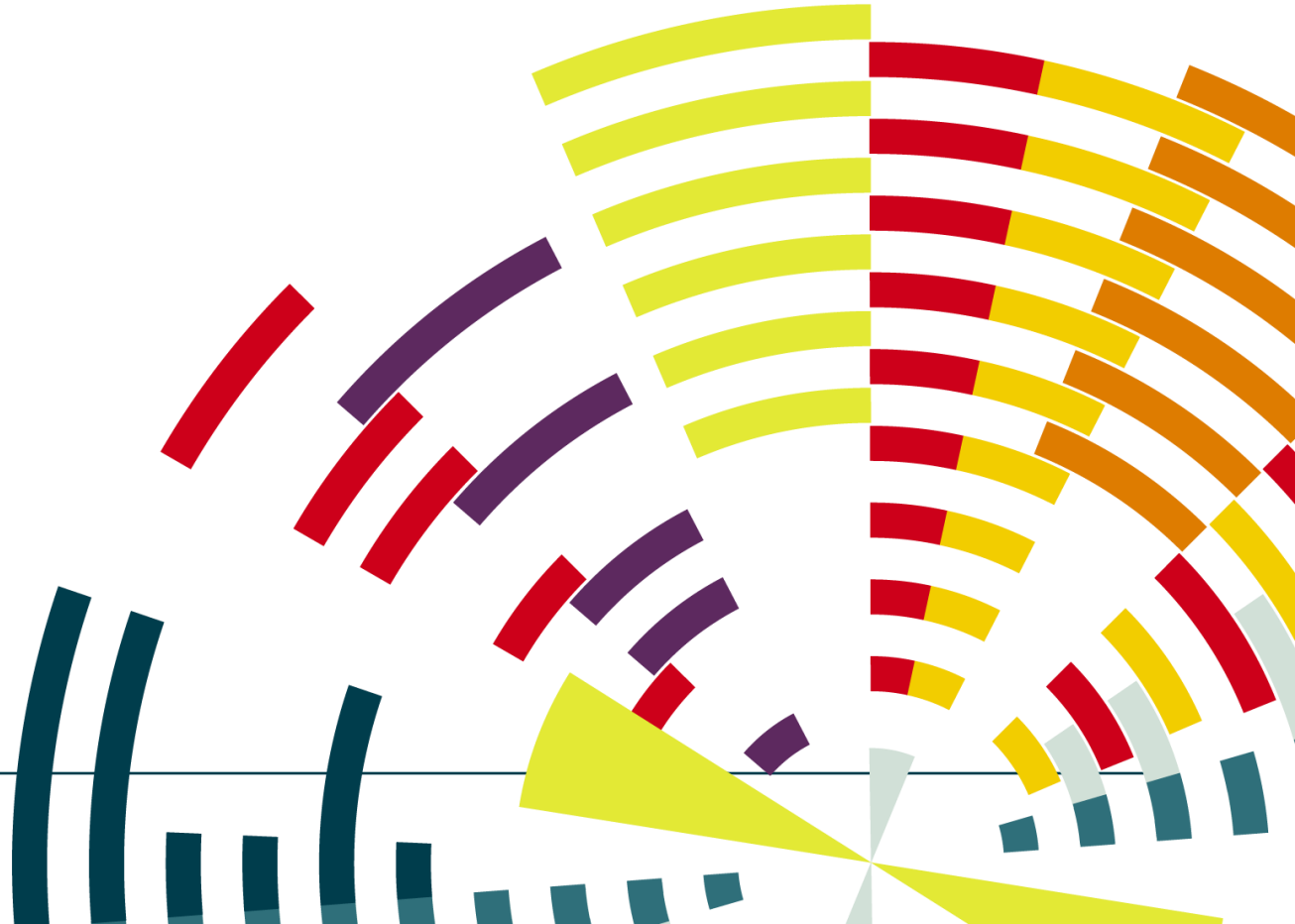
ESTIMATING THE FULL COSTS OF OBESITY

A report for Novo Nordisk

26 JANUARY 2022



CONTENTS

01

EXECUTIVE SUMMARY

EXECUTIVE SUMMARY (I)

AIMS OF THE ANALYSIS

This study, led by Frontier Economics, has been commissioned by Novo Nordisk to provide an independent and objective estimation of the **full annual cost of obesity in the UK.**

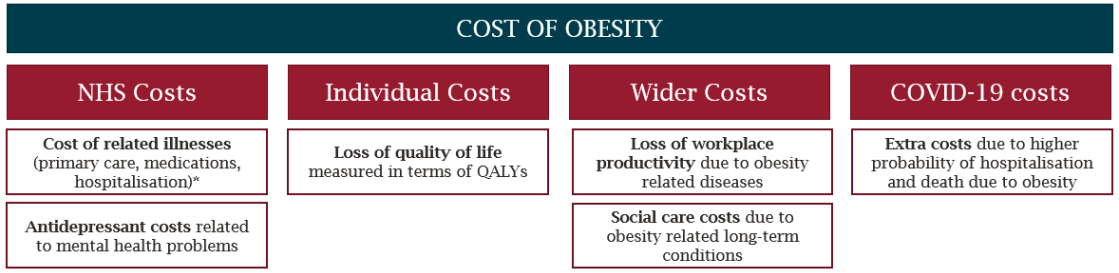
Prevalence of obesity has increased in the UK, especially over recent years. As of today, national statistics suggest there are around **15 million people** with obesity (BMI 30+). The implications for the health outcomes of people with obesity are well-documented. Evidence suggests that people with obesity face an increased risk of several diseases, including recent evidence of more adverse outcomes of **COVID-19**. The high obesity prevalence in the UK imposes costs that are material and rising on individuals, the NHS and the wider economy.

The widely referenced annual cost of obesity in the UK is an estimated £27 billion, based on a report published by the Government Office for Science in 2007. Other studies have attempted to estimate the cost of obesity, which is a complex matter and can be addressed with different methodologies. Most of them are now outdated and risk omitting important elements.

The pace of change in obesity prevalence means that an updated estimate would be timely.

Drawing on a rapid evidence assessment, this study uses the framework below to estimate the costs associated with obesity.

The framework includes **both the direct and indirect costs** of obesity that are widely cited in the literature. Moreover it has taken into account obesity-related costs that have not typically been included in previous studies. These include the potential costs of Covid-related risks for people with obesity, the cost of obesity-related mental health problems and obesity-related social care costs. The framework applied in this study is below.

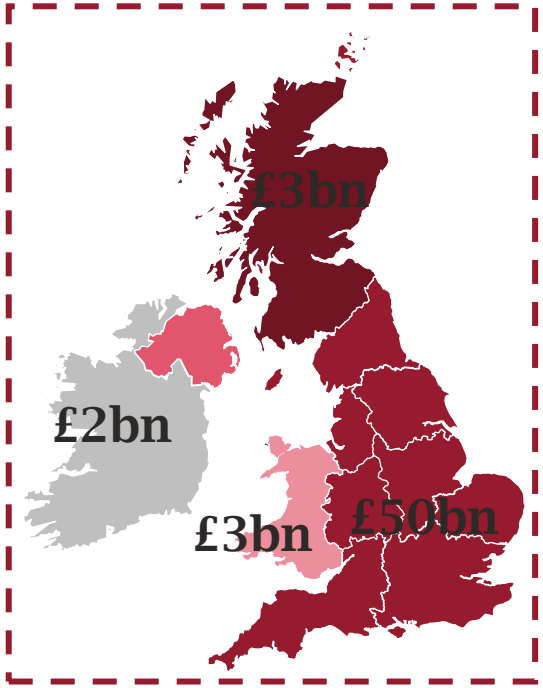


EXECUTIVE SUMMARY (II)

RESULTS

The analysis in this study suggests the current **annual full cost** of obesity in the UK is an **estimated £58 billion*.**

For context, this is of an equivalent magnitude to around 3% of the 2020 UK GDP. The estimated annual **NHS spend** on obesity-related diseases is **£6.5 billion**. This is equivalent to around 40% of the total budget allocated to police forces in England and Wales for 2021/22. The estimated annual cost of **obesity-related risks of COVID-19 is £4 billion**, almost 50% more than the amount the UK spent for securing 267 million doses of vaccines over 2020 and 2021**.



A reduction in obesity prevalence could therefore lead to significant NHS and wider cost savings. The analysis implies that a **10% reduction in prevalence could help save the equivalent of around £6 billion** every year.

Comparing local areas with similar population sizes but different levels of obesity prevalence suggests that **four percentage points of difference in prevalence could lead to £35 million of extra annual obesity-related costs.** Given the data suggests that obesity prevalence is higher in more deprived areas, this could contribute to the widening of already present inequalities across localities.

Action to address the prevalence of obesity would both reduce costs and improve people's lives. However, there is **no single solution to solve this issue**. There is a plethora of interventions that could help reduce current and future prevalence, ranging from those aimed at prevention, to the direct treatment of people with obesity.

The rapid evidence review of seven interventions carried out as part of this study suggests that interventions can vary in effectiveness. **Prevention interventions** can reach many people and they are very useful to build momentum and awareness around the issue, however there is currently limited **evidence on their effectiveness** in directly reducing obesity prevalence**.** Several treatment interventions are found to be effective and the evidence is growing

The nature of this analysis means there are inevitable uncertainties leading to **several limitations** that should be taken into account when interpreting the estimates. The analysis is sensitive to the assumptions made on the basis of the available evidence and the impacts of alternative assumptions have been explored.

* Unemployment benefit payments to individuals with obesity in the UK are estimated to account for an annual £3.6bn but they are not included in the £58 billion as they represent a social transfer. The loss in tax revenues due to obesity-related unemployment have not been possible to include in the estimate of annual full costs of obesity due to data limitations.
**These estimates relate to the current costs of COVID-19 and could be different in future years.

02

INTRODUCTION AND CONTEXT

THIS REPORT PROVIDES AN INDEPENDENT ASSESSMENT OF THE FULL COST OF ADULT OBESITY IN THE UK

AIMS OF THE ANALYSIS

Frontier Economics has been commissioned by Novo Nordisk to provide an independent and objective estimation of the full annual cost of obesity to society in the UK.

The study draws on best practice methods and peer reviewed evidence.

The analysis focuses on the research question described in the box below.

What is the full annual cost of adult obesity in the UK?

The analysis includes the costs to individuals, to the NHS and the social care system and to the wider economy.

BUILDING BLOCKS OF THE ANALYSIS

This report includes several core elements, as below:

1. The economic framework
2. The current scale of the national costs of obesity, including Covid-related additional costs.
3. Illustrative scenario analysis demonstrating the potential benefits of reducing obesity prevalence.
4. Local policy insights.
5. A typology of the types of policy and regulatory options currently available for prevention and intervention.

The uncertainties, limitations and evidence gaps of the analysis are also transparently described in the limitations section.

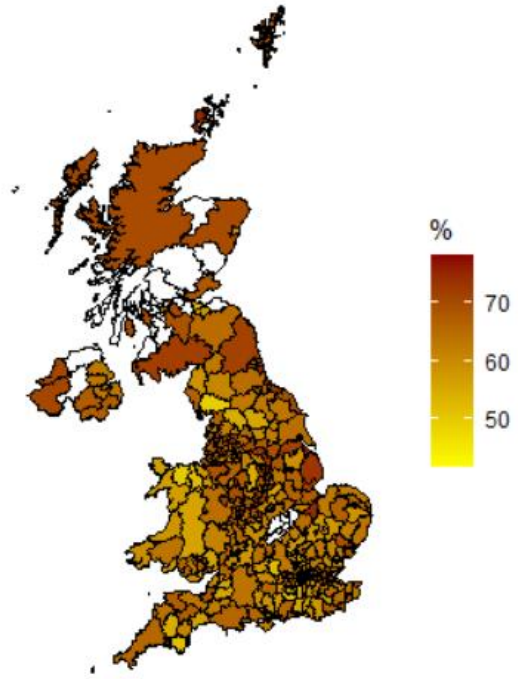
AROUND 15 MILLION PEOPLE IN THE UK ARE CURRENTLY WITH OBESITY

OBESITY IN THE UK

Obesity is defined as when a person has a Body Mass Index (BMI) of 30 or above. The total estimated number of adults with obesity in the UK is currently 14.7 million[1].

The implications for health of people with obesity are well-documented. Obesity increases the risks of several diseases including type 2 diabetes and hypertension, among others. In addition, people with obesity often experience respiratory conditions such as asthma, along with sleep apnoea, mental health issues and more adverse outcomes of Covid-19[2].

The high prevalence of obesity imposes costs that are material and rising on individuals, the NHS and the wider economy.



Source: Frontier analysis of prevalence data of England, Scotland, Wales and Northern Ireland (2019-2020)

12.9M Estimated individuals with BMI 30+ in **England**

0.6M Estimated individuals with BMI 30+ in **Wales**

0.8M Estimated individuals with BMI 30+ in **Scotland**

0.4M Estimated individuals with BMI 30+ in **Northern Ireland**

1. Frontier estimates using prevalence data from Health Survey for England (2019), National Survey for Wales (2019-20), Scottish Health Survey (2020), Northern Ireland Health Survey (2019-20) and ONS population estimates (2021) (Link)
2. Excess Weight and Covid-19, Public Health England 2020, (Link)

PUBLISHED ESTIMATES OF THE COSTS TO THE UK OF OBESITY OFTEN DATE BACK SEVERAL YEARS AND MISS IMPORTANT ELEMENTS

THE MOST RECENT COST ESTIMATIONS

The cost of obesity in the UK that is widely referenced suggests an annual cost of around £27 billion (estimate for 2015)[3]. Of this, around £6.1 billion is estimated to be spent on treating obesity-related illnesses (estimate for 2014/15). These figures derive from 'Tackling Obesities: Future Choices'[4], a report published by the Government Office for Science in 2007. This study calculates the future costs of elevated BMI from 2007 to 2050 on the basis of BMI projections and the NHS costs attributable to elevated BMI.

An earlier study from 2001 by the National Audit Office[5] estimated that direct and indirect costs of obesity in England in 1998 amounted to £2.6 billion. In 2014, McKinsey Global Institute published 'Overcoming obesity: an initial economic analysis' [6], which estimated the annual economic impact of obesity in the UK to be $73 billion (£49 billion) in 2012.

Estimating the cost of obesity is complex and different studies have used different methodologies. Most of them have been undertaken more than a decade ago: the pace of change in obesity prevalence means that an updated estimate would be timely.

ACCOUNTING FOR THE FULL COSTS OF OBESITY

In order to develop a comprehensive framework for this analysis, the methodologies of a number of studies have been reviewed (full list of studies in the reference section). All of them recognise that obesity can lead to direct costs (such as costs on individuals and the health system due to obesity-related diseases) and indirect costs that are related to the negative spillovers that a high prevalence of obesity can have on society (such as reduced productivity).

This analysis has included both direct and indirect costs. Moreover it has taken into account additional obesity-related cost drivers that have not typically been included in previous studies. These include the additional cost of obesity-related risks posed by Covid-19, the cost of obesity-related mental health problems and the costs of obesity-related social care.

Including these elements is complicated due to evidence gaps and interdependency problems (e.g. people with obesity are more likely to experience mental health problems, and conversely, people with mental health problems can in some cases be more susceptible to weight gain). Therefore the best available evidence has been reviewed to underpin the analysis, acknowledging its limitations.

3. Public Health England – Health matters: obesity and the food environment (Link)
4 Tackling obesities: future choices – project report, Government Office for Science 2007 (Link)
5. Tackling obesity in England, National Audit Office 2001 (Link)
6. Overcoming obesity: an initial economic analysis, McKinsey Global Institute 2014 (Link)

PEOPLE WITH OBESITY HAVE AN INCREASED RISK OF SEVERE ILLNESS FROM COVID-19 WHICH PRESENTS AN EXTRA COST FOR SOCIETY

COVID-19 IN THE UK

The COVID-19 pandemic has had severe impacts on health and care systems, economies and daily lives of people around the world. Like many other countries, the United Kingdom has suffered from the consequences of the virus with 10 million people infected, 600,000 hospitalised and 150,000 COVID-related deaths to date since the start of the pandemic [7].

The economic consequences have also been significant. The virus reduced UK's GDP by 9.8% in 2020, a decrease equivalent to the fall in GDP experienced by the UK during the depression of 1920-21. The Government has invested billion of pounds to make sure both the economy and the health system could survive. The estimated cost of government spending as a result of COVID-19 published by the National Audit Office is £370 billion. This includes spending to support businesses, health and social care, other public services and emergency responses, individuals and other operational expenditure. So far, the Bank of England has loaned or guaranteed the Government a total of £129 billion to assist the response to the crisis [8].

THE EFFECT OF OBESITY ON COVID RISKS

Several studies suggest that obesity increases the severity of COVID-19 symptoms. This is because the excess ectopic fat accumulation is associated with higher inflammation, immunologic deficit leading to higher rates of intravascular coagulation[10]

Gao et al. (2021)[11] found a positive relation between a BMI above 23 kg/m^2 and a higher risk of an individual having severe COVID-19 outcomes. Yates et al. (2021)[10] confirmed this result, showing that individuals with obesity are 1.49 times more likely to develop severe symptoms compared to individuals with healthy weight. The 2021 National Food Strategy Report also looks at the increased risks of COVID-19 due to obesity [9]. It reports that individuals with obesity are 1.5 times more likely to die from COVID-19. This number rises to 2.25 times for individuals with morbid obesity (BMI 40+).

The increased severity of COVID-19 for individuals with obesity imposes an extra cost on society. The analysis captures this by calculating the cost of additional hospitalisations and the loss of quality-adjusted life years (QALYs) due to the early death of individuals with obesity.

7. ONS Coronavirus latest insight. Accessed November 2021.
8. Coronavirus economic impact (House of Commons Library) and National Audit Office Covid-19 cost tracker. Accessed November 2021
9. National Food Strategy Report, Independent review for the Government 2021 (Link)
10. Yates et al. 2021
11. Gao et al. 2021

03

OUR APPROACH

THIS STUDY HAS BEEN UNDERTAKEN USING PUBLISHED EVIDENCE AND IN LINE WITH UK GOVERNMENT APPRAISAL GUIDANCE

DEVELOP FRAMEWORK

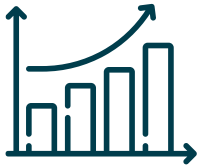
Articulating the channels through which obesity leads to higher costs with respect to a healthy weight.

ASSEMBLE EVIDENCE AND DEVELOP MODEL

Review published evidence on the costs of obesity and associated modelling data and assumptions

LOCAL POLICY INSIGHTS

Exploring the costs of obesity in two illustrative geographical areas



SCENARIO ANALYSIS

Reviewing the evidence on the most common interventions and their effectiveness

CONCLUSIONS

Draw conclusions on the basis of the evidence gathered and the economic analysis

THE ECONOMIC FRAMEWORK MAPS HOW OBESITY CAN LEAD TO COSTS TO THE NHS, INDIVIDUALS AND THE ECONOMY

THE ECONOMIC FRAMEWORK

Informed by the rapid evidence review, the economic framework used for this analysis is shown below.

COST OF OBESITY

NHS Costs	Individual Costs	Wider Costs	COVID-19 costs
Cost of related illnesses (primary care, medications, hospitalisation)*	**Loss of quality of life** measured in terms of QALYs	**Loss of workplace productivity** due to obesity related diseases	**Extra costs** due to higher probability of hospitalisation and death due to obesity
Antidepressant costs related to mental health problems		**Social care costs** due to obesity related long-term conditions	

In addition, evidence shows that individuals with obesity are more likely to be unemployed than healthy weight individuals and therefore to claim government **unemployment benefits.** Although the scale of these payments has been estimated, they are not included within the total annual estimate of the full cost of obesity as they represent a transfer payment.

*Obesity-related diseases included: Type 2 diabetes, Hypertension, Myocardial Infarction, Colon Cancer, Angina, Gall Bladder Diseases, Ovarian Cancer, Musculoskeletal disorders (i.e. Osteoarthritis), Stroke, Sleep Apnoea. This is the basket of diseases considered by NAO in the 2001 paper *Tackling Obesity in England* (Link). Sleep apnoea was added to the basket because evidence shows its relevance as obesity-related disease (Link).

NHS COSTS

COST OF RELATED ILLNESSES

Obesity increases the risk of several diseases such as Type 2 diabetes, Hypertension, Myocardial Infarction, Colon Cancer, Angina, Gall Bladder Diseases, Ovarian Cancer, Musculoskeletal disorders (i.e. Osteoarthritis), Stroke and Sleep Apnoea[12]. The costs of these diseases attributable to obesity has been estimated in the following way:

STEP 1	Estimating the Population Attributable Factors (PAFs) for each disease on the basis of the baseline incidence and increased risk due to obesity[13].
STEP 2	Drawing from the literature, deriving the yearly UK cost for treating each disease per person and adjusting it for double counting of co-morbidities.
STEP 3	Multiplying the results of Step 1 and 2 to arrive at the cost of related illnesses attributable to obesity in the UK.
STEP 4	Estimating the cost per person per year and applying it to the obesity prevalence numbers across devolved nations.

ANTIDEPRESSANT COSTS

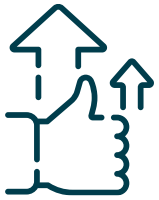
Estimating the extra cost due to mental health problems related to obesity is difficult due to evidence gaps and interdependency problems. Therefore, antidepressant costs attributable to obesity are used as a proxy, though of course this is very partial. This has been calculated in the following way:

STEP 1	Estimating the proportion of antidepressant costs attributable to obesity in England.
STEP 2	Using the unit cost of antidepressant for people with obesity in England.
STEP 3	Applying the results from Step 1 and 2 to the population of people with obesity for all the devolved nations to estimate the total cost of antidepressants per year for the UK.

12. Haase, et al. (2021)
13. PAF: the proportion of all cases with a particular outcome in a population that could be prevented by eliminating a specific exposure

INDIVIDUAL COSTS

LOSS OF QUALITY ADJUSTED LIFE YEARS (QALYS)



QALYs are a well-established method used to measure the state of health of an individual and changes in a person's quality of life[14]. This analysis uses QALYs to estimate the reduction in longevity and in quality of life for individuals with obesity. The estimated monetary costs from the loss of QALYs is calculated in the following way:

STEP 1	Estimating the population with obesity and morbid obesity by age brackets for England and the devolved nations.
STEP 2	Drawing from the literature, estimating the difference in QALYs between healthy weight individuals and people with obesity and morbid obesity for each age bracket.
STEP 3	Multiplying the results of step 1 and 2 to arrive at the total QALYs lost for each of the devolved nations and the entirety of the UK.
STEP 4	Multiplying the results of step 3 by the monetary value of one QALY (that is equivalent to £66,780)[15].

Note, this assumption has a significant impact on cost estimates. For the purposes of assessing the cost-effectiveness of obesity-reducing interventions, the NHS would use a lower figure (£20,000-£30,000). A sensitivity analysis that explores the results using the lower figure is presented in the Appendix.

14. NICE Glossary: Definitions of terms used (Page "Q")
15. HM Treasury Green Book (Link). The original figure is £60,000 uplifted to 2021 prices using the CPI index.
(For sensitivity analysis: value of one QALY: Carrying NICE over the Threshold (Link))

WIDER COSTS

LOSS OF WORKPLACE PRODUCTIVITY

Studies examining the relationship between obesity and sickness absence suggest that individuals with obesity tend to take more sick leave days due to short and long term obesity-related sicknesses. The analysis estimates the monetary impact of this in the following way:

STEP 1	Collecting evidence on the additional number of sick leave days taken by individuals with obesity every year.
STEP 2	Calculating the average daily wage in the UK.
STEP 3	Multiplying the results from steps 1 and 2 by the population with obesity in employment in England and the devolved nations

SOCIAL CARE COSTS

Evidence suggests that people with obesity are more likely to develop long-term serious conditions than people with healthy weight. Studies show that that consequently social care costs are likely to be higher. Social care can be provided formally (through local councils or private funds) or informally (family, friends and neighbours). The extra cost on the social care system due to obesity is estimated in the following way:

STEP 1	Drawing from the literature, estimating the additional hours and cost of social care required for individuals with obesity per year.
STEP 2	Weighting the extra cost by the probability of an individual receiving formal social care to estimate the extra cost of social care in the UK.

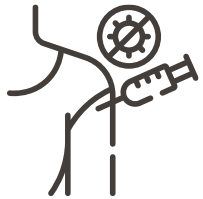
Considered as a transfer and therefore not included in the full cost of obesity estimate but presented separately.

UNEMPLOYMENT BENEFITS PAYMENTS

Employment Support Allowance (ESA) is a Government benefit scheme that supports individuals unable to work due to health reasons. The total cost of benefits paid out to individuals with obesity is estimated in the following way:

STEP 1	Drawing from the literature, estimating the percentage of ESA caseload attributable to obesity for England and Wales.
STEP 2	Dividing results in step 1 by the adult population with obesity of England and Wales to obtain the cost of unemployment benefits per person.
STEP 3	Multiplying the results of step 2 by the obese population in each of England and the devolved nations.

COVID-19



COVID-19 EXTRA COSTS DUE TO OBESITY

Several studies have shown that people with obesity have higher risk of hospitalisation and death once they are infected with COVID-19. PHE has published a review[16] of the evidence which suggests that disparities in excess weight may explain some of the observed differences in outcomes linked to COVID-19 for older adults and some BAME groups. The analysis estimates the cost attributable to the additional probability of hospitalisation and death for individuals with obesity in the following way:

STEP 1	Drawing from the literature, collecting data on the baseline probability of hospitalisation, death and the extra risks of individuals with obesity by age.
STEP 2	Calculating the additional probability of hospitalisation and death from COVID-19 once an individual with obesity is infected. The additional probability is added to the baseline probability of hospitalisation and death of a healthy weight individual calculated on the basis of hospitalisation and death rates in the UK.
STEP 3	Using the results of step 2 to calculate the extra cost of hospitalisation and death from COVID-19 for one individual with obesity.
STEP 4	Multiplying the cost per person by the population with obesity in England and in each of the devolved nations.

16. Public Health England: Excess Weight and COVID – 19 (Link)

04

RESULTS

RESULTS – THE ANNUAL ESTIMATED FULL COST OF OBESITY IN THE UK IS AROUND £58 BILLION

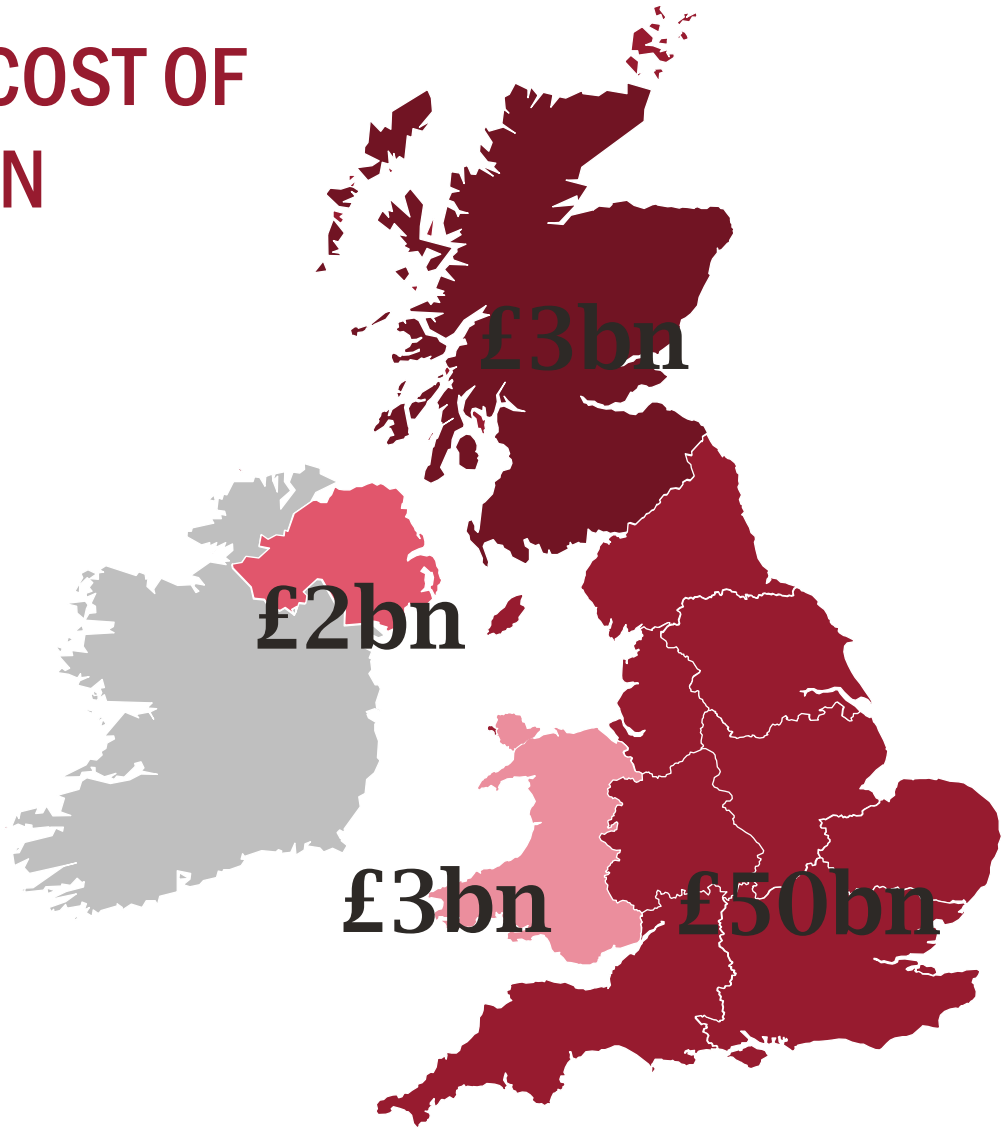
This study has estimated the annual full cost of obesity in the UK taking into account several factors that are not reflected in previous studies, including:

- Cost of obesity on social care
- Cost of obesity related mental health problems
- Costs related to higher COVID-19 risks due to obesity

This analysis suggests that the annual full cost of obesity in the UK is around £58 billion. The box below places this estimate in context.

Quick stats:

- £58 billion corresponds **to 3% of the 2020 UK GDP**[18]
- The estimated annual NHS spend on obesity related diseases is £6.5 billion. This is equivalent to around 40% of the total budget allocated to police forces in England and Wales for 2021/22[19].
- The estimated cost of obesity-related risks of Covid-19 is £4 billion. This is almost 50% more the amount the UK spent for securing 267 million doses of vaccines[20].



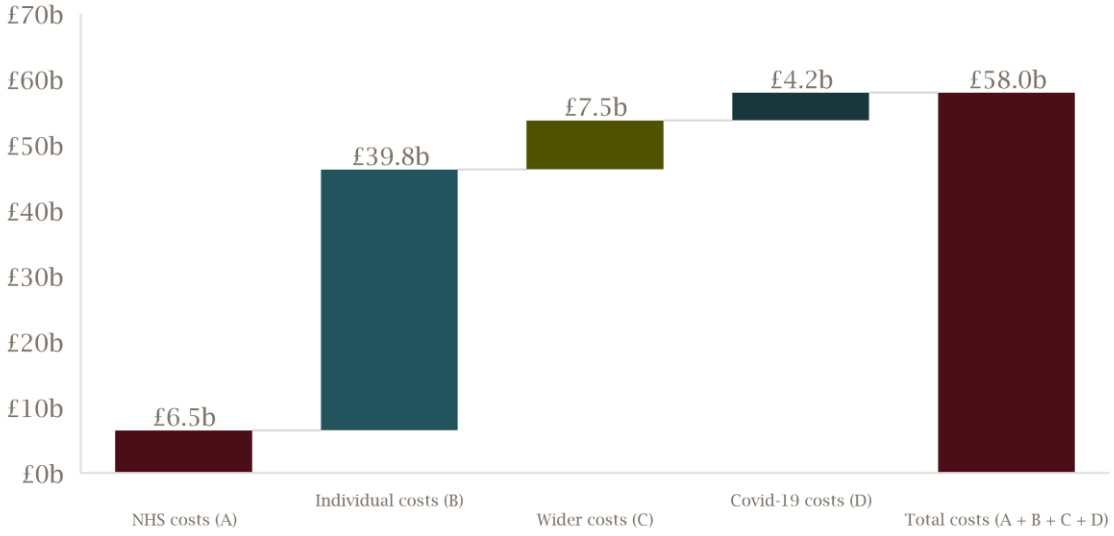
Source: Frontier Economics analysis
Note: unemployment benefits payments to individuals with obesity in the UK are estimated to account for £3.6bn but they are not included in the headline figures.

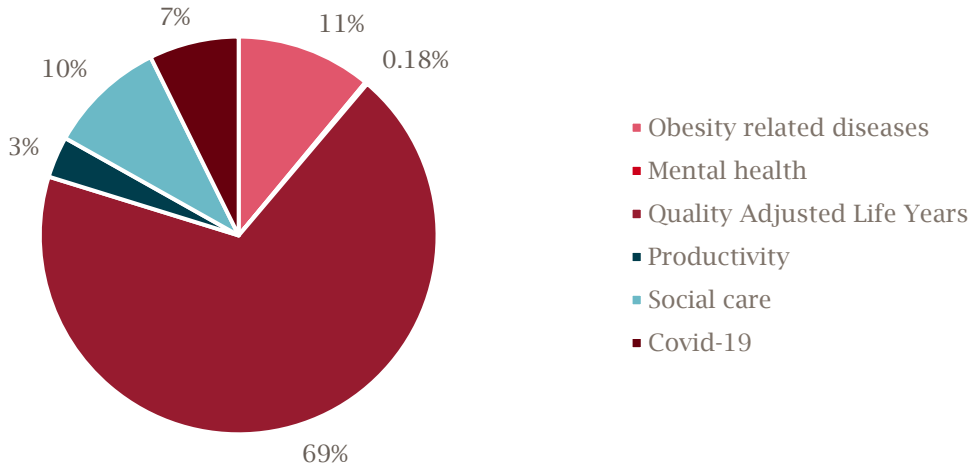
17. Public Health England – Health matters: obesity and the food environment (Link)
18. UK GDP 2020, ONS (Link)
19. England and Wales police spending 2021/22 (Link)
20. Investigation into preparations for potential Covid-19 vaccines, National Audit Office 2020 (Link)

THE IMPACTS OF OBESITY ON INDIVIDUALS ARE SIGNIFICANT, WITH COSTLY SPILLOVERS ON SOCIETY

LOOKING AT THE COST DRIVERS

- The analysis in this report considers four cost categories that make up the overall costs.
- Wider costs, including loss of productivity and social care costs are estimated to account for £7.5 billion. Including the cost of unemployment benefits paid to people with obesity would increase this number by around £4 billion.





- The biggest single contributor to the estimated costs of obesity in the UK (accounting for 69% of all costs) is the costs for individuals calculated through the metric of Quality Adjusted Life Years (QALYs). This metric takes into account both the reduced life expectancy and the loss in quality of life due to obesity. The use of this metric is consistent with Government appraisal guidelines[21].
- The second biggest single contributor is NHS costs for treating obesity-related diseases, which accounts for around 11% of total costs.

21. Green Book, Central Government Guidance on Appraisal and Evaluation, HM treasury 2020 (Link)
The Green Book suggests one QALY is equivalent to £60,000 (2014 prices). For the purposes of assessing obesity-reducing interventions, the NHS would use a lower figure (£20,000) that would lead to lower costs. A sensitivity analysis that explores the results using the lower figure is presented in the Appendix.

LOCAL AREAS ARE LIKELY TO FACE DIFFERENT SCALES OF OBESITY CHALLENGE AND HENCE NEED LOCALLY TAILORED SERVICES

	LOCAL AREA A	LOCAL AREA B
Population	262,100	288,648
Region	Southwest England	East England
Rural/Urban	Urban City and Town	Largely Rural
Deprivation decile*	4	8
Obesity prevalence	12.30%	8.10%
Full cost of obesity	£127 million	£92 million

The prevalence of obesity is heterogeneous within the UK. The tables above compare obesity prevalence, the estimated annual local cost of obesity and the underlying characteristics of two anonymised local areas in the UK with similar population sizes. Local area B has lower levels of obesity which is correlated with lower deprivation (measured with deciles of the Index of Multiple Deprivation). Separate correlation analysis on prevalence and deprivation data of all the local areas in England has revealed that this relationship holds true everywhere: more deprived areas tend to have a higher obesity prevalence.

The cost analysis applied to the two areas implies that around four percentage points of difference in prevalence of obesity is associated with £35 million extra local obesity-related annual costs. This suggests that the demand for local investment in addressing obesity is likely to be higher in more deprived areas where obesity prevalence tends to be higher.

* Deprivation deciles are based on the Index of Multiple Deprivation (IMD) where a smaller number indicates higher levels of deprivation (Link).

EVIDENCE SUGGESTS THERE ARE SEVERAL FORMS OF INTERVENTION TO ADDRESS OBESITY AND ACHIEVE COST SAVINGS – THEY VARY IN EFFECTIVENESS

GOVERNMENT INTERVENTIONS TO TACKLE THE 'OBESITY EPIDEMIC'

There is no single solution to resolve what is often referred as the 'obesity epidemic'. However, there is a wide range of interventions that the Government could promote to help reduce current and future prevalence. Interventions can have different aims which span from ***prevention*** of obesity to ***direct treatment*** to reduce weight and the associated health complications. The prevention actions aim to reduce the development of obesity in individuals. Some are aimed at improving the information and education of the public on healthy eating. Others are based on changes in regulation or pricing while some aim at producing behavioural changes through different types of 'nudging'. The treatment interventions are directed towards those that already live with obesity and often take place in specialised settings.

The effectiveness of the different interventions is likely to vary materially and there is no 'one size fits all' solution – what works for one person may not work for another. A full analysis of interventions is beyond the scope of this study, but to provide some illustration, the effectiveness of seven interventions spanning from prevention to treatment has been subject to a rapid evidence review.

In September 2021 the Obesity Health Alliance published a '10-year Healthy Weight Strategy'[22] that presents 30 policy recommendations to "turn the tide" of the increasing prevalence of excess weight in the UK. Among them, there is a mix of preventative interventions to promote a shift towards healthier lifestyles and to stop perpetuating the weight stigma. Some recommendations also support more direct interventions, in particular making sure the UK has a fully resourced system that offers appropriate and tailored weight management services to people living with overweight and obesity.

The rapid evidence review (summarised on the next page) indicates that generally the prevention interventions can reach many people and are useful to build momentum and awareness around the issue of obesity. However, the evidence on their effectiveness in directly reducing obesity prevalence is currently limited. There are no apparent common standards against which these interventions can be compared. More evidence is needed to understand whether they are effective in reducing prevalence both in the short and the long run so that the policy makers can take informed decision on which actions need to be prioritised to achieve a decrease in prevalence that will lead to cost savings.

22. Turning the tide, a 10-year healthy weight strategy, Obesity Health Alliance 2021 (Link)

Prevention

Direct treatment

Intervention	Description	Evidence availability	Effectiveness	Reason	Source
Traffic Light Labelling	Requirements to include information on fat, sugar, salt on the packaging of any food item. The aim is to nudge people into choosing healthier options and companies to reformulate products. It was introduced in the UK in 2013.	Medium	Low/ Medium	Both national and international evidence show that this intervention has been well received by consumers. Research commissioned by the Department of Health and Social care shows that the current labelling does help consumers make more informed choices about what they buy. However there is little available evidence on the extent to which the intervention helps reduce weight or decreases the rising prevalence of obesity.	1, 2
Targeted promotions for healthy food	Active promotion of healthy foods within the supermarkets to attract customer attention. Current guidelines restrict adverts for unhealthy products but do not mandate active promotion of healthy alternatives.	Low	Medium	Escaron et al (2013) published a review of articles estimating the effectiveness of different targeted promotions. The study looks at seven types of interventions and finds sufficient evidence only for three of them (mixing point-of-purchase, promotion and advertising, increased availability of healthy food and pricing interventions) concluding that more evidence is needed. Effectiveness in most of the studies was evaluated in terms of awareness and use of customers. Seven studies out of 33 have found no significant change in awareness of use in customers exposed to the interventions.	3, 4
Media restrictions for advertising unhealthy food	Restrictions on advertisement of unhealthy food products through methods like time restrictions, complete ban or mandatory disclosures of health risks.	Low	Medium	The Government departments DHSC and DCMS have commissioned research to evaluate the effectiveness of a 9pm watershed for advertising High Fat, Sugar and Salt (HFSS) that has been introduced in the UK. Research shows that a change in exposure to advertising can change children eating's behaviour but there is not enough evidence to show that the intervention can have an impact on adult's obesity.	5
Financial Incentives	Using tax, subsidies, health coupons or tax credits to make healthy food more affordable in comparison to unhealthy food. The 2021 UK food strategy has called for a new tax on salt and sugar.	High	Low	Several studies, including a literature review, have shown that financial incentives have a positive short term effect on dietary behaviour but the changes in behaviour are not maintained over the longer run (i.e. study participants regain weight after interventions).	6, 7
Digital solutions	Use of digital applications to achieve healthier eating habits, increase activity and log health data to supplement traditional weight management processes. The NHS provides the app NHS weight loss plan.	Low	Medium	These are relatively new types of intervention therefore the evidence base is emerging but currently too limited to quantify their effectiveness. Some recent studies show that the digital options can help reach a higher number of individuals than face-to-face weight management interventions. However these are considered to be a complement rather than a replacement to traditional services.	8, 9, 10, 11
Wearable technology	Use of devices to track vitals such as heart rate and step count.	Low	Medium	As for digital interventions, the evidence on the effectiveness on weight loss of wearable technology is limited. The review by Facewett et al (2020) concludes that there is some evidence that wearable devices can improve long-term physical activity and weight loss outcomes, but there is not enough evidence to show a benefit over the comparator methods (like traditional behavioural weight management services, usual care and others).	12, 13, 14
Weight management services (WMS) – Tier 3 and 4	In tier 3, individuals with obesity are offered the assistance of multi-disciplinary team, led by a clinician, alongside specialist nurses, specialist dietitians, psychological support and specialist exercise therapists/physiotherapist. Bariatric surgery is offered in tier 4.	Medium/ High	High	Evidence shows that the use of tier 3 weight management for a period of one or two years could lead to 3 - 5% weight loss, and could be further improved if coupled with drug intervention. The evidence on long-term effectiveness however is quite limited as most of the studies do not follow up for more than 3-4 years. Although it presents some risks, bariatric surgery can lead to weight reduction of 16% to 33% and long-term studies have shown that the majority of people maintain the weight loss over time.	15, 16, 17, 18, 19

LEGEND - **Low Effectiveness**: evidence do not suggest a direct link between the intervention and change in eating behaviour or weight reduction**; Medium Effectiveness:** evidence suggest some link between the intervention and change in eating behaviour but not long term weight reduction; **High Effectiveness:** evidence suggest a direct and material link between the intervention and long term weight reduction.

SCENARIO ANALYSIS – REDUCING OBESITY PREVALENCE BY 10% COULD HELP SAVE AROUND £6 BILLION EVERY YEAR

Obesity is costly for the UK. Over the last 30 years, levels of obesity prevalence have increased significantly across the UK. 2017 evidence suggest that if the trends are not reversed there will be 11 million more adults with obesity by 2030[23]. A range of tailored interventions might help reduce prevalence and consequently could lead to significant **cost savings.**

Reduction in prevalence from current levels (14.7m)	Prevalence equivalent to the levels observed in[24]:			
10%	 Bulgaria	13.2m Individuals in the UK with BMI 30+ assuming a 10% decrease in prevalence from current levels	**£6bn saved in a year**	This is fifteen times the amount spent on **increasing the Police officer numbers** in 2021-22[25]
20%	 Portugal	11.8m Individuals in the UK with BMI 30+ assuming a 20% decrease in prevalence from current levels	**£12bn saved in a year**	This is more than double than the annual NHS costs for **cancer treatment**[26]
30%	 Sweden	10.3m Individuals in the UK with BMI 30+ assuming a 30% decrease in prevalence from current levels	**£17bn saved in a year**	The upper estimate is 50% more than the funding allocated to the **justice system** in 2021[27]

Numbers in context

23. UK Obesity Statistics in 2017, Renew Bariatrics (Link)
24. Prevalence of obesity ranking by country, World of Obesity (Link)
25. Police to receive more than £15 billion to fight crime and recruit more officers, Government news story (Link)
26. 2010 to 2015 government policy: cancer research and treatment, DHSC 2015 (Link)
27. Largest funding increase in more than a decade for justice system, Government press release (Link)

05

LIMITATIONS

ESTIMATING THE COSTS OF OBESITY TO THE UK IS COMPLEX AND IS SUBJECT TO UNCERTAINTY AND LIMITATIONS

LIMITATIONS OF THE ANALYSIS

The analysis presented in this study is attempting the complex estimation of the wider costs of obesity, using best practice methods and peer reviewed evidence. The nature of the analysis means there are inevitable uncertainties, however. The following limitations are an important context to interpret results appropriately.

1. Potential missing costs. The analysis provides a snapshot of the costs of obesity only – there are likely to be further costs that are not yet possible to include. For example the costs of informal care, the impacts on the family and other health complications that could be associated with obesity. There are likely to be other health conditions on which evidence is currently emerging that have not been included at this stage (e.g. liver disease).

2. Need for timely updates. The evidence base on the complications associated with obesity is building, though is limited in some important respects. This means that this analysis should be updated over time as more evidence comes to light.

3. Evidence gaps. The analysis uses the best available evidence to estimate the magnitude of all cost drivers included in the framework. However there are a number of evidence gaps that need to be taken into account:

- antidepressant costs are used as a proxy for the cost of obesity-related mental health problems due to the lack of evidence on mental health interdependency with physical health for people with obesity. Such costs are clearly an under-estimate of the full likely scale of the effect;
- the evidence on COVID-19 and obesity is still at its early stages. It is now well understood that people with obesity have a higher risk of hospitalisation and death due to COVID-19 but there is uncertainty on the specific long-term impacts of COVID-19 for people with obesity;
- while the pressures that obesity-related costs place on the NHS are well known, there has been much less research on the implications obesity has on social care;

ESTIMATING THE COSTS OF OBESITY TO THE UK IS COMPLEX AND IS SUBJECT TO UNCERTAINTY AND LIMITATIONS

- evidence from the UK are insufficient to calculate productivity losses due presenteeism (reduced productivity at work) therefore the analysis conservatively only includes the cost of absenteeism (time away from work) to measure productivity losses. A number of studies reviewed by Goettler et al. (2017)[28], based on American employees surveys, show that the cost of presenteeism due to obesity could range between $11 and $4175 per year.

4. **Accrual of costs over time.** One of the challenges of obesity analysis is considering the costs over time for people. For some, the longer they are with obesity, the greater the challenges they face in terms of mental health and co-morbidities, and the severity of both.

5. **Child obesity.** This study focuses on adults only. The interdependency of children and adult obesity is a further uncertainty and has implications for the costs of obesity in adults and the appropriate interventions.

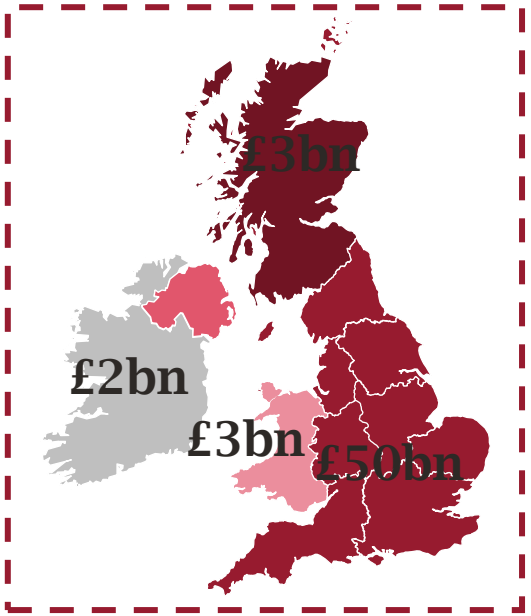
6. **Uncertainty on future technologies.** Looking forward, there are many factors that could affect the future costs associated with obesity including innovations in prevention and treatment options; the ageing population; cultural and lifestyle changes etc. Treatments, vaccines and management methods for obesity-related conditions that emerge over time could have implications for the costs associated with obesity. For example, if diabetes were more effectively managed then the costs associated with it could differ from those in this study. Likewise if co-morbidities were to mutate into more severe variations then this could exacerbate the obesity-related costs.

28. Goettler et al. (2017)

06

CONCLUSIONS

CONCLUSIONS – THE FULL ANNUAL COST OF OBESITY IN THE UK IS AN ESTIMATED £58 BILLION. THIS IS EXPECTED TO INCREASE OVER TIME WITHOUT EFFECTIVE AND WELL-TARGETED INTERVENTIONS



- This analysis estimates the full annual **costs of obesity in the UK to be £58 billion***. This **includes direct costs** such as the cost of obesity-related diseases on the health system (including COVID-19 and mental health issues) and the loss of quality adjusted life years for individuals. In addition it includes the **wider costs to society** such as loss of productivity and cost of social care.
- Wider costs and individual costs are the largest contributors, respectively representing 13% and 69% of the total estimated costs. This means that the **impacts of obesity on individuals are significant, with costly spillovers on society.**
- Individuals with obesity are subject to **additional risks of hospitalisation and death due to COVID-19** relative to healthy weight individuals. This suggests an estimated annual cost in the UK of £4 billion**.
- **Reducing obesity prevalence could lead to significant cost savings**. Reducing prevalence by 10% with respect to the current levels could lead to cost savings up to £6 billion for the United Kingdom.

Prevalence of obesity is heterogeneous in the UK. An analysis of the Multiple Index of Deprivation (IMD) has shown that **more deprived areas are more likely to have a high obesity prevalence with consequently higher costs**. A four percentage point difference in prevalence in the same population size could imply an additional local annual cost of obesity around £35 million. There is **no 'one size fits all' solution to address the costs of obesity**: a package of locally-tailored approaches based on the evidence could better reflect local needs.

The evidence reviewed suggests that **weight management services such as those provided in tier 3 and tier 4 are likely to be effective** for some people in reducing weight. Evidence on digital interventions is currently limited but could potentially be an important complement for some people. **Interventions aimed at prevention of obesity are also important** given they could help raise awareness and build momentum for further action. Enhancing the evidence base through greater monitoring and evaluation could facilitate informed policy decision-making.

* Unemployment benefit payments to individuals with obesity in the UK are estimated to account for an annual £3.6bn but they are not included in the £58 billion as they represent a social transfer. The loss in tax revenues due to obesity-related unemployment have not been possible to include in the estimate of annual full costs of obesity due to data limitations.
**These estimates relate to the current costs of COVID-19 and could be different in future years.

07

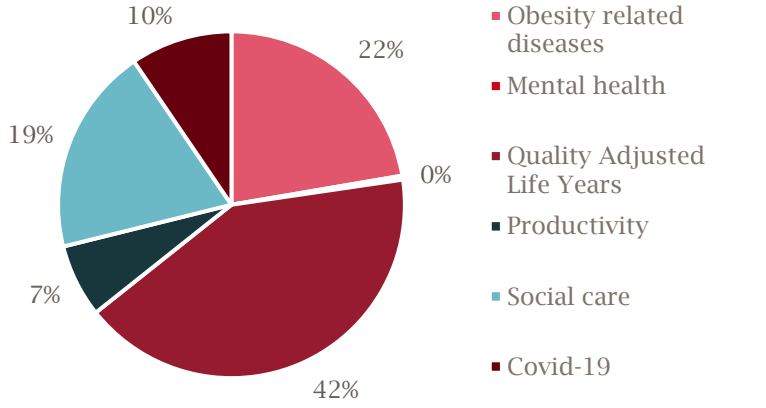
APPENDIX

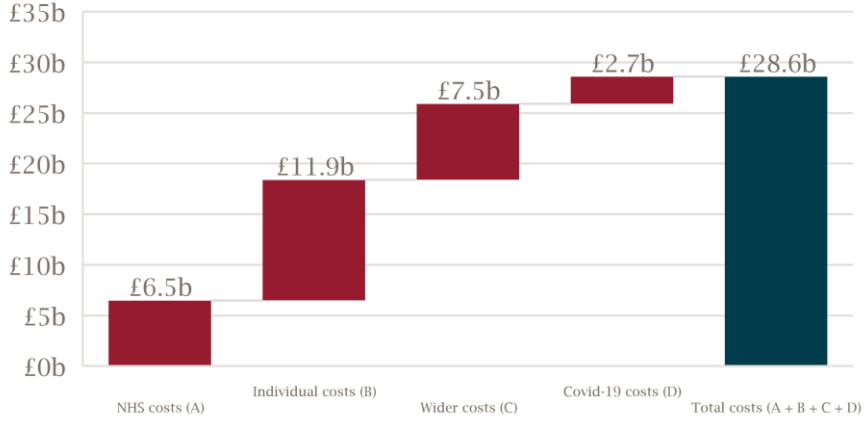
SENSITIVITY ANALYSIS – USING THE NICE QALY THRESHOLD THE ESTIMATED COST OF OBESITY IS £29 BILLION

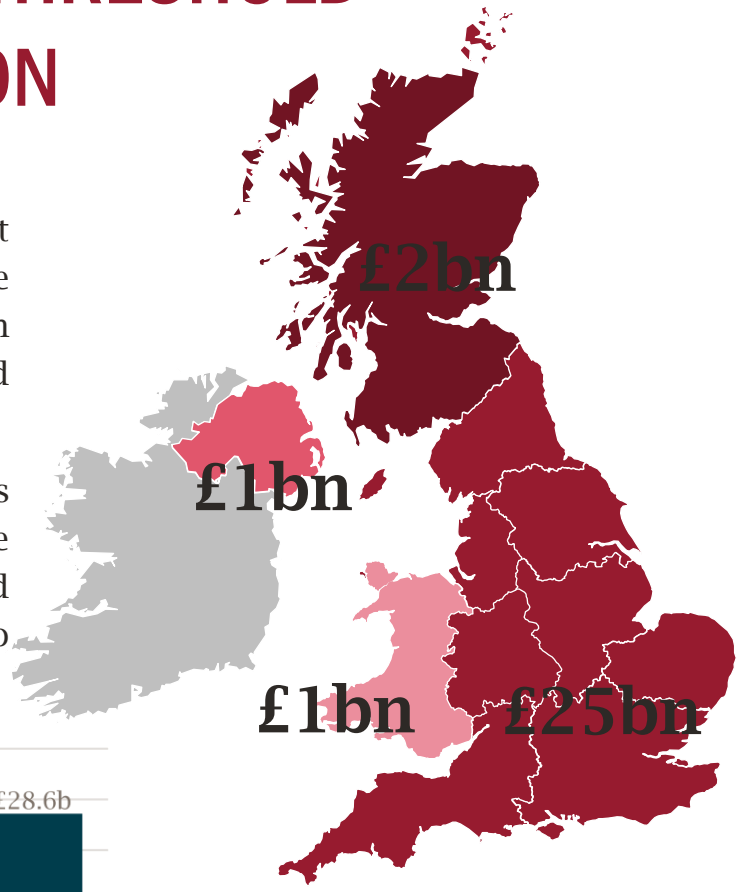
SENSITIVITY ANALYSIS

NICE uses QALYs to compare different drugs, devices and other technologies for different conditions. NICE's 'threshold,' over which treatments are less likely to be recommended for use in the NHS is typically between £20,000 and £30,000 per QALY. There have been discussions on whether these values (which date back to 2014) should be updated, but for now the NHS would still use them to evaluate obesity-reducing interventions.

The main analysis of this report follows Green Book guidance for social cost estimation, which is more appropriate in the context of the estimation of the full cost of obesity for society. The Green Book suggests one QALY is equivalent to £60,000 (2014 prices) which has been updated to £66,780 (2021 prices). However results using the NICE lower threshold (£20,000) are also presented in order to show how the figure used for QALY monetisation impacts the analysis.







Source: Frontier Economics analysis.
Note: unemployment benefits payments to individuals with obesity in the UK are estimated to account for £3.6bn but they are not included in the headline figures.

ASSUMPTIONS – ANTIDEPRESSANTS COST ESTIMATION

Studies have shown an association between obesity and several mental conditions such as anxiety, eating disorders, depression, etc. Isolating the effect of obesity on the mentioned conditions can be difficult and hence the expenditure on antidepressants is used as a proxy for the estimation. This is a conservative approach that is likely to lead to an under-estimate of the true cost of obesity-related mental health issues.

Antidepressant costs attributable to obesity are calculated on the basis of the estimated proportion of people with obesity and depression (23%). The total cost of antidepressants is sourced from the Prescription Cost Analysis data for England. This figure is calculated using the following steps (all assumptions and sources are summarised in Table 1):

- Estimating the number of people with obesity and depression in England (2.96 million).
- Morriss et al (2021) estimates that 66% of people with obesity are given antidepressants. This percentage is applied to 2.96 million to calculate the number people with obesity given antidepressants in England.
- Deriving the proportion of individuals with obesity prescribed antidepressants over the total amount of people prescribed antidepressants in England. Applying this percentage to the total cost of antidepressants to get the cost attributable to obesity. The estimated percentage of individuals with obesity using antidepressants is lower than the one of the general population. Morriss et al. (2021) showed that in the UK the rate of prescription of antidepressants for individuals with obesity and depression is lower than the prescription rate for the entire population because of the possible weight gain side effects associated to antidepressants.
- Using the unit cost estimated for England to get the cost estimate for each devolved nation.

Table 1

Cost of antidepressants	Estimate	Source
Proportion of people with obesity and depression	23%	Prevalence of comorbid depression and obesity in general practice: a cross-sectional survey Mariko Carey, Hannah Small, Sze Lin Yoong, Allison Boyes, Alessandra Bisquera, Rob Sanson-Fisher British Journal of General Practice 2014; 64 (620): e122-e127. DOI: 10.3399/bjgp14X677482.. Page 122
Percentage of depressed individuals with obesity given antidepressants	66%	Morriss R, Tyrer F, Zaccardi F, Khunti K (2021) Safety of antidepressants in a primary care cohort of adults with obesity and depression. PLOS ONE 16(1): e0245722. https://doi.org/10.1371/journal.pone.0245722, Page 10
Percentage of adult population using antidepressants	17%	Prescribed medicines review: summary (PHE, 2020)
Total cost of antidepressants	£374 million	Prescription Cost Analysis – England (2021) (Link)

ASSUMPTIONS – PRODUCTIVITY

Several studies have shown that people with obesity tend to take more sick leave days compared to individuals in the healthy weight category. This has an effect on overall productivity. In particular Harvey et al (2010) estimated that people with obesity take on average four additional days of sick leave compared to an individual in the healthy weight category. These four days of sick leave are converted to a monetary value through the following steps.

- The average annual wage in the UK is sourced from the Office of National Statistics.
- The daily wage (derived from above) is multiplied by the additional days of sick leave to arrive at the cost of unproductive days for one person with obesity.
- The number of obese individuals between 16 and 64 is multiplied by the rate of economic activity and employment in the UK. It should be noted that the employment rate of people with obesity might be up to two percentage points lower than the one of people with healthy weight, as reported by Black (2016). However, because of a lack of up to date data on employment levels of people with obesity, UK level employment rate has been used.
- Multiplying the value of unproductive days per person with obesity by the number of people with obesity who are economically active and in employment in the UK and each of the devolved nations.

All assumptions and sources are summarised in Table 2.

Table 2

Productivity loss	Estimate	Source
Difference between sick leave days taken by individuals with and without obesity	4 days	S. B. Harvey, N. Glozier, O. Carlton, A. Mykletun, M. Henderson, M. Hotopf, K. Holland-Elliott, Obesity and sickness absence: results from the CHAP study, Occupational Medicine, Volume 60, Issue 5, August 2010, Pages 362–368, https://doi.org/10.1093/occmed/kqq031. Page 364
Average wage in the UK	£27,768	Average weekly earnings in Great Britain: April 2021 (Source: ONS)
Rate of economic inactivity in UK	21.1%	Employment in the UK: October 2021 (Source: ONS)
Rate of employment in UK	75.3%	Employment in the UK: October 2021 (Source: ONS)

ASSUMPTIONS – COST OF RELATED ILLNESSES (1/3)

The cost of related illnesses attributable to obesity is calculated by collecting information on the annual cost of each related disease (Table 3 adjusted for 2021 prices), probability of an individual having these diseases (Table 5) and the additional risk of related illnesses attributable to obesity (Table 4). These inputs are used to calculate the cost of related illnesses attributable to obesity in the following manner:

- Population Attributable Factors (PAFs) using the following formula:
  - PAF = P(rr – 1)/[P(rr – 1) + 1]; P = baseline probability of a disease (Table 5), rr = additional risk of disease due to obesity (Table 4).
- The cost of a related illness (Table 3) is multiplied by the number of patients per illness in the UK (Table 6) to derive the total cost for each illness attributable to obesity in the UK.
- Each related disease is multiplied with the respective PAF to derive the total cost of the related disease attributable to obesity.
- The cost of related illnesses attributable to obesity is divided by the population of people with obesity in the UK to arrive at the unit cost.
- The unit cost is multiplied by the population of people with obesity in each of the devolved nations to derive the nation specific cost of related illnesses attributable to obesity.

Table 3- 2021 prices (adjusted from original 2016 prices)

Disease	Cost per case per year (2021)
Colorectal cancer	£ 520.13
Oesophageal cancer	£ 545.06
Kidney cancer	£ 1,662.88
Ovarian cancer	£ 14,990.93
Pancreatic cancer	£ 7,447.27
CHD	£ 1,557.25
Stroke	£ 247.55
Type 2 diabetes	£ 827.33
Hypertension	£ 453.91
Knee Osteoarthritis	£ 27,798.40
Endometrial cancer	£ 520.13
Breast cancer	£ 545.06

Source: Bariatric surgery, lifestyle interventions and orlistat for severe obesity: the REBALANCE mixed-methods systematic review and economic evaluation (link). Page 179
Note these costs include hospital (inpatient and outpatient), primary care and medication.

ASSUMPTIONS – COST OF RELATED ILLNESSES (2/3)

Table 4

Increased probability of diseases attributable to obesity	Male	Female
Type 2 diabetes	5.2	12.7
Hypertension	2.6	4.2
Myocardial Infarction	1.5	3.2
Cancer (colon)	3	2.7
Angina	1.8	1.8
Gall Bladder Disease	1.8	1.8
Ovarian Cancer		1.7
Musculoskeletal disorders (i.e. Osteoarthritis)	1.9	1.5
Stroke	1.3	1.3
CHD (average between myocardial infarction and angina)	1.7	2.5
Sleep Apnoea	2.0	2.0

Source: Excess weight and COVID-19 (Source: Public Health England), page 19-20

Table 5

Baseline probability of disease	Probability for male	Probability for female	Source
Type 2 diabetes	15.7%	3.6%	Diabetes in the UK 2010: Key statistics on diabetes (link), Page 5
Hypertension	31%	26%	Hypertension in adults: diagnosis and management (NICE 2019), page 40
Myocardial Infarction	2%	2%	Health Survey for England 2017 Cardiovascular diseases (NHS Digital), page 9
Cancer (colon)	7%	6%	Bowel Cancer Risk (Cancer Research UK)
Angina	3%	3%	Health Survey for England 2017 Cardiovascular diseases (NHS Digital),), page 9
Gall Bladder Disease	13%	25%	Njeze GE. Gallstones. *Niger J Surg.* 2013;19(2):49-55. doi:10.4103/1117-6806.119236
Ovarian Cancer		1%	Key statistics for Ovarian Cancer (American Cancer Society)
Musculoskeletal disorders (i.e. Osteoarthritis)	23%	31%	Osteoarthritis: How common is it? (NICE 2018)
Stroke	0.128%	0.1%	Briefing document: First incidence of stroke. Estimates for England 2007 to 2016 (Source: Pubic Health England, page 7)
CHD average	3%	3%	Health Survey for England 2017 Cardiovascular diseases (NHS Digital, page 5)
Sleep Apnoea	2%	2%	Obstructive Sleep Apnoea: Health Economics Report (Office of Health Economics, 2014, page 4)

ASSUMPTIONS – COST OF RELATED ILLNESSES (3/3)

Table 6

Number of patients per related illness	Number	Source
Type 2 diabetes	4,700,000	Diabetes UK: Number of People with diabetes reaches 4.7 million
Hypertension	14,400,000	British Heart Foundation: "Four million people are living with untreated high blood pressure, new estimates show" (2019)
CHD	2,300,000	British Heart Foundation: UK Factsheet 2021, page 7
Cancer (colon)	268,000	Bowel Cancer UK
Gall Bladder Diseases	1,653,191	NICE Health and Social Care Directorate. Quality Standard Topic: Gallstone Disease
Ovarian Cancer	17,643	WHO Institute Agency for Research on Cancer
Musculoskeletal disorders (i.e. Osteoarthritis)	8,500,000	NICE Health and Social Care Directorate. Quality Standard Topic: Osteoarthritis
Stroke	113,000	King, D.; Wittenberg, R.; Patel, A.; Quayyum, Z.; Berdunov, V.; Knapp, M. The future incidence, prevalence and costs of stroke in the UK. Age Ageing 2020, 49, 277–282. Page 2
Sleep Apnoea	1,500,000	Sleep Apnoea: British Lung Foundation

ASSUMPTIONS – LOSS OF QUALITY ADJUSTED LIFE YEARS

QALYs are used to reflect the decrease in longevity and the reduction in quality of life for an individual with obesity.

Loss of QALYs due to obesity is a function of the BMI and the age of an individual. NICE guidelines provide figures to convert QALYs into monetary values. The total QALYs lost by people with obesity is derived in the following way:

- Taking the difference between the QALYs of an individual with obesity/morbid obesity and the QALYs of a healthy weight individual by age.
- This figure is multiplied by the number of individuals with obesity and morbid obesity respectively for the UK and each of the devolved nations. This represents the total QALYs lost by individuals with obesity/morbid obesity
- QALYs are converted to a monetary value by multiplying them by £66,780 (following Green Book guidelines).

All assumptions and sources are summarised in Table 8.

Table 8

Inputs to calculate the loss of QALYs	Estimate	Source
QALYs lost by obesity and morbid obesity	0.032 – 0.107 (depending on age)	Managing Overweight and Obesity among Adults (link), page 30-31
Monetary value of one QALY	£66,780	Green Book HM Treasury (link) estimate (£60,000) updated to 2021 prices, page 87

ASSUMPTIONS – SOCIAL CARE COSTS

Evidence shows that individuals with obesity are more likely to require additional assistance with daily activities in older age than people with healthy weight.

Studies have calculated the additional hours of social care required by an individual with obesity (for both formal and informal care). The extra cost of social care due to obesity is calculated by multiplying the extra hours of social care for an individual with obesity required in a year by the hourly wage rate of a social care worker.

This estimate is weighted by the baseline probability of receiving social care.

The unit cost of social care is multiplied by the population of people with obesity in the UK and each of the devolved nations in order to arrive at the total social care costs.

All assumptions and sources are summarised in Table 9.

Table 9

Social care costs	Estimate	Source
Yearly difference in hours of formal social care between individuals with and without obesity	11.43	Estimating the variation in need for community-based social care by body mass index in England and associated cost: population-based cross-sectional study (link), page 9
Yearly difference in hours of informal social care between individuals with and without obesity	153.02	Estimating the variation in need for community-based social care by body mass index in England and associated cost: population-based cross-sectional study (link), page 9
Hourly cost of a social care worker	£28.67	Community based social care unit costs (2020): (Link), page 142
Probability of social care	30%	Nizalova, O., Gousia, K. and Forder, J. Effect of body mass on future long-term care use. BMC Geriatr 20, 293 (2020). https://doi.org/10.1186/s12877-020-01688-4, Page 4

ASSUMPTIONS – COVID-19 COSTS

Several studies suggest that an individuals with obesity face additional risk of hospitalisation and death once infected with COVID-19 compared to a healthy weight individual. This is calculated in the following way:

- Calculating the baseline risk of hospitalisation and death due to COVID-19 using the weekly average hospital admissions and deaths in the UK for the period February to November 2021.
- Calculating the cost of hospitalisation using the average of long and short non-elective inpatient stays adjusted to 2021 prices.
- Multiplying the baseline risk of hospitalisation by the increased risk of hospitalisation due to obesity (hazard ratio). Then multiplying this by the cost of hospitalisation.
- Multiplying the baseline risk of death by the increased risk of death due to obesity (hazard ratio). Then multiplying this by the cost of one QALY.
- Multiplying the costs estimated for an individual by the number of obese individuals in the UK and the devolved nations.

Table 10

Covid-19 costs	Estimate	Source
Risk of hospitalisation due to COVID-19	1 – 28% (depending on age) – weekly average over February – November 2021 of hospital admissions per 100 people.	Office of National Statistics (Link)
Risk of death due to COVID-19	0 – 2% (depending on age) – weekly average over February – November 2021 of deaths per 100 people.	Office of National Statistics (Link)
Hazard ratios by age and BMI (hospitalisation and death)	1 – 1.17	Min Gao, et al (2021), "Associations between body-mass index and COVID-19 severity in 6·9 million people in England: a prospective, community-based, cohort study", The Lancet Diabetes and Endocrinology, Volume 9, Issue 6, Pages 350-359, ISSN 2213-8587, https://doi.org/10.1016/S2213-8587(21)00089-9. Page 356
Cost of hospital stays	£2,031	Curtis, L. and Burns, A. (2020) Unit Costs of Health and Social Care 2020, Personal Social Services Research Unit, University of Kent, Canterbury., Page 87
QALYs lost by obesity and morbid obesity	0.032 – 0.107	Managing Overweight and Obesity among Adults (link), page 30-31

ASSUMPTIONS – INFLATION RATES

This analysis is carried out in 2021 prices. The inputs in the analysis rely on the most recent and relevant evidence available. In those cases where inputs refer to years prior to 2021, the analysis uses the CPI index to bring the inputs to 2021 prices using the following formula:

Adjusted input = Original input * (CPI 2021/CPI reference year)

Table 11 – Consumer Price Inflation

Year	CPI
2008	84.7
2009	86.6
2010	89.4
2011	93.4
2012	96.1
2013	98.5
2014	100
2015	100
2016	100.7
2017	103.4
2018	105.9
2019	107.8
2020	108.7
2021	111.3

Source: Office of National Statistics (Link)

ASSUMPTIONS – UNIVERSAL CREDIT PAYMENTS (NOT INCLUDED IN THE FULL COST OF OBESITY)

The Employment and Support Allowance (ESA) is a monetary benefit paid by the Government to people with disabilities or health conditions that affect their ability to work.

Evidence from an independent review of the impact of obesity on employment outcomes presented to the parliament showed that 35% of the ESA caseload have conditions that may arise due to obesity. To factor this into the model, the total amount of Employment Support Allowance in 2021 prices for England and Wales (2020 ESA adjusted for inflation) is multiplied by 35% (the proportion attributable to obesity).

The total amount of ESA paid out to people with obesity in England and Wales is divided by the population of people with obesity in these two nations to arrive at an ESA unit cost.

The unit cost of ESA is multiplied by the population of people with obesity in the UK and each of the devolved nations to arrive at the total benefits paid out to people with obesity.

All assumptions and sources are summarised in Table 7.

Table 7

Employment Support Allowances	Estimate	Source
ESA in 2021	£ 9,637 million	Department for Work and Pensions: Main estimate 2020-21 (link), page 13
ESA attributable to obesity	35%	An independent Review into the impact on employment outcomes of drug or alcohol addiction, and obesity (link), page 62

08

REFERENCES

REFERENCES (1/5)

OBESITY INTERVENTION STUDIES

1. Building on the Success of Front of Pack Nutrition Labelling in the UK: A Public Consultation (Dept of Health and Social Care)
2. Emrich TE, Qi Y, Lou WY, L'Abbe MR (2017) Traffic-light labels could reduce population intakes of calories, total fat, saturated fat, and sodium. PLoS ONE 12(2): e0171188. https://doi.org/10.1371/journal.pone.0171188
3. Vandevijvere, S., Van Dam, I. The nature of food promotions over one year in circulars from leading Belgian supermarket chains. *Arch Public Health* **79,** 84 (2021). https://doi.org/10.1186/s13690-021-00591-7
4. Escaron AL, Meinen AM, Nitzke SA, Martinez-Donate AP. Supermarket and grocery store-based interventions to promote healthful food choices and eating practices: a systematic review. *Prev Chronic Dis.* 2013;10:E50. Published 2013 Apr 11. doi:10.5888/pcd10.120156
5. Evidence note. Impact of advertisement interventions (Dept of Health and Social Care)
6. Purnell JQ, Gernes R, Stein R, Sherraden MS, Knoblock-Hahn A. A systematic review of financial incentives for dietary behavior change. *J Acad Nutr Diet.* 2014;114(7):1023-1035. doi:10.1016/j.jand.2014.03.011
7. John, Leslie & Loewenstein, George & Troxel, Andrea & Norton, Laurie & Fassbender, Jennifer & Volpp, Kevin. (2011). Financial Incentives for Extended Weight Loss: A Randomized, Controlled Trial. Journal of general internal medicine. 26. 621-6. 10.1007/s11606-010-1628-y
8. A service evaluation exploring the effectiveness of a locally commissioned tier 3 weight management programme offering face-to-face, telephone and digital dietetic support (Rosemary Huntriss (Oviva), 2020)
9. Unleashing the power of digital to tackle obesity (Oviva, 2021)
10. Hurkmans E, Matthys C, Bogaerts A, Scheys L, Devloo K, Seghers J. Face-to-Face Versus Mobile Versus Blended Weight Loss Program: Randomized Clinical Trial. JMIR Mhealth Uhealth. 2018 Jan 11;6(1):e14. doi: 10.2196/mhealth.7713. Erratum in: JMIR Mhealth Uhealth. 2018 Mar 15;6(3):e10159. PMID: 29326093; PMCID: PMC5785684.
11. Beleigoli AM, Andrade AQ, Cançado AG, Paulo MN, Diniz MFH, Ribeiro AL. Web-Based Digital Health Interventions for Weight Loss and Lifestyle Habit Changes in Overweight and Obese Adults: Systematic Review and Meta-Analysis. J Med Internet Res. 2019 Jan 8;21(1):e298. doi: 10.2196/jmir.9609. PMID: 30622090; PMCID: PMC6330028.
12. Fawcett E, Van Velthoven MH, Meinert E. Long-Term Weight Management Using Wearable Technology in Overweight and Obese Adults: Systematic Review. JMIR Mhealth Uhealth. 2020;8(3):e13461. Published 2020 Mar 10. doi:10.2196/13461
13. McDonough DJ, Su X, Gao Z Health wearable devices for weight and BMI reduction in individuals with overweight/obesity and chronic comorbidities: systematic review and network meta-analysis British Journal of Sports Medicine 2021;55:917-925.
14. Fawcett E, Van Velthoven MH, Meinert E. Long-Term Weight Management Using Wearable Technology in Overweight and Obese Adults: Systematic Review JMIR Mhealth Uhealth 2020;8(3):e13461

REFERENCES (2/5)

OBESITY INTERVENTION STUDIES

15. Developing Integrated Clinical Pathways for the Management of Clinically Severe Adult Obesity: a Critique of NHS England Policy (**link**)
16. Dombrowski S U, Knittle K, Avenell A, Araújo-Soares V, Sniehotta F F. Long term maintenance of weight loss with nonsurgical interventions in obese adults: systematic review and meta-analyses of randomised controlled trials BMJ 2014; 348 :g2646
17. SCALE 1839 study (2017)
18. National Bariatric Surgery Registry (link)
19. Review of the key results from the Swedish Obese Subjects (SOS) trial – a prospective controlled intervention study of bariatric surgery (link)

REFERENCES (3/5)

COST OF OBESITY STUDIES

1. National Audit Office Report by the Comptroller and Auditor General. *Tackling Obesity in England.* 2001. (Link)
2. Dobbs R, Sawers C, Thompson F, et al. "Overcoming obesity: an initial economic assessment. A discussion paper by the McKinsey Global Institute." http://www.mckinsey.com/industries/healthcare-systems-and-services/our-insights/how-the-world-could-better-fight-obesity Date: November, 2014 (accessed March 29, 2017)
3. Fry J, Finley W. The prevalence and costs of obesity in the EU. Proc Nutr Soc. 2005 Aug;64(3):359-62. doi: 10.1079/pns2005443. PMID: 16048669.
4. Lehnert T, Streltchenia P, Konnopka A, Riedel-Heller SG, König HH. Health burden and costs of obesity and overweight in Germany: an update. Eur J Health Econ. 2015 Dec;16(9):957-67. doi: 10.1007/s10198-014-0645-x. Epub 2014 Nov 8. PMID: 25381038.
5. Frank B. Hu, "Economic Costs of Obesity", Oxford Published to Oxford Scholarship Online: September 2009, ISBN-13: 9780195312911, DOI:10.1093/acprof:oso/9780195312911.003.0013
6. Arterburn, David E., Matthew L. Maciejewski, and Joel Tsevat. "Impact of morbid obesity on medical expenditures in adults." *International journal of obesity* 29.3 (2005): 334-339.
7. James, W. Philip T., and Klim McPherson. "The costs of overweight." *The Lancet Public Health* 2.5 (2017): e203-e204.
8. Tremmel, M., Gerdtham, U. G., Nilsson, P. M., & Saha, S. (2017). Economic burden of obesity: a systematic literature review. *International journal of environmental research and public health*, *14*(4), 435.
9. Harvard School of Public Health, "Economic Costs", Source: Harvard T.H. Chan School of Public Policy
10. Obesity Health Alliance, "The Costs of Obesity", Source: Obesity Health Alliance UK

REFERENCES (4/5)

IN-TEXT REFERENCES

1. Frontier estimates using prevalence data from Health Survey for England (2019), National Survey for Wales (2019-20), Scottish Health Survey (2020), Northern Ireland Health Survey (2019-20)
2. Excess Weight and Covid-19, Public Health England 2020, (Link)
3. Public Health England – Health matters: obesity and the food environment (Link)
4. Tackling obesities: future choices – project report, Government Office for Science 2007 (Link)
5. Tackling obesity in England, National Audit Office 2001 (Link)
6. Overcoming obesity: an initial economic analysis, McKinsey Global Institute 2014 (Link)
7. ONS Coronavirus latest insight. Accessed November 2021.
8. Coronavirus economic impact (House of Commons Library) and National Audit Office Covid-19 cost tracker. Accessed November 2021
9. National Food Strategy Report, Independent review for the Government 2021 (Link)
10. Yates, T., Razieh, C., Zaccardi, F. et al. Obesity, walking pace and risk of severe COVID-19 and mortality: analysis of UK Biobank. Int J Obes 45, 1155–1159 (2021). https://doi.org/10.1038/s41366-021-00771-z11. Gao et al. 2021
11. Min Gao, Carmen Piernas, Nerys M Astbury, Julia Hippisley-Cox, Stephen O'Rahilly, Paul Aveyard, Susan A Jebb, "Associations between body-mass index and COVID-19 severity in 6·9 million people in England: a prospective, community-based, cohort study", The Lancet Diabetes & Endocrinology, Volume 9, Issue 6, 2021, Pages 350-359, ISSN 2213-8587, https://doi.org/10.1016/S2213-8587(21)00089-9.
12. Haase, C.L., Lopes, S., Olsen, A.H. et al. Weight loss and risk reduction of obesity-related outcomes in 0.5 million people: evidence from a UK primary care database. Int J Obes 45, 1249–1258 (2021). https://doi.org/10.1038/s41366-021-00788-4
13. PAF: the proportion of all cases with a particular outcome in a population that could be prevented by eliminating a specific exposure
14. NICE Glossary: Definitions of terms used (Page "Q")
15. Value of one QALY: Carrying NICE over the Threshold (NICE)
16. Public Health England: Excess Weight and COVID – 19
17. Public Health England – Health matters: obesity and the food environment (Link)
18. UK GDP 2020, ONS (Link)
19. England and Wales police spending 2021/22 (Link)
20. Investigation into preparations for potential Covid-19 vaccines, National Audit Office 2020 (Link)
21. Green Book, Central Government Guidance on Appraisal and Evaluation, HM treasury 2020 (Link)
22. Turning the tide, a 10-year healthy weight strategy, Obesity Health Alliance 2021 (Link)

REFERENCES (5/5)

IN- TEXT REFERENCES

23. UK Obesity Statistics in 2017, Renew Bariatrics (Link)
24. Prevalence of obesity ranking by country, World of Obesity (Link)
25. Police to receive more than £15 billion to fight crime and recruit more officers, Government news story (Link)
26. 2010 to 2015 government policy: cancer research and treatment, DHSC 2015 (Link)
27. Largest funding increase in more than a decade for justice system, Government press release (Link)
28. Goettler, Andrea, Anna Grosse, and Diana Sonntag. "Productivity loss due to overweight and obesity: a systematic review of indirect costs." BMJ open 7.10 (2017): e014632.