	**43**	**44**

FIGURE 158 Cost-effectiveness of THA in patients of different age and baseline OHS (averaged over men and women): Assuming that patients accrued no costs in the absence of joint replacement



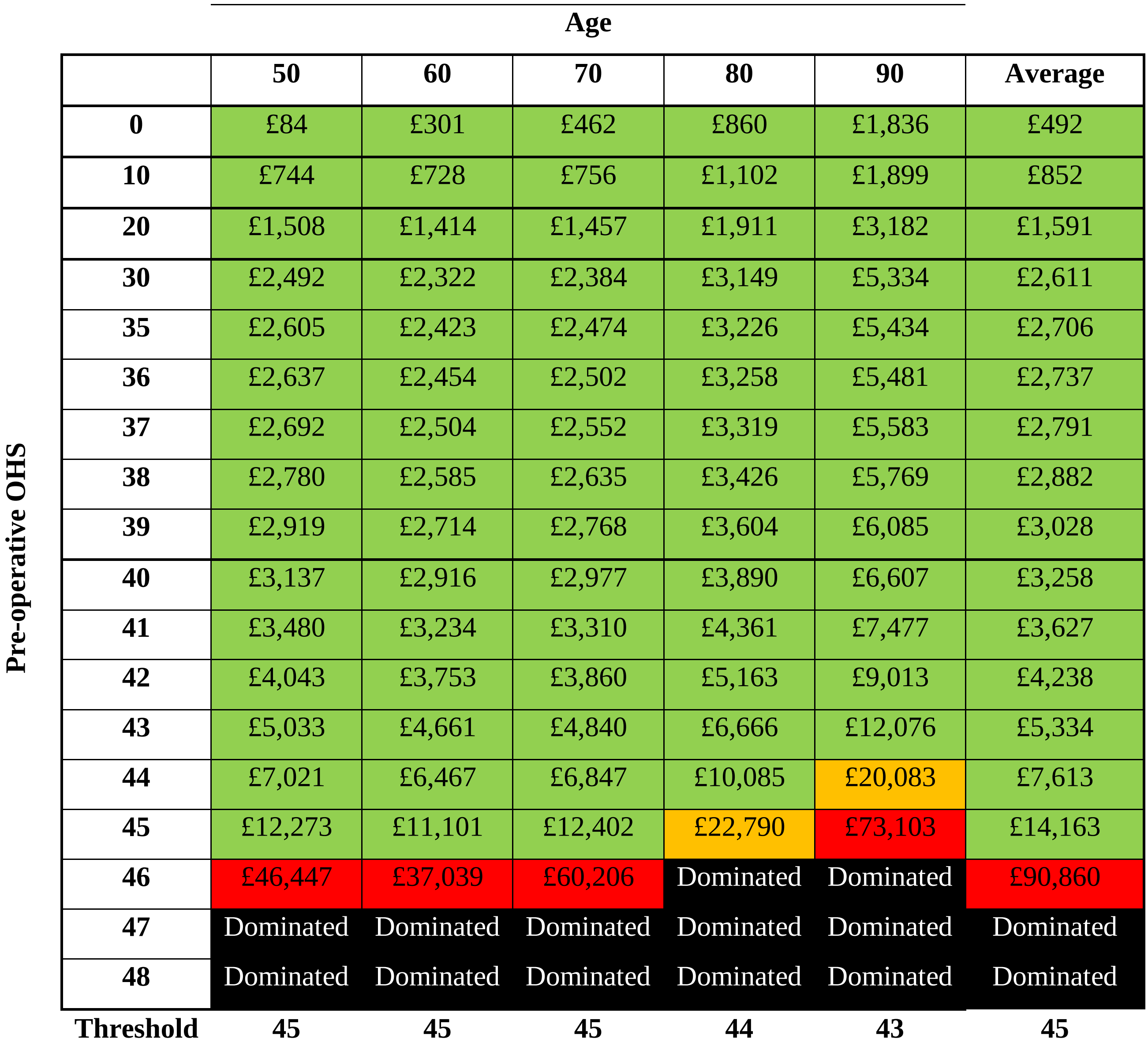
		Age					
		50	**60**	**70**	**80**	**90**	**Average**
Pre-operative OHS	**0**	£1,291	£1,264	£1,366	£1,865	£3,041	£1,481
	10	£1,286	£1,171	£1,170	£1,558	£2,441	£1,303
	20	£2,294	£2,060	£2,065	£2,585	£3,995	£2,254
	30	£3,613	£3,249	£3,264	£4,145	£6,568	£3,571
	35	£3,708	£3,341	£3,342	£4,199	£6,635	£3,652
	36	£3,742	£3,373	£3,372	£4,231	£6,681	£3,684
	37	£3,806	£3,432	£3,430	£4,301	£6,793	£3,747
	38	£3,917	£3,534	£3,533	£4,430	£7,009	£3,858
	39	£4,099	£3,700	£3,701	£4,649	£7,380	£4,043
	40	£4,390	£3,963	£3,970	£5,008	£8,000	£4,339
	41	£4,855	£4,383	£4,403	£5,602	£9,039	£4,818
	42	£5,622	£5,072	£5,122	£6,618	£10,878	£5,616
	43	£6,976	£6,283	£6,405	£8,524	£14,548	£7,050
	44	£9,703	£8,694	£9,038	£12,861	£24,128	£10,039
	45	£16,907	£14,884	£16,319	£28,926	£86,830	£18,626
	46	£63,671	£49,453	£78,440	Dominated	Dominated	£118,581
	47	Dominated	Dominated	Dominated	Dominated	Dominated	Dominated
	48	Dominated	Dominated	Dominated	Dominated	Dominated	Dominated
	Threshold	**45**	**45**	**45**	**44**	**43**	**45**

FIGURE 159 Cost-effectiveness of THA in patients of different age and baseline OHS (averaged over men and women): Halving the cost in the absence of joint replacement



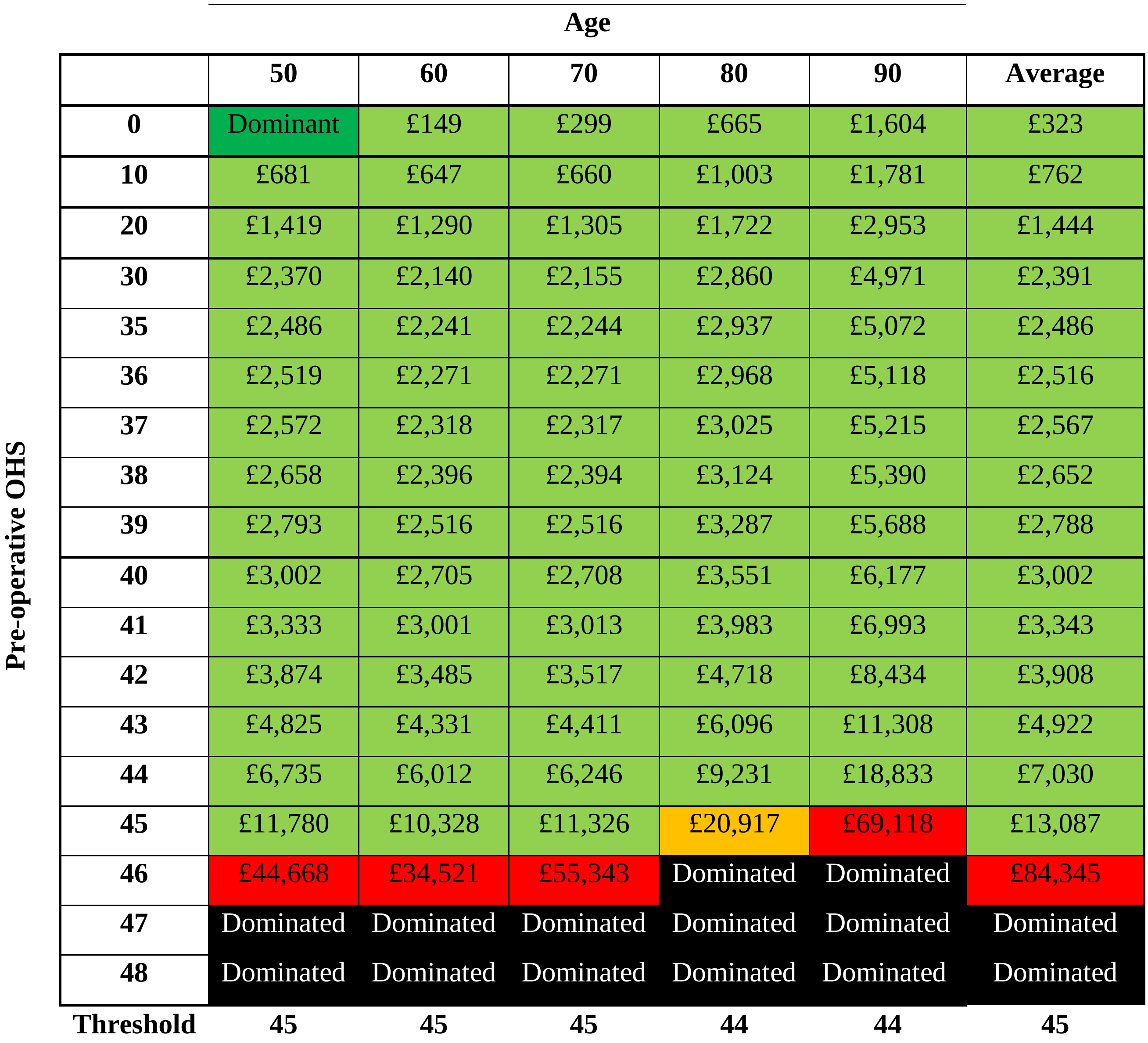
Pre-operative OHS	Age					
	50	**60**	**70**	**80**	**90**	**Average**
0	Dominant	Dominant	Dominant	Dominant	Dominant	Dominant
10	Dominant	£32	£121	£444	£1,151	£162
20	£331	£491	£610	£1,003	£2,117	£665
30	£905	£1,072	£1,228	£1,884	£3,801	£1,344
35	£1,083	£1,219	£1,363	£2,023	£3,986	£1,491
36	£1,123	£1,254	£1,396	£2,062	£4,043	£1,528
37	£1,172	£1,300	£1,442	£2,120	£4,140	£1,578
38	£1,238	£1,362	£1,507	£2,207	£4,301	£1,650
39	£1,328	£1,452	£1,603	£2,341	£4,560	£1,754
40	£1,456	£1,582	£1,744	£2,549	£4,974	£1,909
41	£1,647	£1,779	£1,962	£2,881	£5,654	£2,150
42	£1,949	£2,092	£2,313	£3,437	£6,843	£2,540
43	£2,470	£2,631	£2,930	£4,470	£9,199	£3,230
44	£3,503	£3,694	£4,186	£6,804	£15,332	£4,655
45	£6,217	£6,411	£7,646	£15,431	£55,442	£8,736
46	£23,819	£21,574	£37,148	Dominated	Dominated	£56,198
47	Dominated	Dominated	Dominated	Dominated	Dominated	Dominated
48	Dominated	Dominated	Dominated	Dominated	Dominated	Dominated
Threshold	**45**	**45**	**45**	**45**	**44**	**45**

FIGURE 160 Cost-effectiveness of THA in patients of different age and baseline OHS (averaged over men and women): Doubling the cost in the absence of joint replacement



	Age					
Pre-operative OHS	50	60	70	80	90	Average
0	£84	£301	£462	£860	£1,836	£492
10	£744	£728	£756	£1,102	£1,899	£852
20	£1,508	£1,414	£1,457	£1,911	£3,182	£1,591
30	£2,492	£2,322	£2,384	£3,149	£5,334	£2,611
35	£2,605	£2,423	£2,474	£3,226	£5,434	£2,706
36	£2,637	£2,454	£2,502	£3,258	£5,481	£2,737
37	£2,692	£2,504	£2,552	£3,319	£5,583	£2,791
38	£2,780	£2,585	£2,635	£3,426	£5,769	£2,882
39	£2,919	£2,714	£2,768	£3,604	£6,085	£3,028
40	£3,137	£2,916	£2,977	£3,890	£6,607	£3,258
41	£3,480	£3,234	£3,310	£4,361	£7,477	£3,627
42	£4,043	£3,753	£3,860	£5,163	£9,013	£4,238
43	£5,033	£4,661	£4,840	£6,666	£12,076	£5,334
44	£7,021	£6,467	£6,847	£10,085	£20,083	£7,613
45	£12,273	£11,101	£12,402	£22,790	£73,103	£14,163
46	£46,447	£37,039	£60,206	Dominated	Dominated	£90,860
47	Dominated	Dominated	Dominated	Dominated	Dominated	Dominated
48	Dominated	Dominated	Dominated	Dominated	Dominated	Dominated
Threshold	45	45	45	44	43	45

FIGURE 161 Cost-effectiveness of THA in patients of different age and baseline OHS (averaged over men and women): Discounting QALYs at 1.5% and costs 3.5%



	Age					
Pre-operative OHS	**50**	**60**	**70**	**80**	**90**	**Average**
0	Dominant	£149	£299	£665	£1,604	£323
10	£681	£647	£660	£1,003	£1,781	£762
20	£1,419	£1,290	£1,305	£1,722	£2,953	£1,444
30	£2,370	£2,140	£2,155	£2,860	£4,971	£2,391
35	£2,486	£2,241	£2,244	£2,937	£5,072	£2,486
36	£2,519	£2,271	£2,271	£2,968	£5,118	£2,516
37	£2,572	£2,318	£2,317	£3,025	£5,215	£2,567
38	£2,658	£2,396	£2,394	£3,124	£5,390	£2,652
39	£2,793	£2,516	£2,516	£3,287	£5,688	£2,788
40	£3,002	£2,705	£2,708	£3,551	£6,177	£3,002
41	£3,333	£3,001	£3,013	£3,983	£6,993	£3,343
42	£3,874	£3,485	£3,517	£4,718	£8,434	£3,908
43	£4,825	£4,331	£4,411	£6,096	£11,308	£4,922
44	£6,735	£6,012	£6,246	£9,231	£18,833	£7,030
45	£11,780	£10,328	£11,326	£20,917	£69,118	£13,087
46	£44,668	£34,521	£55,343	Dominated	Dominated	£84,345
47	Dominated	Dominated	Dominated	Dominated	Dominated	Dominated
48	Dominated	Dominated	Dominated	Dominated	Dominated	Dominated
Threshold	**45**	**45**	**45**	**44**	**44**	**45**

FIGURE 162 Cost-effectiveness of THA in patients of different age and baseline OHS (averaged over men and women): No discounting

Online Supplement 17 - Additional results of the economic evaluations presented in Chapter 8

Coefficients for the regression models

Knee replacement

We conducted logistic regression model predicting odds of being referred for surgical assessment from the hub on 110 patients with complete data who attended the hub and met inclusion criteria. Adding age and sex into the model worsened model fit, so the final model included only OKS (Table *185*).

TABLE 185 Results of logistic regression predicting the odds of knee patients attending the hub being referred for surgical assessment

Variable	Mean coefficient (SE)
OKS	-0.048 (0.021)*
Constant	0.768 (0.459)

* p<0.05

Hip replacement

Similarly, logistic regression was used to predict the odds of being referred for surgical assessment based on 101 patients with complete data who attended the hub and met inclusion criteria. Adding age into the model worsened AIC, so the final model included only OHS and gender (Table *186*).

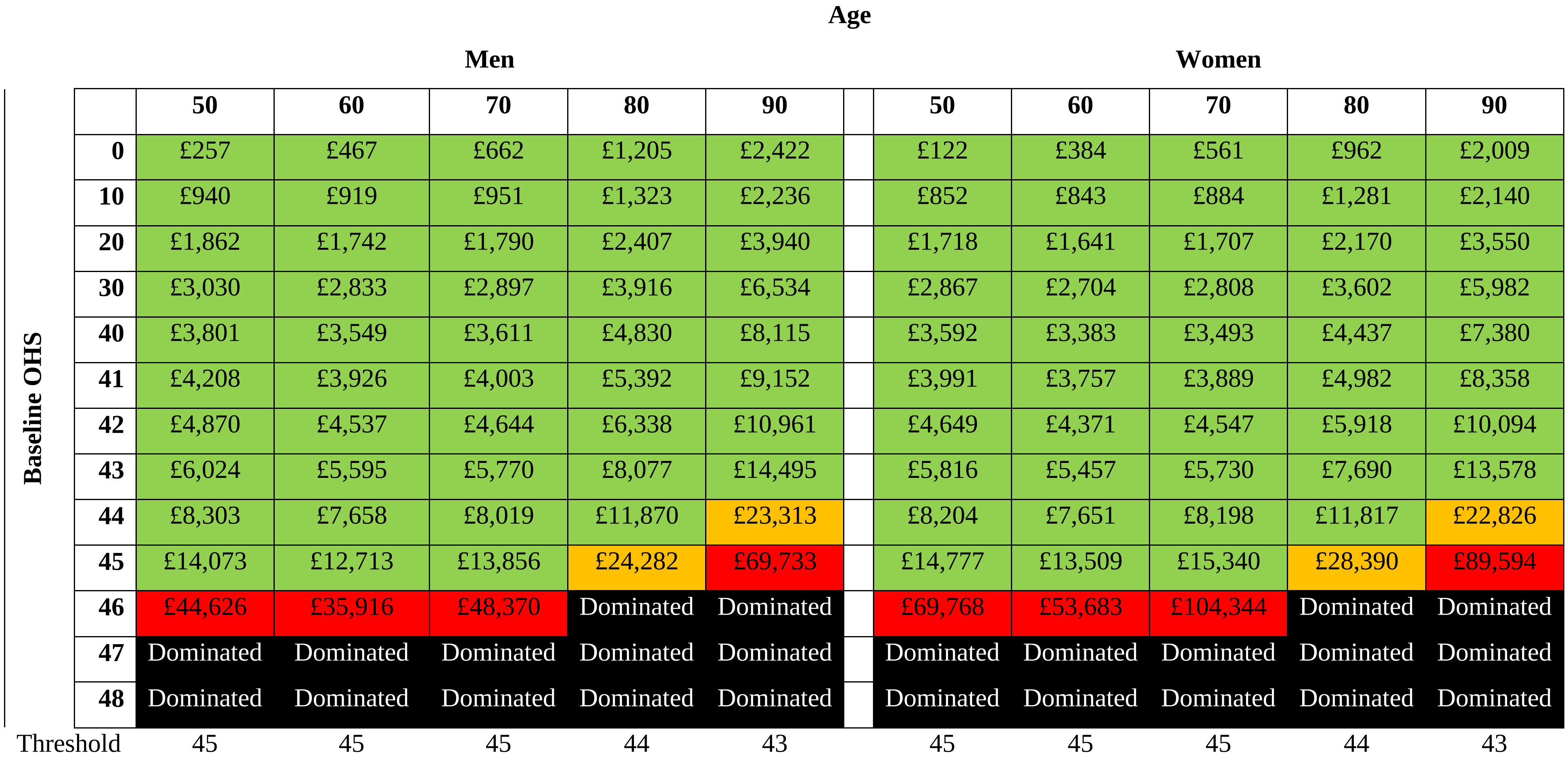
TABLE 186 Results of logistic regression predicting the odds of hip patients attending the hub being referred for surgical assessment

Variable	Mean coefficient (SE)
OHS	-0.0397 (0.0213)
Male	0.6965 (0.4804)
Constant	0.1428 (0.5376)

* p<0.05

		Age										
		Male	**Male**	**Male**	**Male**	**Male**		**Female**	**Female**	**Female**	**Female**	**Female**
		50	**60**	**70**	**80**	**90**		**50**	**60**	**70**	**80**	**90**
Baseline OKS	**0**	£2,660	£2,132	£2,342	£3,338	£6,175		£1,836	£1,660	£1,950	£2,823	£5,225
	10	£327	£473	£810	£1,515	£3,212		£86	£312	£653	£1,272	£2,732
	20	£332	£647	£1,306	£2,642	£5,983		Dominant	£425	£1,088	£2,296	£5,232
	30	£2,324	£2,281	£3,341	£5,621	£12,144		£1,884	£2,046	£3,130	£5,258	£11,063
	40	£5,133	£4,402	£5,742	£8,384	£16,607		£4,752	£4,242	£5,652	£8,163	£15,430
	41	£6,164	£5,161	£6,866	£10,152	£20,846		£5,748	£5,007	£6,828	£10,024	£19,548
	42	£8,023	£6,454	£8,965	£13,735	£30,864		£7,545	£6,316	£9,065	£13,918	£29,492
	43	£12,162	£9,003	£13,848	£23,553	£73,093		£11,573	£8,931	£14,504	£25,553	£75,110
	44	£27,664	£15,750	£34,434	£116,046	Dominated		£27,082	£16,082	£41,780	£336,233	Dominated
	45	Dominated	£65,880	Dominated	Dominated	Dominated		Dominated	£81,952	Dominated	Dominated	Dominated
	46	Dominated	Dominated	Dominated	Dominated	Dominated		Dominated	Dominated	Dominated	Dominated	Dominated
	48	Dominated	Dominated	Dominated	Dominated	Dominated		Dominated	Dominated	Dominated	Dominated	Dominated
	Threshold	43	44	43	42	40		43	44	43	42	41

FIGURE 163 Cost-effectiveness of referring patients with knee osteoarthritis symptoms to surgical assessment compared with no referral in patients of different age and baseline OKS for men and women separately.



		Age										
		Men						Women				
		50	**60**	**70**	**80**	**90**		**50**	**60**	**70**	**80**	**90**
Baseline OHS	**0**	£257	£467	£662	£1,205	£2,422		£122	£384	£561	£962	£2,009
	10	£940	£919	£951	£1,323	£2,236		£852	£843	£884	£1,281	£2,140
	20	£1,862	£1,742	£1,790	£2,407	£3,940		£1,718	£1,641	£1,707	£2,170	£3,550
	30	£3,030	£2,833	£2,897	£3,916	£6,534		£2,867	£2,704	£2,808	£3,602	£5,982
	40	£3,801	£3,549	£3,611	£4,830	£8,115		£3,592	£3,383	£3,493	£4,437	£7,380
	41	£4,208	£3,926	£4,003	£5,392	£9,152		£3,991	£3,757	£3,889	£4,982	£8,358
	42	£4,870	£4,537	£4,644	£6,338	£10,961		£4,649	£4,371	£4,547	£5,918	£10,094
	43	£6,024	£5,595	£5,770	£8,077	£14,495		£5,816	£5,457	£5,730	£7,690	£13,578
	44	£8,303	£7,658	£8,019	£11,870	£23,313		£8,204	£7,651	£8,198	£11,817	£22,826
	45	£14,073	£12,713	£13,856	£24,282	£69,733		£14,777	£13,509	£15,340	£28,390	£89,594
	46	£44,626	£35,916	£48,370	Dominated	Dominated		£69,768	£53,683	£104,344	Dominated	Dominated
	47	Dominated	Dominated	Dominated	Dominated	Dominated		Dominated	Dominated	Dominated	Dominated	Dominated
	48	Dominated	Dominated	Dominated	Dominated	Dominated		Dominated	Dominated	Dominated	Dominated	Dominated
Threshold		45	45	45	44	43		45	45	45	44	43

FIGURE 164 Cost-effectiveness of referring patients with hip osteoarthritis symptoms to surgical assessment compared with no referral in patients of different age and baseline OHS for men and women separately.

Online Supplement 18 - Patient and GP usability surveys

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November 2016

Dear Sir/Madam,

Arthroplasty Candidacy Help Engine (ACHE) – Patient Survey

We would like to invite you to take part in our ACHE survey that is being organised by Professor Andrew Price and Professor David Beard, based at the Nuffield Orthopaedic Centre in Oxford.

The Arthroplasty Candidacy Help Engine (ACHE) is an evidence based tool to assist GPs in deciding which patients are highly likely to benefit from hip or knee joint replacement surgery and which patients are expected to do better under other forms of care. The tool combines an established scoring system (the Oxford Hip Score and the Oxford Knee Score) and a set of evidence based thresholds for treatment.

The goal of the ACHE tool is to deliver better consistency of care and effective treatment across the NHS in this area. Applying the ACHE tool would allow selection of patients for surgery who have the capacity to improve whilst protecting patients without such capacity from unnecessary surgical intervention. The tool would be used by GPs to guide referral of patients from Primary to Secondary care, but could also be used in Secondary care to confirm continued candidacy for surgery.

You have been invited to take part in the survey as you indicated that you would like to take part in hip and knee research and have been a patient with hip or knee arthritis/problems.

We would like you to;

Watch this 3 ½ minute video - video

Use the ACHE tool - ACHE Tool
Complete a short survey - short survey
This should only take about 10 minutes of your time.

Your participation in the survey is completely voluntary and all of your participation and answers will be anonymous. You are under no obligation to take part in the survey.

If you would like any further information about the survey, please do not hesitate to contact me on **01865 223670** or on james.smith@ndorms.ox.ac.uk.

Thank you for your help and collaboration.

Yours sincerely,

James Smith
Postdoctoral Research Fellow

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