Cost-benefit analysis of obesity interventions

Data Input and Assumptions Appendix

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Contents

Population Data

Table 1. Population data

Parameter	Reference
Mortality	ONS, 2022 (1)
Population data	ONS, 2021 (2)
Births by mothers age	ONS, 2018 (3)
Population projections	NOMIS, 2023 (4)
Total fertility rate	1.63 (5)

Risk Factor Data

Table 2. Risk factor data

Risk Factor	Reference
BMI distribution	Health Survey for England Data 2013-2019 (6)

Epidemiological Data

Table 3. Epidemiological data

Disease	Incidence	Prevalence	Mortality	Relative Risk	Age Group	Survival
T2D	Holden et al, 2013 (7)	HSE, 2021 (8)		Yu et al, 2022 (9); Jayedi et al, 2022 (10); Abbasi et al, 2017 (11)	18-102 2-15	
Hypertension			Non-terminal	Jayedi et al, 2018 (12)	18-102	Non-terminal
CHD	BHF, 2020 (13)	HSE, 2017 (14)	NOMIS, 2021 (15)	Flint et al, 2009 (16)	Men: 39-75 Women: 39-65	
Stroke				Wang et al, 2022 (17)	15-94	
Colon Cancer	Cancer Research UK, 2018 (18)		Cancer Research UK, 2018 (19)	Fang et al, 2018 (20)	Adults ≥ 18	Cancer Research UK, 2021 (21)
Ovarian Cancer				Elwanger et al, 2022 (22)	14-96	
Liver Cancer				Larsson & Wolk, 2007 (23)		
Gallstone Disease	Li et al., 2023 (24)	Heaton et al 1991 (25)	Williams et al, 2007 (26)	Aune et al, 2015 (27)	15-79	
Knee Osteoarthritis	Swain et al, 2020 (28)		Non-terminal	Zheng et al, 2015 (29)	15-76	Non-terminal
Depression (Depressive Disorder) *	Rait et al*, 2009 (30)	Mccrone et al, 2008 (31)**	Non-terminal	Luppino et al, 2010 (32)	Mean ages from 14-72	Non-terminal

*Diagnosed depression taken from this study, also has incidence rates for symptoms of depression
**Depressive disorder taken from this study, also has incidence for Depressive in general practice, and depression categories.

Table 4. Type 2 Diabetes incidence per 100,000

Age Group	Male	Female
0-4	40	36
5-9	32	28
10-14	32	35
15-19	52	90
20-24	60	132
25-29	89	170
30-34	136	181
35-39	209	219
40-44	329	287
45-49	516	425
50-54	770	597
55-59	992	739
60-64	1233	915
65-69	1486	1142
70-74	1656	1338
75-79	1625	1380
80-84	1411	1252
85-89	1189	1060
90+	538	452

Table 5. Type 2 Diabetes prevalence per 100,000

Age Group	Male	Female
0-15	0	0
16-24	1,000	1,000
25-34	1,000	0
35-44	3,000	2,000
45-54	4,000	5,000
55-64	11,000	7,000
65-74	17,000	13,000
75+	19,000	13,000

Table 6. Hypertension prevalence per 100,000

Age Group	Male	Female
0-15	0	0
16-44	1,000	2,000
45-64	8,000	8,000
65+	22,000	17,000

Table 7. CHD incidence per 100,000

Age Group	Male	Female
0-15	0	0
16-34	0	0
35-44	0	0
45-54	277.2	104
55-64	606.9	236
65-74	761	332.7
75+	965.4	561.3

Table 8. CHD prevalence per 100,000

Age Group	Male	Female
0-15	0	0
16-34	389.899628170389	183.146943029683
35-44	651.193891966781	121.250358309237
45-54	3764.51938141596	1559.30638247164
55-64	7033.12484140579	2562.57279209045
65-74	17016.7040285534	6179.80162017192
75+	19218.0307077741	12786.3834311254

Table 9. CHD mortality per 100,000

Age Group	Male	Female
0-4	0	0
5-9	0	0
10-14	0	0
15-19	0	0
20-24	0	0
25-29	0	0.2
30-34	0	0.51
35-39	0	1.65
40-44	0	5.3
45-49	40.46	9.03
50-54	69.55	15.76
55-59	111.56	27.74
60-64	173.91	51.25
65-69	248.89	79.99
70-74	355.57	122.47
75-79	534	213.56
80-84	857.22	381.94
85-89	1360.66	697.44
90+	2340.17	1348.68

Table 10. Stroke incidence per 100,000

Age Group	Male	Female

0-44	0	0
45-54	138.8	119.5
55-64	280.5	235.4
65-74	560.5	466.1
75+	1318.1	1275.8

Table 11. Stroke prevalence per 100,000

Age Group	Male	Female
0-15	0	0
16-34	292.9323593	201.36267
35-44	252.2218805	267.2093832
45-54	2480.577211	1884.708483
55-64	3622.448744	1959.211335
65-74	6040.317164	4140.800622
75+	10,389.73314	7508.012649

Table 12. Stroke mortality per 100,000

Age Group	Male	Female
0-44	0	0
45-49	10.21	6.41
50-54	15.15	9.41
55-59	20.2	14.38
60-64	32.54	24.18
65-69	55.19	36.81
70-74	96.43	71.85
75-79	181.94	149.43
80-84	359.14	317.39
85-89	668.72	659.5
90+	1283.43	1393.89

Table 13. Colon Cancer incidence per 100,000

Age Group	Male	Female
0-4	0	0
5-9	0	0.1
10-14	0.3	0.5
15-19	0.5	1
20-24	0.9	1.5
25-29	2.7	2.5
30-34	6.3	6.8
35-39	11.6	11.3
40-44	14.5	13.5
45-49	24.4	21.6
50-54	47.1	37.1
55-59	87.7	60.6
60-64	151.4	91
65-69	198.3	119.1
70-74	273.5	171.2
75-79	351.7	234.8
80-84	464.7	309.6
85-89	503	352
90+	443.5	293

Table 14. Colon Cancer mortality per 100,000

Age Group	Male	Female
0-4	0	0
5-9	0	0
10-14	0	0
15-19	0.1	0.1
20-24	0.2	0.1
25-29	0.5	0.4
30-34	1.5	1.4
35-39	3.3	3.5
40-44	4.1	3.3
45-49	7.1	5.5
50-54	12.9	10.1
55-59	23.1	15.7
60-64	41	23.4
65-69	60.2	35.9
70-74	85.5	52.3
75-79	134	86.1
80-84	220	138.7
85-89	304.6	215.2
90+	414.5	266.4

Table 15. Ovarian Cancer incidence per 100,000

Age Group	Female

0-4	0.2
5-9	0.2
10-14	0.9
15-19	2.1
20-24	3.5
25-29	5.8
30-34	6.9
35-39	9.1
40-44	13.2
45-49	19.4
50-54	27.1
55-59	34.8
60-64	41.6
65-69	52.3
70-74	60.8
75-79	73.8
80-84	66.9
85-89	64.4
90+	53.4

Table 16. Ovarian Cancer mortality per 100,000

Age Group	Female
0-4	0
5-9	0
10-14	0
15-19	0
20-24	0.1
25-29	0.3
30-34	0.6
35-39	0.8
40-44	2.4
45-49	4.8
50-54	8.6
55-59	14.2
60-64	19.8
65-69	29.5
70-74	39.8
75-79	54.7
80-84	63
85-89	63.5
90+	54.1

Table 17. Liver Cancer incidence per 100,000

Age Group	Male	Female
0-4	0.7	0.5
5-9	0.1	0.1
10-14	0.1	0.1

15-19	0.1	0.1
20-24	0.1	0.2
25-29	0.2	0.2
30-34	0.5	0.3
35-39	1.1	0.5
40-44	1.7	0.9
45-49	3.6	1.6
50-54	8.1	3.2
55-59	16.1	5.6
60-64	26.6	9.9
65-69	37.6	14.6
70-74	48.8	18.8
75-79	63.1	26.8
80-84	74.2	35.1
85-89	79.4	41.3
90+	69	39.6

Table 18. Liver Cancer mortality per 100,000

Age Group	Male	Female
0-4	0.1	0
5-9	0.1	0
10-14	0	0
15-19	0.1	0
20-24	0.1	0
25-29	0.1	0.1
30-34	0.3	0.2
35-39	0.5	0.5
40-44	1.1	0.7
45-49	2.4	1.5
50-54	5.3	2.3
55-59	10.4	5.1
60-64	19.3	9.1
65-69	29.1	14.5
70-74	41.2	20.2
75-79	56.7	30.4
80-84	75.4	41.2
85-89	88.1	49.3
90+	81	51.2

Table 19. Gallbladder disease incidence per 100,000

Age Group	Male	Female
0-20	0	0
21-39	0	1593.45
40-46	662.6887147	930.7612853
50-59	552.1902053	1041.259795
60+	542.4963284	1050.953672

Table 20. Gallbladder disease prevalence per 100,000

Age Group	Male	Female
0-20	0	0
21-39	0	6508.08
40-49	2706.599624	3801.480376
50-59	2255.293879	4252.786121
60+	2215.701469	4292.378531

Table 21. Gallbladder disease mortality per 100,000

Age Group	Male	Female
0-20	0	0
21-39	0	1.5
40+	1.5	1.5

Table 22. Knee Osteoarthritis incidence per 100,000

Age Group	Male	Female
0-4	0	0
5-9	0	0
10-14	0	0
15-19	0	0
20-24	17.0735461904847	13.0036888645712
25-29	21.374757773874	20.240217448859
30-34	29.3795389101184	19.9666413682337
35-39	30.0315120343374	30.9714598372665
40-44	41.7217523588754	53.2723229256757
45-49	94.2236992230658	146.994193127063
50-54	172.596301863557	274.542421942567
55-59	269.486752268324	334.437933529838
60-64	403.449118930764	495.812520959458
65-69	489.265081406089	657.204758458796
70-74	612.098629045403	822.35646080802
75-79	620.103410181647	713.049579045838
80-84	676.272705869569	780.464020332881
85-89	528.745676150461	633.562490071836
90+	421.957911512759	306.233122120833

Table 23. Depression incidence per 100,000

Age Group	Male	Female
0-15	0	0
16-24	13.4	13.4
25-44	20.4	20.4
45-64	18	18
65-74	12.2	12.2
75+	14	14

Table 24. Depression prevalence per 100,000

Age Group	Male	Female
0-15	0	0
16-19	880.818868	2688.80519
20-24	785.47788	3518.24894
25-29	2697.55266	2093.48705
30-34	1165.27512	3015.07308
35-39	3608.62867	3908.03397
40-44	2986.02362	2581.68121
45-49	4407.03193	2775.03965999999
50-54	3212.87054	3309.15809
55-59	2199.92558	4610.83511999999
60-64	3499.44839	1395.38602999999
65-69	180.465705	994.50345
70+	481.829398	1695.99901

Survival data

Table 25. Colon cancer survival data

Age group	Male			Female		
	1-year	5-year	10-year	1-year	5-year	10-year
15-44	0.176	0.064350219	0.002845898	0.15	0.04939084	0.002729383
45-54	0.172	0.08177401	0.020069595	0.159	0.057140453	0.021353595
55-64	0.159	0.059454167	0.019636011	0.161	0.051355598	0.01872334
65-74	0.201	0.064218122	0.010975322	0.206	0.047546618	0.016648542
75-110	0.338	0.089925166	0.041195 15	0.393	0.060301181	0.019151143

Table 26. Liver cancer survival data

Age group	Male			Female		
	1-year	5-year	10-year	1-year	5-year	10-year
15-44	0.47	0.110982847		0.394	0.168471916	
45-54	0.52	0.192777181		0.499	0.130417139	
55-64	0.516	0.224720294		0.565	0.172082055	
65-74	0.562	0.264584597		0.622	0.224541968	
75-110	0.684	0.384058627		0.776	0.31229969	

Table 27. Ovarian cancer survival data

Age group	Male			Female		
	1-year	5-year	10-year	1-year	5-year	10-year
15-44	1	1	1	0.041	0.016286802	0.016991344
45-54	1	1	1	0.087	0.049170584	0.041226441
55-64	1	1	1	0.138	0.083074967	0.044277525
65-74	1	1	1	0.235	0.10612565	0.070701074
75-110	1	1	1	0.497	0.129687228	0.040303201

Cost Data

Direct Costs

Table 28. Direct costs

Disease	Original cost from reference	Year	Cost for 2019 per prevalent case	Cost definition	Reference
Type 2 Diabetes	£859.68	2015	£928.12	Includes cost of primary care, secondary care and prescription costs for Type 1 and Type 2 Diabetes	PHE, 2020 (33)
Hypertension	£75 + £57.20	2016 + 2009	£79.46 + £67.78	Includes the costs of hypertension treatment (drug costs and annual clinical review) and monitoring	Constanti et al, 2021 (34) & Lovibond et al, 2011 (35)
CHD	€1,401	2015	£1,512.53	Includes costs of primary care, outpatient care, A&E, inpatient care and medications	Wilkins et al, 2017 (36)
Stroke	€4,405		£4,755.68		
Colon Cancer	€1,404	2015	£1,515.77	Includes primary, outpatient, emergency, and hospital care costs, and systemic anti-cancer therapy costs	Henderson et al, 2021 (37)
Liver Cancer	£1,532	2013	£1,688.86	NHS reported budget data for liver cancer, plus specialised	Briggs et al, 2018 (38)

				services and primary care	
Gallstone disease	$5.76B (total population)	2004	£438.68	Includes hospital services, physician services, prescription drugs, over-the-counter drugs, nursing home care, home health care, hospice care, and outpatient endoscopy	Everhart et al, 2009 (39)
Ovarian Cancer	£1,408.94	2016	£1,492.73	NHS reported budget data, includes hospital (inpatient and outpatient), primary care, and medication	Avenell et al, 2018 (40)
Knee Osteoarthritis	£223.97	2016	£237.29	Cost of NSAIDS, iatrogenic events, PPI, arthroscopic lavage and debridement & hip and knee replacement	Avenell et al (40) (REBALANCE); taken from Chen et al 2012 (41)
Depression	£1.7B	2007	£188.65	Health services	Department of Health 2007 (42)

Indirect Costs

Table 29. Indirect Costs

Disease	Original Value	Year	Cost for 2019 per prevalent case	Cost definition	Reference
Type 2 Diabetes	£3,788.25	2010/11	£4,338.45	Estimated from data on mortality, sickness, presenteeism (potential loss of productivity among people who remain in work) and informal care	Hex et al, 2012 (43)
Hypertension	$282.34	2008-2017	£200.39	Ecnomic losses caused by decreased productivity (presenteeism), their absence from work caused by sickness (absenteeism) and premature deaths	Wierzeiska et al, 2020 (44) (Meta-analysis)
CHD	€4,456	2015	£4,810.74	Includes production losses due to mortality and morbidity, and informal care	Wilkins et al, 2017 (36)
Stroke	€5,510		£5,948.65		
Colon Cancer	€6,423	2015	£6,934.34	Cost of loss of productivity due to disabiliy and premature death, and opportunity costs for informal carers	Henderson et al, 2021 (37)
Liver Cancer	£238,022,467	2020	£138.21	Indirect costs caused by premature mortality constitute the future lost earnings of patients who have died due to their disease, creating productivity loss. Indirect costs caused by morbidity constitute the patient's inability to work due to sickness or incapacity, creating productivity loss for a period of time.	Digestive Cancers Europe (45)
Gallstone disease	£406.2M (total population)	2004	£30.92	Indirect costs comprise the implicit value of forgone earnings or production owing to (1)	Everhart et al, 2009 (39)

				consumption of hospital or ambulatory care, (2) premature death, and (3) additional work loss associated with acute and chronic digestive diseases. Also included is the value of leisure time lost owing to morbidity and mortality.	
Ovarian Cancer	€14,640	2011-2018	£1,163.77	Loss of productivity was estimated as a function of individual annual days of sick leave multiplied with each woman's individual daily income for women of working age (up to 67 years old)	Palmqvist et al, 2022 (46) (Sweden proxy)
Knee Osteoarthritis	£3.458B	2002	£550.45	Loss of economic production, money spent of community services and money spent on social services for osteoarthiritis	Chen et al, 2012 (41)
Depression	£20.3B	2007	£2,252.70	Lost earnings, lower productivity, and human costs	Departmen t of Health 2007 (42)

Social Care Costs

In order to estimate social care costs given that there is limited data available from publications, we applied the findings of Copley et al. (47), who reported that with increasing BMI there was a increased need for social care such, such that for each 1-unit increase in BMI, there was a 5% increased odds of needing social care. Thus, we calculate the probability that an individual will require social care based on their BMI, and in each BMI category apply an estimated cost for social care.

Table 30. Social care costs

BMI category	Original Value	Year	Reference
Obese (30-40)	£98.31	2022	Frontier economics, 2022 (48)
Morbidly obese (40-65)	£98.31	2022	Frontier economics, 2022 (48)

Based on assumption that Frontier methods "yearly difference in hours" are an increase in the average per person. Unclear if informal care is costed in the same way. So costs were conservative: 11.43*28.67/100*30 =£98.31 (no informal care included).

Utility weights

Table 31. Utility weights

Disease	Original Value	Reference
Type 2 Diabetes	0.719	Sullivan et al., 2016
Hypertension	0.721	Sullivan et al., 2011 (49)
CHD	0.759	Stevanovic et al., 2016 (50)
Stroke	0.713	Rivero-Arias et al., 2010 (51)
Colon Cancer	0.676	Sullivan et al., 2011 (49)
Gallstone disease	0.870	Deborah et al., 2022 (52)
Ovarian Cancer	0.848	Sullivan et al., 2011 (49)
Liver Cancer	0.746	Muszbek et al., 20020 (53)
Osteoarthiritis	0.640	Zhao et al., 2022 (54)
Depression	0.660	Balazs et al., 2023 (55)

Intervention Data

Remission Data

Table 32. Remission data

Policy Name	Diseases affected	Remission rate	Reference
Everyone with a BMI of 30 or above is offered a free referral to a behavioural weight management programme via primary care	Type 2 diabetes	33.33% (in the first year after intervention)	Lean et al., 2018 (56)
Extend access to pharmacological interventions by providing an extra £500 million per year of ring-fenced funding to provide increased access to NICE recommended weight loss treatments (Orlistat, Liraglutide, Semaglutide)	Type 2 diabetes	41.2% (in the first year after intervention)	van Houtum et al., 2024 (57)
Expand NHS provision of bariatric surgery to individuals with BMI ≥ 35 with a pre-existing condition (specifically double the amount of people receiving surgery from approximately 6,500 per year to 13,000 per year)	Type 2 diabetes Hypertension	58.8%, 57.7%, 56.7%, 55.8% and 54,7% (in subsequent years from 2020-2024) 54% (in each year after intervention)	Canakis et al., 2023 (58); Moricini et al., 2023 (59); Toolabi et al., 2020 (60)

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