



**FORESIGHT**

Tackling Obesities:  
Future Choices –  
Project Report

2<sup>nd</sup> Edition

**Government Office for Science**

# *Foresight*

## Tackling Obesities: Future Choices – Project report

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This edition includes a revised figure for the estimated future costs of obesity and overweight.

# Contents

<b>Foreword</b>	<b>1</b>
<b>Preface</b>	<b>3</b>
<b>Tackling Obesities: Future Choices – Executive summary</b>	<b>4</b>
<b>Section 1: Introduction</b>	<b>19</b>
<b>Section 2: The scale of the problem</b>	<b>23</b>
2.1 The prevalence of obesity	24
2.2 Future trends in obesity	33
2.3 Economic costs of overweight and obesity	39
<b>Section 3: Causes of obesity</b>	<b>42</b>
3.1 Biology	43
3.2 Impact of early life and growth patterns	47
3.3 Behaviour	48
3.3.1 Food intake and activity behaviours	48
3.3.2 What motivates people’s decisions and choices?	49
3.4 The living environment	52
3.4.1 Technology	52
3.4.2 Opportunities for physical activity	52
3.4.3 Food and drink access and availability	54
3.5 Economic drivers of food production and consumption	55
3.5.1 The price of food and drink	55
3.5.2 Food marketing	56
3.5.3 Purchasing capacity and impact on eating patterns	57
3.5.4 Impact of working practices	57
<b>Section 4: Tackling obesity: the evidence and the uncertainty</b>	<b>60</b>
4.1 Prevention	61
4.1.1 A lifelong approach	62
4.1.2 Opportunities arising from future technological developments	62
4.1.3 Opportunities in behaviour change	64
4.1.4 Opportunities in the built environment	66
4.2 Treatment	67

4.3 Policy	70
4.3.1 Lessons from other countries	72
4.3.2 Lessons from other health issues	75
<b>Section 5: A complex system</b>	<b>78</b>
5.1 Structure of the obesity system map	79
5.1.1 The core 'system engine'	80
5.1.2 Thematic clusters within the obesity system map	82
5.2 Key variables and intervention points	83
5.2.1 Key variables	86
5.2.2 Identifying additional intervention points	87
5.3 Different maps for different population groups	88
<b>Section 6: Visualising the future: scenarios to 2050</b>	<b>94</b>
6.1 Drivers for change	95
6.2 The scenarios in brief	96
6.3 Prevalence of obesity in the scenarios	99
6.4 Using the scenarios	99
6.4.1 Views from groups within the food industries	99
6.4.2 Obesity, technology and lifestyle	101
6.4.3 Views of 10- and 13-year-old children	102
<b>Section 7: Managing the consequences</b>	<b>104</b>
7.1 Qualitative modelling of options for policy responses to obesity	105
7.2 Quantitative modelling of the consequences of changing population BMI levels	111
7.2.1 Alternative BMI reduction strategies and their relative impact on health outcomes and NHS costs	111
7.3 Conclusions	116
<b>Section 8: Building a sustainable response</b>	<b>118</b>
8.1 The way forward	119
8.1.1 What makes a successful response to obesity?	120
8.1.2 Core principles for tackling obesity	128
8.1.3 Developing a strategic framework	132
8.1.4 Moving towards practice-based evidence	137
8.1.5 Management and co-ordination of the government response	138
8.2 Conclusion	139



<b>Acknowledgements</b>	<b>141</b>
<b>Appendix 1 Background to Foresight and this project</b>	<b>146</b>
<b>Appendix 2 Foresight Tackling Obesities: Future Choices – project publications and resources</b>	<b>149</b>
<b>Appendix 3 Definitions of obesity</b>	<b>150</b>
<b>Appendix 4 Interpreting the system map</b>	<b>151</b>
<b>References</b>	<b>153</b>

## Foreword



Extensive media coverage has ensured that we're all aware that obesity is on the increase. But popular views on the issue all too often draw on stereotypes, present simplified descriptions of the problem, and have an unrealistic assessment of the solutions. These oversimplifications do not reflect the current state of scientific evidence and understanding. Nor do they help Government develop and implement a sustained response to a problem that will have profound long-term consequences for health and well-being and major costs to the health budget and the wider economy.

That's why I commissioned Foresight to examine the question, 'How can we deliver a sustainable response to obesity over the next 40 years?' The project has assembled evidence and expertise from academic disciplines as diverse as epidemiology, food science, genetics, psychology and sociology, and from professionals and interested organisations within and beyond Government.

The project's findings, summarised here, challenge the simple portrayal of obesity as an issue of personal willpower – eating too much and doing too little. Although, at the heart of the problem, there is an imbalance between energy intake and energy expenditure, the physical and psychological drivers inherent in human biology mean that the vast majority of us are predisposed to gaining weight. It's not surprising that the median body mass index in the UK is now above that considered to be in the 'healthy' range. We evolved in a world of relative food scarcity and hard physical work – obesity is one of the penalties of the modern world, where energy-dense food is abundant and labour-saving technologies abound.

Creating an environment that better suits our biology and supports us in developing and sustaining healthy eating and activity habits is a challenge for society and for policy makers. It's not simply a health issue, nor a matter of individual choice. The current and likely future scale of the obesity problem is daunting, but the encouraging findings are that there is considerable scope to align policies to tackle climate change and sustainability, for example, with policies for public health.



The work reported here represents an independent scientific enquiry into the complex system of factors contributing to obesity – the system map, included in this report, is the first attempt to capture this complexity schematically. Futures thinking, through scenario planning and the quantitative model developed for Foresight, has allowed the exploration of longer-term trends and demonstrates that achieving change will require patience and persistence. The work assembled for this project gives the UK a platform to become a global leader in tackling a problem that is challenging policy makers across the world.

The findings do not represent government policy. Nonetheless, I would like to acknowledge the contribution made by many colleagues across Government and, in particular, to thank the Ministers concerned Dawn Primarolo, Caroline Flint, Kevin Brennan, and Gerry Sutcliffe for their support and active sponsorship of the project.

**Sir David King KB ScD FRS**

**Chief Scientific Adviser to HM Government, and Head of the Government  
Office for Science**

## Preface

We are delighted to receive this Foresight report from Sir David King. Its far-reaching research and evidence has given us new insights into the challenges we face in tackling obesity.

The report points out that the attention often given to the most extreme cases of morbid obesity has masked the important reality that, as a nation, we are slowly getting fatter. At this rate, we are in real danger of obesity ultimately becoming the norm.

An unhealthy weight is often seen as a result of individual choice on diet, exercise and lifestyle. However, this report maps the complex web of societal and biological factors that have, in recent decades, exposed our inherent human vulnerability to weight gain. If we fail to tackle this 'obesogenic environment' the consequences for individuals, families, communities and society as a whole are grave.

We will therefore jointly be acting on the findings of this project, taking a system-wide approach with Ministers across Government and with professionals and policy makers on a local level. An Expert Panel, drawing on the breadth and depth of expertise that contributed to the report will help us with this.

As the report demonstrates, there is no quick and easy solution to tackling obesity. However, we have the long-term commitment – and the learning now – to work together to create a 21<sup>st</sup> century society better in tune with our biology.



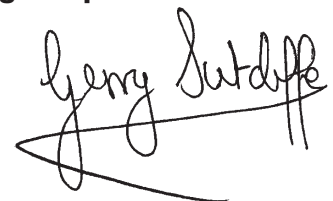
**Rt Hon Dawn Primarolo MP**

**Minister of State for Public Health**



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**Parliamentary Under Secretary of State for Children,  
Young People and Families**



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## Executive summary:

key messages and principles for action



## Tackling Obesity: Future Choices – Executive summary

The rapid increase in the number of obese people in the UK is a major challenge. This analysis by the government's Foresight programme shows that over half of the UK adult population could be obese by 2050.<sup>1</sup> The economic implications are substantial. The NHS costs attributable to overweight and obesity are projected to double to £10 billion per year by 2050. The wider costs to society and business are estimated to reach £49.9 billion per year (at today's prices).<sup>1,2</sup>

People in the UK today don't have less willpower and are not more gluttonous than previous generations. Nor is their biology significantly different to that of their forefathers. Society, however, has radically altered over the past five decades, with major changes in work patterns, transport, food production and food sales. These changes have exposed an underlying biological tendency, possessed by many people, to both put on weight and retain it. Being overweight or obese increases the risk of a wide range of chronic diseases, principally type 2 diabetes, hypertension, cardiovascular disease including stroke, as well as cancer.<sup>3</sup> It can also impair a person's well-being, quality of life and ability to earn.

The pace of the technological revolution is outstripping human evolution<sup>4,5,6,7,8,9,10</sup> and, for an increasing number of people, weight gain is the inevitable – and largely involuntary – consequence of exposure to a modern lifestyle. This is not to dismiss personal responsibility altogether, but to highlight a reality: that the forces that drive obesity are, for many people, overwhelming. Although what we identify in this report as 'passive obesity' occurs across all population groups, the socially and economically disadvantaged and some ethnic minorities are more vulnerable.

Being overweight has become a normal condition, and Britain is now becoming an obese society. But this transition has been at least three decades in the making. The research commissioned by Foresight reveals that the causes of obesity are embedded in an extremely complex biological system, set within an equally complex societal framework. It will take several decades to reverse the factors that are driving current obesity trends. Currently, no country in the world has a comprehensive, long-term strategy to deal with the challenges posed by obesity.<sup>11</sup> There is an urgent need for action to halt the rapid current increase and to develop a sustainable response.

The UK Government's Foresight programme in the Government Office for Science was asked to consider how society might deliver a sustainable response to obesity in the UK over the next 40 years. Foresight works across government departments to analyse complex cross-cutting issues. Its projects entail the



rigorous use of science to inform futures thinking in Government. The Tackling Obesities: Future Choices project has involved over 300 experts and stakeholders, has extensively reviewed the evidence base and used a variety of futures techniques to help identify possible solutions.

The project's objectives were to:

- use the scientific evidence base from across a wide range of disciplines in order to **identify the broad range of factors** that influence obesity, looking beyond the obvious
- create a **shared understanding of the relationships** between key factors influencing levels of obesity and their relative importance
- build on this evidence to **identify effective interventions**
- analyse how **future levels of obesity** might change and identify the **most effective future responses**.

This report presents the key messages and implications for the UK. These are based on an extensive analysis of a wide range of evidence, including several commissioned evidence reviews, a systems analysis of the primary determinants of obesity, scenarios of possible futures and a quantitative model of future trends in obesity and associated diseases (these reports are listed in Appendix 2 and are referenced throughout the text).

## Visualising the future

Obesity is already a major issue in some countries, such as the USA, and the rise in obesity is worldwide<sup>11</sup>. However the prevalence of obesity has more than doubled in the last 25 years in the UK. In England, nearly a quarter of adults and about 10% of children are now obese, with a further 20–25% of children overweight (see Section 2).<sup>12</sup> Foresight's extrapolations suggest that we can anticipate some 40% of Britons being obese by 2025.<sup>1</sup> **By 2050, Britain could be a mainly obese society.**<sup>1</sup>

Socioeconomic differences in the prevalence of obesity are predicted to continue<sup>1</sup> as is the greater prevalence in some regions of Britain, including Scotland and the north and east of England. The marked rise in childhood obesity is also predicted to continue (see Section 2).<sup>1</sup> And the proportion of chronic disease including type 2 diabetes, stroke and chronic heart disease that is attributable to obesity will increase substantially.<sup>1,3</sup>

The rate of increase in obesity is susceptible to a number of external drivers of change and to lifestyle and societal factors.<sup>13–16</sup> To help us understand how such critical uncertainties influence the predictions above,<sup>16</sup> four scenarios were developed that are based on differing attitudes to future challenge ('prepare' or

‘mitigate’) and on whether responsibility is held by society to lie first and foremost at the national, community or individual level (see Section 6).

The scenarios strongly suggest that social values and the way society chooses to respond to long-term challenges will be critical in determining the extent to which the possible futures described here might be fulfilled. Indeed, the greatest opportunity to tackle obesity effectively was found in the scenario that is the most ‘socially responsible and prevention focused’.

Expert opinion suggested that, in the absence of additional interventions, the prevalence of obesity would continue to rise in each of the four scenarios. There was no expectation of any spontaneous reversal of obesity trends<sup>16</sup> but a strong feeling that a crisis, for example, a dramatic increase in food or fuel prices precipitated by water shortage or climate change, might be the only way of triggering action.<sup>16</sup>

Attitudes to intervention also emerged as a leading determinant of success.<sup>16</sup> It is clear that efforts to reverse the rising trend and address the prospect of the rising health burden and societal costs will be demanding and will necessitate major changes in behaviour – not only in individuals, but also in families, communities, organisations and economic markets. These behaviour changes will be more acceptable in some social settings than in others.

### Obesity: a complex system

A systems mapping approach was used to gain insight into the biological and social complexity of obesity. An obesity system map was constructed using detailed advice from a large group of experts drawn from several different disciplines. It represents the most comprehensive ‘whole systems’ view of the determinants of energy balance that exists<sup>17,18</sup> (see Section 5).

The system map, together with scientific and other evidence, confirms that energy balance (or imbalance) is determined by a **complex multifaceted system of determinants (causes)** where no single influence dominates<sup>17,18</sup> (see Sections 3, 4 and 5). Altering this complex system to tackle obesity will be far from straightforward. Currently, the evidence for effective preventative measures is weak<sup>19</sup> (see Section 4). There are few international examples of success on which the UK can draw,<sup>11</sup> although a growing number of demonstrator projects offer some promise (see Section 4).

At the heart of the issue of excess weight lies a homeostatic biological system, struggling to cope in a fast-changing world, where the **pace of technological revolution outstrips human evolution**<sup>4-10</sup> (see Section 3). Research clearly indicates how human biology gives many people an underlying propensity to accumulate energy and conserve it because of genetic risk,<sup>4</sup> the influence of early life experiences<sup>9,20</sup> and the sensitivity of the appetite control system



(see Section 3.1).<sup>7,8,21</sup> The concept of a family of 'obesities' is therefore a useful way of reflecting the diverse origins of the condition.

However, except in very rare cases, these factors alone can't explain the rapid increase in the prevalence of obesity in the population over the last three decades. Rather, changes in the external environment have revealed this underlying tendency to gain weight in more of the population. Obesity is linked to broad social developments and shifts in values, such as changes in food production, motorised transport and work/home lifestyle patterns. The technological revolution of the 20th century has left in its wake an '**obesogenic environment**' that serves to expose the biological vulnerability of human beings. An understanding of the causes of obesity is critical to the success of focused treatment and prevention strategies (see Sections 2, 3 and 4).<sup>4-9,14,22</sup>

Obesity takes time to develop and excess weight takes time to be lost. The risks of becoming obese may also start at an early stage. Growth patterns in the first few weeks and months of life affect the risk of later obesity and chronic disease (see Section 3.2).<sup>9,20</sup> There is therefore a **life course component**.

There is also a **generational dimension**. The most significant predictor of childhood obesity is parental obesity (obesity in a parent increases the risk of childhood obesity by 10%).<sup>23</sup> Although this is the result of many biological, social and environmental factors, it is important to break this reinforcing pattern.<sup>12</sup>

But most children are not obese and currently most cases of obesity become apparent in adulthood. Interventions must therefore continue to attempt to avert adult-onset obesity.

### Key determinants of obesity

The scientific evidence and the map of the obesity system commissioned for this project have identified a multitude of influences on energy balance. They can be broadly grouped into physiological factors, eating habits, activity levels and psychosocial influences<sup>17,18</sup> (see Section 5). Within each of these four categories, we identified a key determinant of vulnerability. These are:

- primary appetite control in the brain
- the force of dietary habits, keeping individuals from adopting healthier alternatives
- the level of physical activity
- the psychological ambivalence experienced by individuals in making lifestyle choices.

The central dynamic of the obesity system is a **positive feedback cycle that locks us into a pattern of positive energy balance**<sup>17</sup> as individuals and at a societal level. This 'lock-in' is a powerful force that, when well-intentioned interventions are made, can give rise to unexpected consequences both for individuals – e.g. compensatory changes in eating and activity (see Section 3.1) – and for society – e.g. the drive to make food cheaper, which may increase the amount eaten (see Section 5).

These four determinants, combined with the lock-in to a positive feedback cycle, are driving excess weight gain in an increasing proportion of the UK population. In addition, many of the other determinants in the obesity system map are driven by powerful forces, such as the need for more time or convenience, the desire to reduce stress, the availability of greater choice, and the desire for short-term rewards or compensations (see Section 5).

New insights in neurobiology show how powerfully the wide variety and appeal of modern foods, with their increased palatability and ability to heighten sensory stimulation, drive us to reward ourselves with more food<sup>8,21</sup> (see Section 3.1). This has the effect of overwhelming the efforts of our innate biological system trying to balance energy intake with energy needs. Many unhealthy behaviours that are common today are often the 'easy' option – in some cases, they are the only option. So, while many children who are currently driven to school *could* walk or cycle, a combination of parental fears, a sense that roads are dangerous, long travelling distances and the desire for convenience mean that the numbers who do so remain small.

Taken together, these four determinants point to the development of obesity as a more passive activity than is often assumed (see Sections 3, 4 and 5) and this passivity contributes to the normalisation of obesity. **'Passive obesity' makes healthy behaviours an inherent challenge** and more people need to use active coping strategies to prevent weight gain. This suggests that broadly based societal interventions are needed to combat these drivers. The concept of passive obesity raises important questions over how we respond as a society and where the responsibility for action lies.

Our attitudes and responses are also key drivers of obesity trends. Ambivalence emerges as a key driver of obesity<sup>16–18,22,24–27</sup> (see Section 3). The psychological conflict between what people want (e.g. tasty, high-fat, sweet foods) and their desire to be healthy and/or slim combined with mixed feelings and beliefs about broader lifestyle priorities complicates individual choices. People who are ambivalent about an issue may react to health-related messages in unexpected and counterintuitive ways. In addition, many people do not perceive obesity as an issue that affects them personally and consequently public demand for significant action is relatively weak.<sup>22,24</sup> This reinforces the importance of designing options for healthy behaviour or 'cues' for behavioural change that can become usual





practice and which will influence those not yet ready to make active choices. Behaviour change, we note, is not only the concern of individuals. It is a concern for organisations, communities and families. All of these influence the settings in which individual behaviour occurs.

### What approaches might work?

The complexity and interrelationships of the obesity system described in this report make a compelling case for the futility of isolated initiatives. Focusing heavily on one element of the system is unlikely to successfully bring about the scale of change required.<sup>1,25</sup> There are, as yet, no concerted strategies or policy models that adequately address the problem<sup>11,13</sup> (see Section 4) either in the UK or Europe. There are opportunities for the UK to take a leading role by developing and implementing a cross-cutting, comprehensive, long-term strategy that brings together multiple stakeholders. There is also a strong case for the promising approaches of community-based interventions in other countries to be expanded to one or two regions or cities in the UK as exemplars.

The distinction between prevention and treatment is important. Once gained, weight is difficult to lose. Emphasis on prevention is therefore vital and the focus of this report. However, there are already significant numbers of obese people requiring treatment and the numbers will rise regardless of any short-term measures. Treatments are of limited effectiveness but there have been some successes.<sup>28</sup> Modest weight loss (by 5–10% of initial weight) reduces the risk of developing type 2 diabetes, improves blood pressure and reduces total cholesterol. However, many people find it very difficult to maintain weight loss and there is often a gradual regain.

### Behaviour change

Preventing obesity requires changes in the environment and organisational behaviour, as well as changes in group, family and individual behaviour. Behaviour change is an important component of any response to obesity. However, this is a complex process for individuals that goes beyond education and the provision of information<sup>22</sup> (see Section 4.1). Achieving change is difficult, resource-intensive and time-consuming. Campaigns to encourage reflection, maintained and supported by changes in the environment, can help prevent unhealthy behaviours from resurfacing.<sup>22</sup>

Interventions based on improved nutrition and increased physical activity can be effective for individuals (see Section 4.2). But shifting the *population* distribution of obesity will require interventions that target elements of the obesogenic environment as well. Evidence suggests that current strategies are failing to have sufficient impact because they do not offer the range and depth of interventions needed (see Sections 3, 4, 5, 6 and 7). Interventions need to cover the entire

terrain; otherwise continued drivers acting on one part of the obesity system might undermine positive action elsewhere (see Section 8).

### Changing the environment we live in

Changes to our environment (including both the activity- and food-related environment) are a necessary part of any response to support behaviour change and appropriate behaviour patterns.<sup>29</sup> Solutions to address the obesogenic environment such as changes in transport infrastructure and urban design (in Section 4) can be more difficult and costly than targeting intervention at the group, family or individual. However, they are more likely to affect multiple pathways within the obesity system in a sustainable way.<sup>17,18,29</sup> In the short term, creating demand for such change may rely on aligning the benefits with those arising from broader social and economic goals such as reducing energy consumption, pollution, direct and indirect health costs, traffic congestion and crime rates. In the long term, strengthening action against obesity may not only reduce health and disability costs but also produce a generally healthier and more environmentally sustainable society.

### Changing biology

It is unlikely that our biological predisposition to gain weight in a modern society can itself be modified significantly in the medium term. Nevertheless, it is possible to ensure that physiological development is optimal to reduce our vulnerability to the 'obesogenic environment' and the risk of obesity and associated chronic disease (see Sections 3 and 4). Early life interventions such as breast-feeding, healthy weaning practices and appropriate maternal nutrition have all been linked to reduced obesity later in life.<sup>9,20</sup>

### Will technology provide a solution?

Recent attention by the media reflects an interest and desire for technological solutions to obesity. New drugs that can help regulate appetite control and energy intake may be developed that do not have the side-effects and limited efficacy of current treatments.<sup>7,30</sup> However, the relatively high costs, possible risks and lack of societal acceptability mean the use of medicines alone is not a long-term sustainable solution (see Section 4.2).

Other technology to support healthy behaviours will become available. Devices to monitor and provide feedback on energy intake and energy expenditure, along with biomarkers of health, such as blood pressure, and blood glucose in real time are anticipated.<sup>31</sup> Although these devices may help individuals gain more rapid feedback, research suggests that people may not act on this information<sup>22</sup> (see Section 4.1).



Altering the composition and manufacture of food products could help address obesity by seeking to control the release of macronutrients, by reducing energy-dense ingredients and by structuring food to slow the rate at which the stomach empties<sup>32</sup> (see Section 4.1). Whether such products would be acceptable to consumers, especially in the current climate, which favours a more 'natural' choice, is uncertain<sup>33</sup> (see Section 6.4.1).

To date, technological developments have tended to reduce energy needs, and this trend is likely to continue.<sup>31</sup> The development of active leisure pursuits built around computing technologies is expanding (see Section 6.4.2), but the contribution to physical activity levels is unclear.<sup>31</sup> Currently, technology in the home is increasing the desirability of indoor leisure activities, whereas the incentives for outdoor play have changed little or decreased due to perceptions of safety and reduced opportunities (see Section 3).

### The policy challenge: a paradigm shift

The prevalence of obesity is a major challenge, not just for medicine and public health but for governance and decision making. The deceptively simple issue of encouraging physical activity and modifying dietary habits, in reality, raises complex social and economic questions about the need to reshape public policy in food production, food manufacturing, healthcare, retail, education, culture and trade. In some respects, the objectives of previous eras, for example, improvements in food availability or opportunities for personal travel, now need reassessment in a time when energy-dense food is ubiquitous and transport choices restrict walking or cycling.

Our evidence shows that a **substantial degree of intervention** is required to affect an impact on the rising trend in obesity. A systemic or paradigm shift is needed to disrupt the cycle of accumulation of fat and to restore balance. Achieving this would inevitably require some fundamental choices to be made, raising a range of ethical issues. Developing a mandate for such a shift is a formidable challenge. However, much progress could be made by creating a new framework for delivering an integrated strategy of prevention (see Section 8).

The challenge is to produce a range of solutions that are effective *across* different areas of government policy rather than *within* them to deliver a corrective population-wide shift. But the effectiveness of policies isn't just a matter of what works well – policies also have to work in a way that society finds acceptable.<sup>13,16,25</sup> Therefore the appropriate level for policy intervention and the apportioning of responsibility is more than a question for policy makers – it is **a case for national debate**.

## The wider health agenda

Obesity has much in common with many of the other challenges faced in public health, and many of the wider determinants of health are the same. The social, infrastructural and environmental factors that need to frame the planning and implementation of policies for obesity coincide with many other public health issues, including the management of several chronic diseases, for example:

- acting when the degree of intervention required to achieve a significant impact on obesity prevalence may create tensions with broader societal aspirations
- providing strategic leadership and co-ordinating action when implementation is complex, requires cross-government attention and responsibilities are dispersed
- making choices and policy trade-offs
- managing risks in the context of limited evidence
- stimulating changes in approach when a sense of urgency or policy priority in the wider community is lacking
- managing the risk of unexpected consequences of policy measures.<sup>22,25</sup>

The scale of the challenge to prevent obesity is magnified by the complex nature of the condition. The multiplicity of causes of obesity argues against a dependence on fragmented solutions to address the issue; and too heavy a focus on one part of the obesity system – on one population group, for example – is not likely to bring about the scale of change required.

A long-term comprehensive strategy will need to incorporate a range of policies that will need to act in at least three dimensions, specifically:

- Systemic change is needed across the 'system map' and focusing on initiatives aimed at behaviours and the cues for behaviours relating to food, physical activity and physiological and psychosocial factors.
- Interventions designed to change a single factor may need to be conducted at multiple levels of governance, i.e. at individual, local, national and global levels.
- Different interventions targeting the same process of behaviour change will be needed across the life course.

## The way forward

The issue of obesity challenges the traditional research paradigm for clinical medicine and epidemiology. The collation of diverse data over long periods of time is at variance with the need for urgent action. In addition, as the prevalence of obesity rises, it will become normal to be obese, which may dilute calls to action. Scientists must, where necessary, make do with the best evidence available. This



means placing greater priority on ‘practice-based evidence’. Likewise, policy makers must accept that some well-intentioned interventions may fail.<sup>10,34</sup>

Action through **alignment with other major policy issues is vital** in maximising the engagement of a broad range of stakeholders. Some policies can act indirectly to reduce the prevalence of obesity through actions motivated by other priorities. For example, policies relating to climate change and health inequalities have been identified as particularly critical in developing a strategy to tackle obesity.<sup>12,14,16-18,20,25,35</sup>

There are strong **parallels between climate change and obesity**. In both issues, failure to act early will lead to serious adverse consequences in just a few decades. Delay in agreeing remedies and acting on them raises the real possibility that reversal of the trends may cease to be an option for both. Similarly, disagreement about the causes of a complex issue will marginalise a multiple approach to remedial change.

There is very considerable evidence for identifying synergies and complementarities with other policy goals such as climate change, social inclusion and well-being to strengthen the case for action and provide multiple benefits. There is a fundamental need to actively explore links with a number of policy issues to provide the foundation of a long-term, comprehensive, integrated strategy (see Figure 8.3, p 126).

### Principles for action

Given the serious challenges identified, obesity can and must be tackled. It is beyond the scope of this report to recommend specific policies. However, we have identified five core principles to developing a strategy framework for triggering, and achieving, sustained policy success (Table ES1).

**Table ES1: Core principles for tackling obesity**

1	A system-wide approach, redefining the nation’s health as a societal and economic issue
2	Higher priority for the prevention of health problems, with clearer leadership, accountability, strategy and management structures
3	Engagement of stakeholders within and outside Government
4	Long-term, sustained interventions
5	Ongoing evaluation and a focus on continuous improvement

A strategy to tackle obesity needs a **comprehensive portfolio of interventions** targeting a broad set of variables and different levels within the obesity system (see Section 8). Although, alone, each component part of the strategy may not create significant impact, their complementary and reinforcing action is critical to achieving the significant shift required in population obesity trends if the strategy



is not to fail.<sup>13,17,18,25</sup> The need for short-term action and impact must be balanced against the drive for longer-term sustainable change. Table ES2 outlines criteria for including specific policies in a portfolio.

### Table ES2: Critical dimensions of an obesity policy portfolio

#### **Does the strategy:**

- ... contain interventions that act at different levels with varying but cumulative degrees of impact (amplifiers, enablers, focused initiatives)?
- ... influence a broad set of systems levers (physiological/psychosocial/food-related factors and the physical activity environment)?
- ... obtain a balance between population-level measures and targeted interventions?
- ... act at multiple levels, from the national through the local to the individual?
- ... take time into account (e.g. life-course and generational effects)?
- ... have interim targets and measures, as well as a long-term obesity goal?
- ... actively seek alignment with other policy agendas, recognising synergies and conflicts?
- ... engage a broad range of stakeholders?
- ... consider the balance between cost-effectiveness and achievability?
- ... consider the impact on and implications for health inequalities?

#### **Is the strategy supported by:**

- ... an ongoing strategy development process underpinned by expert analysis, data-gathering processes and a robust evaluation framework?
- ... suitable government management structures to enable clear leadership, strategy formulation and co-ordination of action across Government (UK, devolved administrations, regions and localities) and with other key stakeholders?
- ... underpinning risk analysis (for management of unexpected consequences)?
- ... sufficient resources to enable a scaled-up response?

Greater interaction between scientists and policy makers, building on existing links, will help maximise the potential to develop and execute effective interventions in a virtuous circle of continuous improvement that combines scientific development, policy implementation and joint evaluation.<sup>10</sup> Ongoing surveillance and monitoring is essential for the analysis of policy options and impact. There is scope to refine these procedures to enhance their utility and to improve risk management through rigorous evaluation.<sup>36</sup>



## Engagement of stakeholders within and outside Government

Progress will be enhanced by stimulating multi-sector, multi-level action within and beyond the public health profession, as recognised by the National Institute for Health and Clinical Excellence (NICE) in its recent review of the evidence for action on obesity.<sup>37</sup> Numerous organisations from the public sector, industry, patient and consumer groups, and many others outside Government are already engaged in the efforts to combat obesity. Action to build on this and improve co-ordination would enable maximum benefit to be realised from this significant level of energy and resources. The systems mapping work shows that the majority of the levers of change lie outside the traditional health arena and outside the control of Government (see Sections 5 and 8). Working in partnership with multiple stakeholders to promote the health of the nation is critical to success.

## Long-term, sustained interventions

Interventions will only be effective if they are designed to have in-built sustainability.<sup>10</sup> Just as obesity develops slowly, both within individuals and populations, it will take time to establish new habits and build new structures to support healthy diets and enhanced physical activity. This also implies the need for long-term strategies spanning several generations and beyond traditional planning cycles. The introduction of interim targets and supporting measures will help us evaluate progress, with the expectation that impact will increase over time (see Section 8).

## Changes in priorities

A higher priority for the prevention of health problems is needed, with clearer leadership, accountability, strategy, resource and management structures. To succeed in tackling obesity, it is critical that the health of the population is seen as a priority both by government ministers and society at large. Other goals may be acting counter to this aim. Structural changes in Government may provide a mechanism to ensure the development and continued refinement of an overarching strategy and the co-ordination of activities. Seeing 'health impact' as a criterion for policy impact assessment, along with economic impact and environmental impact, could help reinforce this approach.

## Management and co-ordination of government response

Reducing the prevalence of obesity requires concerted long-term action from numerous stakeholders at multiple levels. The lead, however, must come from Government. We have argued that the infrastructure and environment to deliver a comprehensive long-term obesity strategy and a wide array of specific policies has much in common with other policy goals as well as other public health issues.

There are therefore wide-ranging implications for the strategic management and co-ordination of a complex issue within central government.

Different models for decision making in public health have been debated extensively in recent years. They range from the establishment of a government department dedicated to public health to a cross-cutting agency, office or commission of public health and the introduction of an 'obesity champion' or figurehead. Whatever model is used, it will benefit from a strong symbolic appreciation of the cross-cutting approach required to tackle obesity and similar public health issues, and must be able to:

- offer senior (Cabinet-level) government support
- develop a high-level, long-term comprehensive strategy
- obtain and act on strategic expert advice on an ongoing basis, for example, through the establishment of an expert advisory group
- deliver a sustained long-term view as well as short-term interim measures
- develop synergies with other cross-cutting policy issues
- co-ordinate implementation within and outside Government, including links between local and central government
- further develop relationships and partnerships with multiple stakeholders inside and outside Government
- further develop and resource mechanisms of surveillance and evaluation
- have sufficient resources to meet the rising challenges
- build on existing best practice

## Conclusion

In recent years, Britain has become a nation where being overweight has become usual, rather than unusual. The rate of increase in overweight and obesity, in children and adults, is striking. Obesity threatens the health and well-being of individuals and will place an intolerable burden on the Exchequer in terms of health costs, on employers through lost productivity and on families because of the increasing burden of long-term chronic disability.

Obesity is a consequence of abundance, convenience and underlying biology. It might also be viewed as the perverse outcome of constantly expanding 'choice'. What is certain is that this epidemic of 'passive obesity' is unlikely to come to a natural end, i.e. without intervention. Obesity presents society with a number of tough choices about the relative importance of different goals and aspirations. Obesity, like climate change, is a complex problem but it is not insoluble. At present the best current scientific advice suggests that solutions will not be found



in exhortations for greater individual responsibility, nor in short-term fragmented initiatives.

Tackling obesity is fundamentally an issue about healthy and sustainable living for current and future generations. This is only likely to be achieved if there is a paradigm shift in thinking, not just by Government but by individuals, families, business and society as a whole. There is therefore an urgent need for leadership, vision and above all, sustained commitment. The case for action can be strengthened by identifying potential synergies and complementarities with other policy goals, such as climate change, to provide multiple benefits. Alignment with other issues is crucial if the prospect of 60% of the UK population being obese in less than 50 years, with its attendant costs, is to be prevented from becoming reality. The UK has the opportunity to build on existing action and pioneer a new long-term integrated approach that sets a global standard for success.



# 1. Introduction







## Section 1: Introduction

The rising prevalence of obesity is a major issue for the UK. Being overweight has become normal and Britain is now becoming an obese society. Before we can begin to contemplate what a sustainable response to the issue might look like, several questions have to be confronted:

- What causes obesity?
- Why has the prevalence risen so sharply in the UK?
- How many people will be obese in future years?
- Is the populist view that we eat too much of the wrong food and take too little exercise correct?
- Are some people more vulnerable to gaining weight than others?
- Are there effective ways of treating obesity and how can we prevent it?

What quickly becomes apparent to anyone who examines the body of evidence from several different disciplinary sources is that the answers are neither straightforward nor, as is popularly supposed, necessarily known. Although a great deal of research has been done into the problem, much of the evidence is not integrated. Further, many of the studies that have been carried out have not been long-term studies or well controlled to exclude confounding effects.

The Foresight Tackling Obesity: Future Choices project is one of a number of projects within the Foresight programme based in the Government Office of Science. The aim of the Foresight programme is to build on the scientific evidence base to provide challenging visions of the future to help inform government strategies, policies and priorities. Foresight drew on a wide range of evidence in this project on obesity to provide policy makers and others with a framework for developing a strategic and sustainable response. New research was also commissioned to fill some of the gaps and cast new light on the determinants of obesity and its likely prevalence in the future. A systems mapping approach to help unravel the complexity of the condition was central to the analysis.

The Foresight programme uses futures methodology to explore uncertainty and future possibilities. In this project, scenarios were used to create possible futures, with two primary objectives in mind. The first was to test how strong drivers of obesity might influence the prevalence of the condition in different social and public policy settings. The second was to explore the potential impact of a range of interventions in those settings. A key component of gaining insight into the development of obesity in the future, and the likely impact on the incidence of related diseases and the healthcare costs, was the use of quantitative modelling

to simulate the prevalence of obesity in adults and children up to 2050. These data played an important role in shaping the conclusions of this report. As well as using published evidence, much emphasis was placed on the views and judgements of over 200 experts in workshops and other settings. This approach was particularly important in cases where evidence was absent or weak or where futures methodologies called for debate and discussion.

The background reports for this project, listed in Appendix 2, represent a comprehensive evidence base on each strand of the project's work, which is summarised in this report. Much of the scientific and related evidence was originally published in the *Obesity Reviews* journal.<sup>38</sup> Other reports compare international trends in the prevalence of obesity and their determinants and identify future trends in technology and the possible impact of these trends on obesity. We review the evidence for obesogenic environments and lifestyle changes and consider the perspectives of the food industry. The project also includes a system map, which frames the complexity of the determinants of obesity.


The project focuses primarily on the prevention of obesity. However, the rising numbers of obese people will need care and treatment in the coming decades and some attention has therefore been given to the likely implications in terms of health, cost and skills.

Any project that seeks to both unravel the complexities of an issue such as obesity and explore how it is likely to develop in the future is necessarily ambitious. Our aim was to analyse the evidence to inform future choices that need to be made and to guide the development of a comprehensive and integrated strategy to combat obesity. Foresight's primary goal is to inform policy makers, and this was our focus throughout. However, the resolution of obesity, like many other cross-cutting issues, doesn't lie solely with Government. Many stakeholders outside of the political process have a crucial role to play in helping to shape a future where obesity is no longer a major threat to health and well-being. Numerous organisations ranging from industry to patient and consumer groups and many others outside Government are already engaged with the challenge of obesity. This report is therefore aimed at a wide audience.

The success of any Foresight project depends not only on the quality and robustness of its analysis but, crucially, on the impact and effectiveness of follow-up actions that stakeholders sign up to undertake. Stakeholders commonly commit to using Foresight reports to inform their policy development, decision making, guidance and other activities. An 'action plan' is reviewed one year after the publication of a report and is an integral part of any Foresight project. The action plan for this project is published separately.



In this final report, we begin by setting out the scale of the problem (Section 2). A synthesis of the current evidence for the causation (Section 3) and effectiveness of interventions then follows (Section 4). The systems analysis is presented in Section 5, followed by a visualisation of possible futures using scenarios (Section 6). In Section 7, we discuss the implications of, first, different responses to tackling obesity using the scenarios in a qualitative modelling exercise, and, second, quantitative modelling simulations that examine the consequences of changes in BMI for health and the costs to the NHS. The implications of our analysis for developing a sustainable response to obesity are set out in Section 8.



## 2. The scale of the problem

This section draws on data from the Health Survey for England<sup>39</sup> to examine the current incidence and distribution of overweight and obesity. It explores their possible future trajectories and summarises the current evidence of co-morbidities. It reports the outcomes of a quantitative modelling exercise, using this evidence and current estimates of the associated costs to the NHS and society, to explore potential future costs



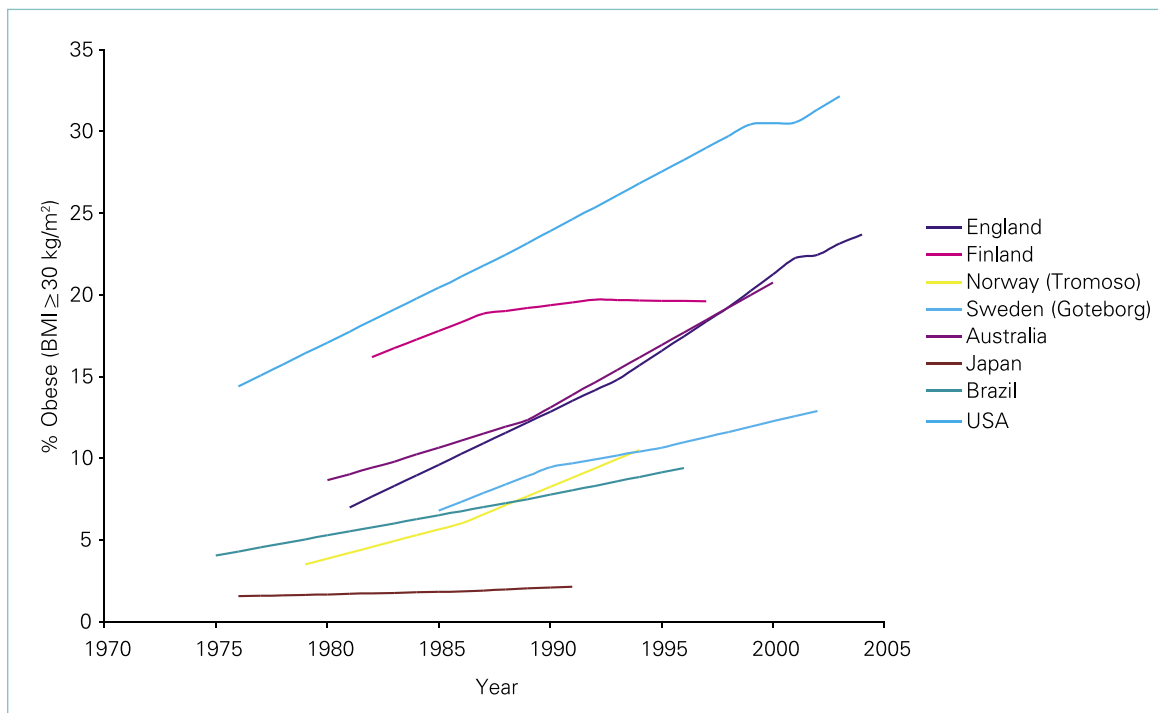
## Section 2: The scale of the problem

### 2.1 The prevalence of obesity

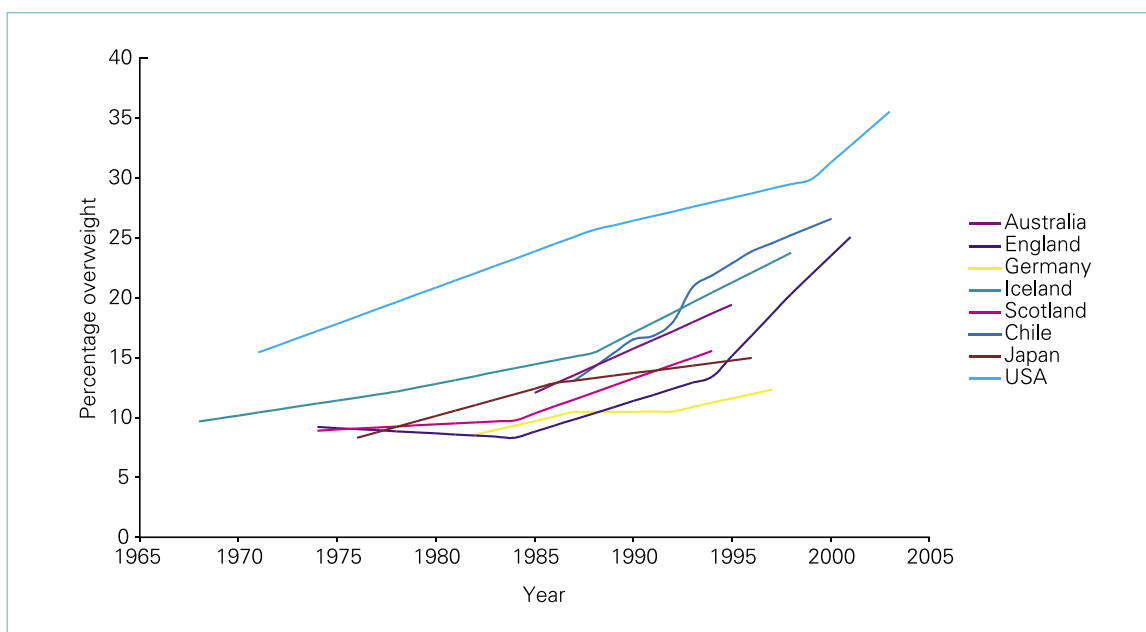
Obesity, or excessive fatness, is not a new phenomenon.<sup>40</sup> What is startling is the recent increase in the prevalence of overweight and obesity in virtually every country in the world (Figure 2.1). The latest World Health Organisation (WHO) estimates are that approximately 1.2 billion people in the world are overweight, of which at least 300 million are obese. In some countries, including the USA and the UK, the rates of obesity have more than doubled in the last 25 years, and being overweight has become the norm for adults. In 2003/2004, the mean body mass index (BMI) of men and women in the UK general population was 27kg/m<sup>2</sup>, outside the healthy range of 18.5–25kg/m<sup>2</sup> (BMI is a measure of weight relative to height, defined as weight (kg) divided by height (m<sup>2</sup>). The BMI range for normal weight = 18.5–24.9kg/m<sup>2</sup>; overweight = 25–29.9kg/m<sup>2</sup>, obese = 30–40kg/m<sup>2</sup> and morbidly obese = >40kg/m<sup>2</sup> (see Appendix 3)).

The increase in overweight and obesity around the world is seen in virtually all age groups, including pre-school and primary-school-age children (Figure 2.2).<sup>11</sup>

**Figure 2.1: Trends in adult prevalence of obesity – percentage of the adult population assessed as obese in a selection of countries from around the world<sup>11</sup>**





**Figure 2.2: Increasing overweight in children around the world<sup>11</sup>**

### Current trends in the UK: adults

Data on health are collected separately in England and Wales, Scotland and Ireland. The Health Survey for England,<sup>39</sup> which also includes Wales, is a series of annual surveys first instituted in 1991 and is part of an overall programme of surveys commissioned by the UK Department of Health designed to provide regular information on various aspects of the nation's health. Data from the devolved administrations show broadly similar trends but are collected less frequently. This report therefore draws primarily on the comprehensive data in the Health Survey for England. The Health Survey for England records BMI and other measurements such as waist and hip size, which makes possible the monitoring of the increasing prevalence of obesity in the population and its distribution across age groups, gender, socioeconomic status and region. Although BMI needs careful interpretation on an individual basis, it provides a meaningful picture at the population level.

The population median BMI (i.e. the middle value) has progressively increased among adults during the past three decades. Other measures that give an estimate of central or abdominal fatness, such as waist circumference and waist-to-hip ratio also show this rising trend. These measures may be more accurate predictors of disease in some groups.<sup>39</sup> The population shift towards overweight has been accompanied by a concomitant increase in the proportion of the population who are obese or morbidly obese.<sup>12</sup>





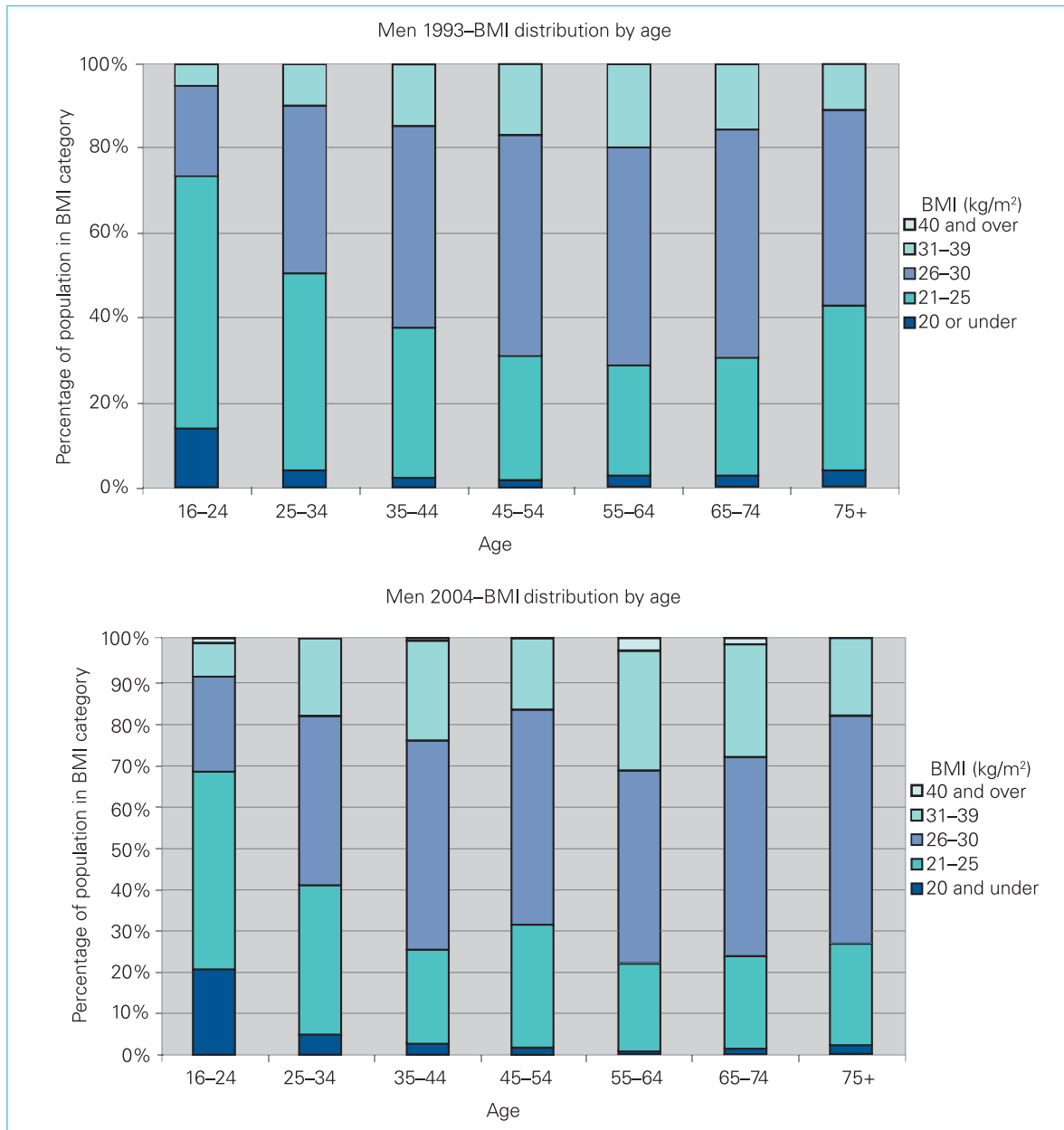
The most recent data from the Health Survey for England show that, in 2004, nearly a quarter of men (23.6%) and women (23.8 %) were obese. These figures have been predicted, in a recent report for the Department of Health, to increase to approximately 33% in men and 28% in women by 2010.<sup>41</sup>

The data from the Health Survey for England demonstrate how the incidence of overweight and obesity varies with age. Measurements of BMI in 1993 and 2004 (Figure 2.3) show an upward shift across all age groups over the decade, and reveal that the highest proportion of obesity is in men and women in the 55–64 age bracket. They also show the marked decline in the proportion of people in the healthy weight range, although the lower portion of the distribution, representing individuals classified as underweight, has remained remarkably constant over time.

### Current trends in the UK: children

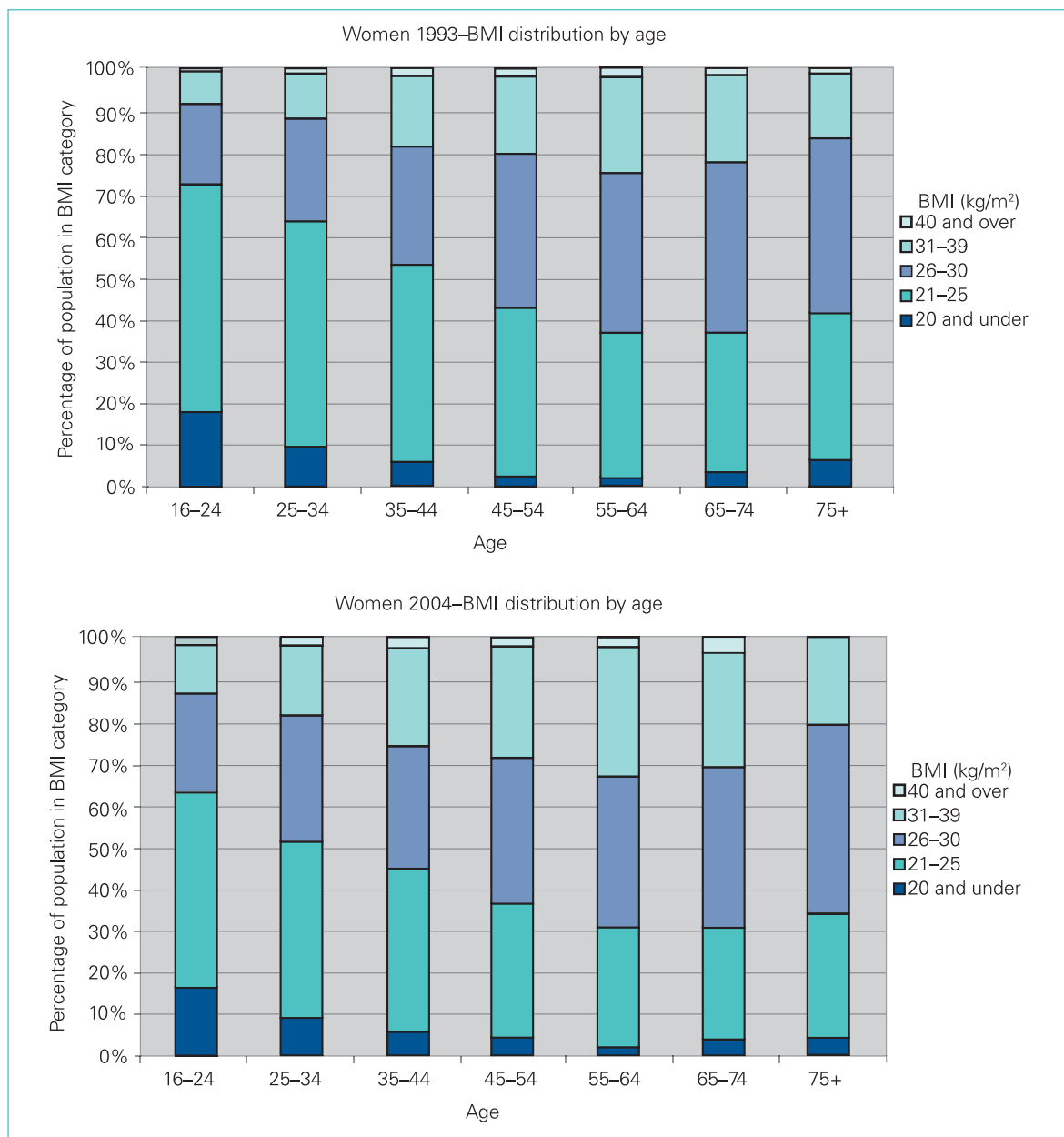
The classification of obesity in children is controversial because of difficulties stemming from variation in normal patterns of growth, weight gain and changes in body composition (see Box 2.1 and the report<sup>1</sup> – [Modelling Future Trends in Obesity and the Impact on Health](#)). For consistency, we refer throughout this report to childhood incidence rates calculated using the definition of childhood obesity from the International Obesity Task Force (IOTF)<sup>42</sup> – our figures may therefore differ from others reported.<sup>41</sup> This brings the advantage of comparability across nations and, most importantly, provides a smooth transition between the classification of obesity in children and adults. Applied to the raw data from the Health Survey for England for 2004, this definition identifies as obese around 10% of 6–10-year-old boys and girls, 5% of 11–15-year-old boys and 11% of 11–15-year-old girls. Across the under-20 age group as a whole, 10% of females and 8% of males are obese, and in the under-20 age group, a further 25% of females and 20% of males are overweight.<sup>1</sup> These figures do not include any adjustment to allow for bias in non-respondents to the survey and may actually under-represent the proportion of obese teenagers.

**Figure 2.3: Proportions of people overweight and obese – variation with age and changes over time.** Graphs show the proportion of the population in different BMI categories by age. Graphs are shown for men and for women in 1993 and in 2004. Data source HSE<sup>39</sup>





**Figure 2.3: Proportions of people overweight and obese – variation with age and changes over time.** Graphs show the proportion of the population in different BMI categories by age. Graphs are shown for men and for women in 1993 and in 2004. Data source HSE<sup>39</sup> (*Continued*)



### Box 2.1: Measuring the prevalence of obesity in children

In children, the relationship between BMI and being overweight or obese is subject to variation by age, height and gender. Obesity and overweight must therefore be defined with reference to age-specific and sex-specific points of the BMI distribution. The classification of an individual as overweight or obese will depend on the reference population used and the particular points of the distribution selected to define obesity or overweight.

In the UK, it has been common to use the 85th and 95th percentiles from the 1990 UK Growth Charts to define overweight and obesity at a population level. Therefore the diagnosis of obesity rests on an individual's position in a distribution that may have no strong association with health risk.<sup>43</sup>

The International Obesity Task Force (IOTF) has put forward an alternative derived from data collected among children from six countries. The IOTF identifies the childhood percentile in the dataset corresponding to a BMI of 25 or 30 (overweight or obese) at age 18 and makes the assumption that this percentile is the definition of overweight and obese tracking backwards to birth. The benefit of this approach is that it allows international comparisons of levels of obesity in children to be made and allows for a smooth transition from children to adults i.e. the weight status of an 18-year-old will be similarly classified by other adult criteria and the IOTF children's obesity definitions. This is not the case using the 85th and 95th percentiles from the UK Growth Charts. The IOTF definition is not designed for individual clinical diagnosis but is a useful epidemiological and surveillance tool and has been used in the quantitative modelling for this project.<sup>42</sup>

Crucially, whatever methodology is used for determining obesity prevalence in children, the data clearly demonstrate that the prevalence of overweight and obesity in children in the UK is increasing. We consider projected future trends in Section 2.2.

### Current trends in the UK: social class

The Health Survey for England moved from reporting by social class (I–V) to reporting by socioeconomic category (professional–routine occupations) in the late 1990s.<sup>39</sup> We refer to 'social class' where appropriate throughout this report rather than socioeconomic status because class categorisation remained consistently defined throughout the period for which data was available and was therefore used in our quantitative modelling exercise.<sup>1</sup>



The prevalence of obesity shows a marked gradient in relation to social class. The prevalence of obesity among men in 2004 was about 18% in Social Class 1 and 28% in Social Class V. For women, the gap is larger, with 10% prevalence in Social Class 1 and around 25% in Class V in 2004.<sup>39</sup> For women, the social class disparity is longstanding, while for men it has only become pronounced in recent years.

The factors underpinning the social gradient are currently poorly understood. Comparisons of populations internationally<sup>11</sup> show that, above a basic threshold, both obesity and diabetes are linked less strongly to absolute levels of national wealth than they are to indicators of inequalities within nations (such as the GINI index, which measures the extent to which the distribution of income among individuals within an economy deviates from a perfectly equal distribution). This suggests that links between socioeconomic status and obesity in the UK may be associated with the degree of relative social inequality.<sup>11</sup>

### Current trends in the UK: ethnicity

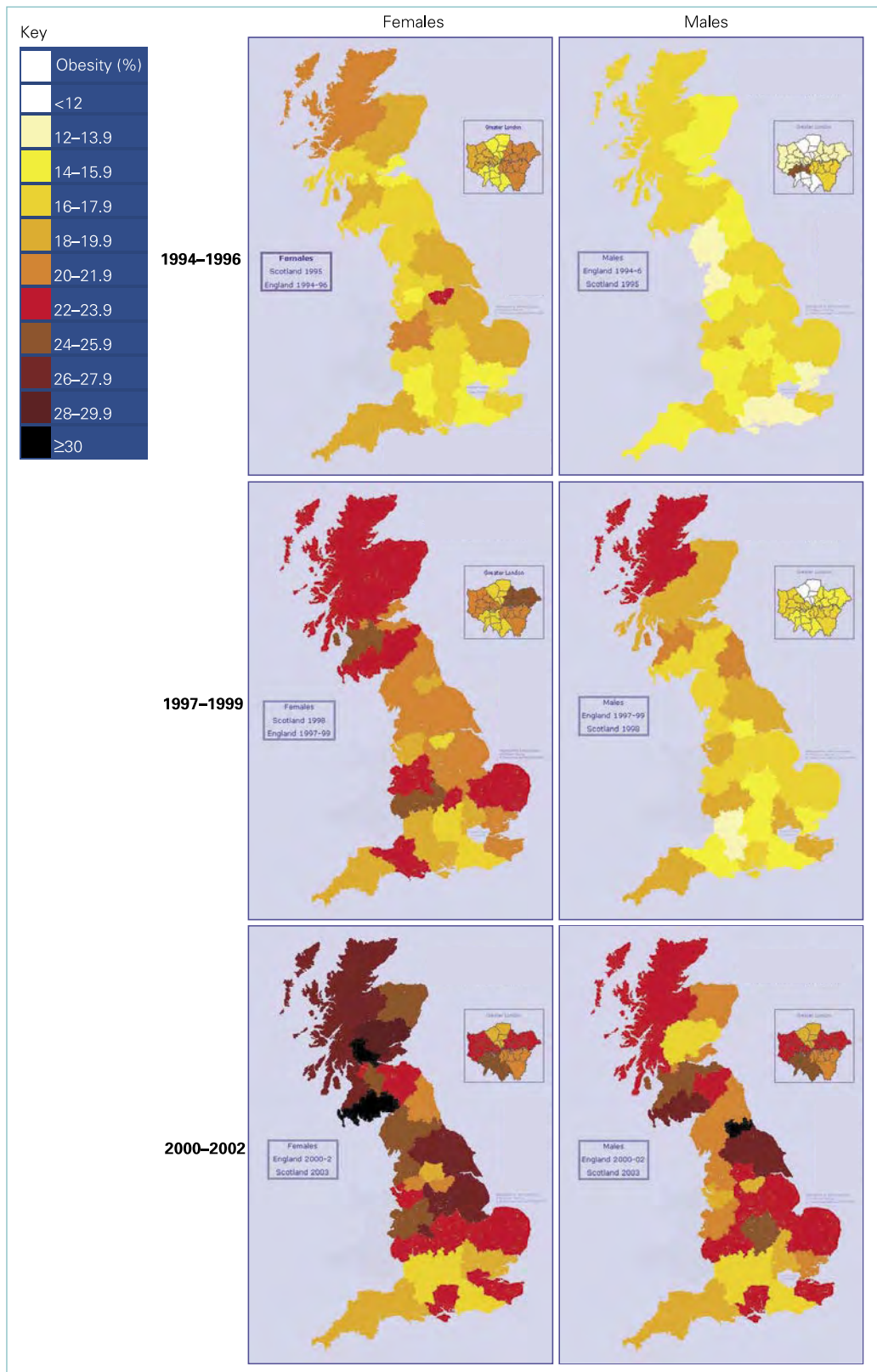
Data on the incidence of obesity in different ethnic groups are limited because national surveys tend to sample only relatively small numbers from minority groups. For many ethnic groups, the sample size is too small to allow for reliable comparisons or predictions. Nevertheless, it is notable that the prevalence of obesity is currently greatest in the Caucasian and Bangladeshi populations (i.e. 26% of Caucasian men, 23% of Caucasian women and 24% of Bangladeshi women).<sup>39</sup>

### Regional variation in obesity

The prevalence of obesity increased across Scotland and the English regions between 1994 and 2002 (Figure 2. 4).<sup>11</sup> Incidence is generally greater in Scotland and the north of England than in the south-west of England. The variations by age, socioeconomic status and ethnicity described above contribute to regional variations in obesity prevalence and are linked to other inequalities in long-term health. However, the contribution of other regionally specific factors to the difference revealed across the UK map is not clear from the available evidence.

### Obesity and the burden of disease

One of the challenges for policy makers, public health practitioners and other stakeholders is that the public and the media often focus on excess weight as an appearance issue, rather than one that concerns health. Obesity has become stigmatised, triggering the appearance of 'fat and proud' movements in the USA,<sup>44</sup> but at the same time overweight has become normalised. Still, obesity is known to lead to both chronic and severe medical problems, long documented though only formally classified by the WHO in 1997.<sup>3,13,39</sup> Not only do these medical



**Figure 2.4: Trends in levels of obesity (%) in males and females from 1994 to 2002 in England and Scotland<sup>11</sup>**

Notes: Figures for London are shown on the side of each map. In Scotland, the maps are based on Scottish Health Survey data. Areas were defined by Health Board. In England, maps are based on the Department of Health's Health Survey for England data. The data were produced by the National Centre for Social Research, February 2004. Areas were defined by Strategic Health Authority.





conditions adversely affect people's quality of life, but they create serious, rising financial and social burdens. The potential future costs are explored in Section 2.3.

Several conditions are associated with overweight and obesity. They include type 2 diabetes, hypertension, coronary heart disease and stroke, metabolic syndrome, osteoarthritis and cancer.<sup>3</sup> An overview of associations between BMI and the development of a range of diseases is given in Box 2.2.

### **Box 2.2: Increasing body fatness is associated with serious medical complications.<sup>3</sup>**

#### **Type 2 diabetes**

90% of Type 2 diabetics have a body mass index (BMI) of  $>23 \text{ kg/m}^2$

#### **Hypertension**

5 fold risk in obesity

66% of hypertension is linked to excess weight

85% of hypertension is associated with a BMI  $>25 \text{ kg/m}^2$

**Dyslipidaemia** progressively develops as BMI increases from  $21 \text{ kg/m}^2$  with rise in small particle low-density lipoprotein (LDL)

#### **Coronary artery disease (CAD) and stroke**

2.4 fold in obese women and two-fold in obese men under the age of 50 years

70% of obese women with hypertension have left ventricular hypertrophy

Obesity is a contributing factor to cardiac failure in  $>10\%$  of patients

Overweight/obesity plus hypertension is associated with increased risk of ischaemic stroke

#### **Respiratory effects**

Neck circumference of  $>43 \text{ cm}$  in men and  $>40.5 \text{ cm}$  in women is associated with obstructive sleep apnoea, daytime somnolence and development of pulmonary hypertension

#### **Cancers**

10% of all cancer deaths among non-smokers are related to obesity (30% of endometrial cancers)

#### **Reproductive function**

6% of primary infertility in women is attributable to obesity

Impotency and infertility are frequently associated with obesity in men

#### **Osteoarthritis (OA)**

Frequent association in the elderly with increasing body weight – risk of disability attributable to OA equal to heart disease and greater than any other medical disorder of the elderly

**Liver and gall bladder disease**

Overweight and obesity associated with non-alcoholic fatty liver disease and non-alcoholic steatohepatitis (NASH). 40% of NASH patients are obese; 20% have dyslipidaemia

3 fold risk of gall bladder disease in women with a BMI of  $>32 \text{ kg/m}^2$ ; 7 x risk if BMI of  $>45 \text{ kg/m}^2$

Risk factors for some conditions start to increase at relatively low BMIs (e.g. hypertension and type 2 diabetes). Eighty-five per cent of patients with hypertension have a BMI of  $>25 \text{ kg/m}^2$  and 90% of those with type 2 diabetes have a BMI  $>23 \text{ kg/m}^2$ . The risk of developing type 2 diabetes is about 20 times more likely for people who are obese compared to lean people. Abdominal obesity is a particular risk for the cluster of diseases that have become known as the metabolic syndrome – type 2 diabetes, hypertension, and dyslipidaemia – and is strongly linked to an increased risk of cardiovascular disease.<sup>3</sup> Thirty per cent of middle-aged people in developed countries have features of the metabolic syndrome. Its association with abdominal fat suggests that specific measures of excess weight distribution in the body may be more accurate predictors of disease among some groups than measures such as BMI. However, these are harder to establish and so are less commonly recorded and reported than BMI.<sup>3</sup>

Greater awareness of the substantial and chronic disease burden associated with overweight and obesity has led to particular concern about the economic implications of the population's weight gain. The numbers of those who are overweight and obese are set to rise significantly. A sense of urgency has extended beyond the healthcare sector to Government to try and understand the causes of the problem and to consider how it can be addressed. A critical step in managing what some see as an epidemic is to gain insight into the likely prevalence of overweight and obesity in the future. Section 2.2 explores the possible future trajectories of current trends.

## 2.2 Future trends in obesity<sup>1</sup>

In order to explore the possible prevalence of obesity in the UK population in the future, an analysis using extrapolation and microsimulation techniques was commissioned by Foresight to obtain the best predictions based on current knowledge.<sup>1</sup> This work has created a unique tool for exploring future trends in obesity and their health implications. The dataset of the Health Survey for England<sup>39</sup> from 1994–2004 was used as the basis for extrapolating the distribution of people across the various BMI categories, to 2050.<sup>1</sup> The simulation allows estimation of trends in obesity for different age groups and by gender, social class and geographical region.



Attempting to make projections so far into the future is always compromised by lack of evidence. Additional investigation and data gathering would be required to fully explore the complexity of these trends. However, the 10-year dataset on which the extrapolations are built demonstrate clear and stable trends. This gives confidence that the projections have value in the medium term, even though the confidence intervals associated with the predicted figures generated by the model grow larger as we project into the future. By 2050, the 95% confidence intervals for predicted population figures are frequently 10 percentage points, and sometimes wider. For ease of presentation, we cite figures without the confidence intervals, unless they are exceptionally wide.

Discussion here focuses on the forecasts of obesity in adults and children. Other data, for example, on subgroups by age, can be found in the project's quantitative modelling report (Tackling Obesities: Future Choices - Modelling Future Trends in Obesity and the Impact on Health).<sup>1</sup>

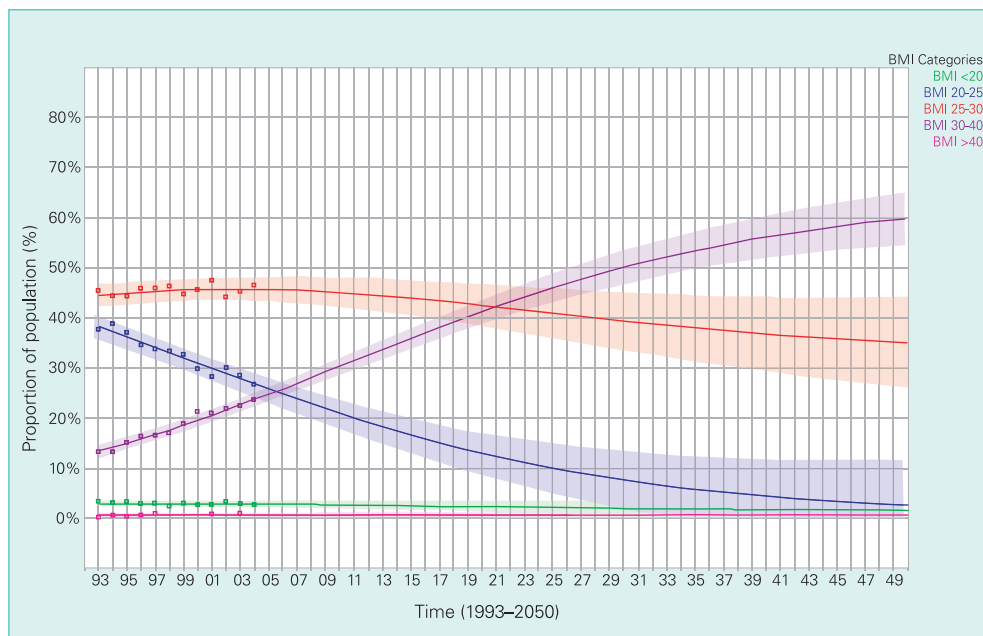
### Future trends: adults<sup>1</sup>

The extrapolation of current trends, which underpins the microsimulation, indicates that, by 2015, 36% of males and 28% of females will be obese.<sup>1</sup> By 2025, these figures are estimated to rise to 47% and 36% respectively. By 2050, 60% of males and 50% of females could be obese (see Figure 2.5). The proportion of men having a healthy BMI (18.5–25kg/m<sup>2</sup>) declines from about 30% at present to less than 10% by 2050. Similarly, the proportion of women in this 'healthy weight' category drops from just over 40% to about 15% by 2050.<sup>1</sup>

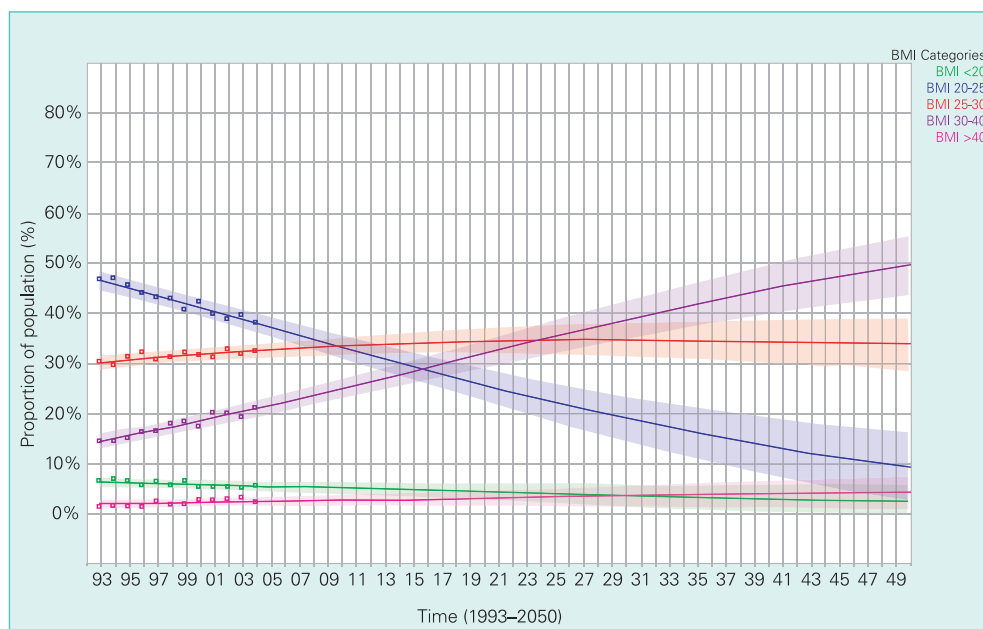
Figure 2.5 shows the proportion of the population aged 21–60 in each of the five BMI categories for each year of data taken from the Health Survey for England. It extrapolates from these data the predicted proportions shown by the curves, with 95% confidence intervals. The regression curves are fitted to the data as described in the project's detailed quantitative modelling report<sup>1</sup>. For any given year, all five categories must add up to 100%. The figure shows the same information separately for adult males (a) and females (b).

**Figure 2.5: Proportions of the population belonging to different BMI categories** – underweight ( $<20\text{kg/m}^2$ ), normal ( $20\text{--}25\text{kg/m}^2$ ), overweight ( $25\text{--}30\text{kg/m}^2$ ), obese ( $30\text{--}40\text{kg/m}^2$ ), morbidly obese ( $>40\text{kg/m}^2$ ) for each year of data from the Health Survey for England (1993–2004) – marked by dots – and the predicted future proportions to 2050 shown by the curves, with 95% confidence intervals shaded.

**Figure 2.5a: Proportion of males aged 21–60 belonging to different BMI categories in a given year**



**Figure 2.5b: Proportion of females aged 21–60 belonging to different BMI categories in a given year**





### Future trends: children<sup>1</sup>

As discussed in Section 2.1, the measurement of overweight and obesity in children is not straightforward, and different methodologies are applied. Throughout this report, we use the IOTF definition<sup>42</sup> (Box 2.1, p29), and the quantitative modelling work undertaken for this project applies this to interpret and extrapolate the Health Survey for England data.<sup>1</sup> Our predictions suggest a growth in the prevalence of obesity among people under age 20, from current levels (8% males, 10% females) to around 15% by 2025, with prevalence being slightly less in males than females. Looking ahead to 2050, the confidence intervals become wide, but by 2050 approximately 25% of under-20-year-olds are predicted to be obese. As far as specific age bands within the under-20 category are concerned, the trends in the 11–15 age group are clear. By 2025, obesity among 11–15-year-olds will have increased by six percentage points for boys and 11 percentage points for girls. For younger girls, the confidence intervals on the extrapolation again become large, but it appears that, among children aged 6–10 years, males will become more obese than females, with an estimate of 21% of boys and 14% of girls being obese by 2025.<sup>1</sup> These current and predicted obesity prevalence levels are summarised in Table 2.1.

**Table 2.1 Percentage predicted to be obese (IOTF criteria), by sex and age<sup>1</sup>**

	Age	2004	2025	2050
Boys	6–10	10%	21%	>35%
	11–15	5%	11%	23%
	All under 20	8%	15%	25%
Girls	6–10	10%	14%	20%*
	11–15	11%	22%	35%
	All under 20	10%	15%	25%

\*Very wide CI

If, as well as looking at the prevalence of obesity, the proportion of overweight young people is considered, Foresight’s extrapolations suggest that, by 2050, 70% of girls could be overweight or obese, with only 30% in the healthy BMI range. For boys, the picture is somewhat different, with 55% being overweight or obese and around 45% in the healthy range.

### Future trends: social class<sup>1</sup>

There is no evidence that social class differences in the prevalence of obesity in future will increase above and beyond those that already exist, with one possible exception. Obesity prevalence among Social Class I women (aged 20–60) is forecast to be only 15% by 2050, in contrast to 62% forecast for women in Social

Class V. This compares to current prevalence levels of 10% and 25% respectively. However, the confidence levels on these long-term forecasts are broad at  $\pm 10\%$ . Moreover, the apparent levelling out for Social Class I women is heavily influenced by the few data points from recent years. For men, the trend is for a modest social class gradient to persist into the future, with 52% of Social Class I men predicted to be obese by 2050, compared to 60% of those in other classes.

### Future trends: ethnicity<sup>1</sup>

As already noted, the Health Survey for England samples are relatively small for some ethnic groups and so extrapolations should be treated with particular caution. The projections suggest only very slight increases in the prevalence of obesity among Indian men and women. In contrast, the obesity trends among black African women and Pakistani men and women are similar (although slightly attenuated) to that of the white population, i.e. levels are forecast to rise markedly. There is further discussion in the Foresight quantitative modelling report.<sup>1</sup>

### Future regional trends<sup>1</sup>

The model does not make assumptions about future changes in regional demography as it simply extrapolates existing trends. On that basis, the model suggests that, in general, current regional differences will become magnified in the future. Among 20–60-year-olds, by 2050, the prevalence of obesity in the London region is predicted to be about 38% for men and women, below the predicted national averages of 50–60%. The sharpest increases are predicted for 20–60-year-old women in Yorkshire and Humberside, reaching a rate of about 65% ( $\pm 12\%$ ) by 2050. In contrast, obesity is currently in decline among women in the south-west of England, resulting in a predicted 2050 prevalence of only 7%, a reduction from the current level of 17%. In men in this age range, Yorkshire and Humberside along with the West Midlands and the north-east of England have the highest predicted prevalence in 2050, at about 70%. There are no regions where prevalence rates for 20–60-year-old men are predicted to decrease from current levels.

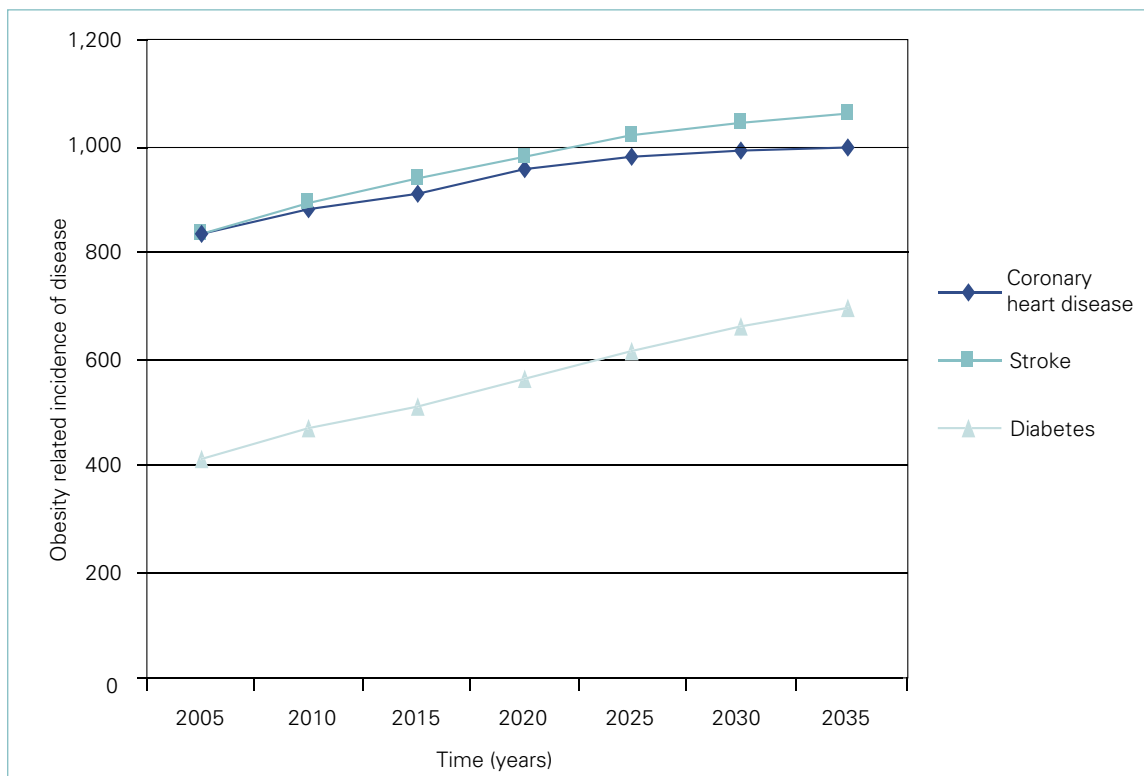
### Prevalence of disease attributable to overweight and obesity<sup>1</sup>

The impact of overweight and obesity on the incidence of disease in the future was assessed using a microsimulation that imposed the known association between BMI and health risks from the present day on simulated populations to 2050. No allowance was made in the simulation for future variation in factors other than BMI, so the predicted increases in disease incidence arise solely as a result of changes in population BMI. The analysis indicates that the greatest increase in the incidence of disease would be for type 2 diabetes (a  $>70\%$  increase by 2050) with increases of 30% for stroke and 20% for coronary heart disease over the same period (see Figure 2.6).





**Figure 2.6: Rise in age- and sex-standardised rates of CHD, stroke and diabetes from 2005 (CHD, Stroke and diabetes)<sup>1</sup>**



It is also possible to use the microsimulation to examine the future impact on life expectancy resulting from the additional increase in BMI. The Government Actuary’s Department currently predicts that life expectancy will rise in the next 50 years by around eight years for men and seven years for women, to 84 and 87.5 years respectively. The role of the increase in obesity will have surprisingly little impact (less than a year) on the life expectancy of the population for the same period.<sup>1</sup> This is because of the dominance of downward trends in major obesity-related chronic disease mortality as a result of other factors such as a decline in smoking, even when the large increase in predicted obesity levels are taken into account. Moreover, the relatively modest impact on average life expectancy averaged across the population needs to be compared to the increased risk to obese individuals who could suffer several years’ reduction in life expectancy, especially those who also smoke and those in the younger age groups (i.e. for any given degree of overweight, younger adults generally have a greater number of years of life lost than older adults; the maximum number of years of life lost for white men and women aged 20–30 with a severe level of obesity (BMI >45) is 13 and 8 respectively<sup>45</sup>). Such a modest impact on average population life expectancy also conceals the significant increase in healthcare costs associated with additional years of obesity-related ill health and the associated impact on quality of life. The expected increases in costs to the NHS and beyond are considered in Section 2.3.

## 2.3 Economic costs of overweight and obesity

The costs of obesity are very likely to grow significantly in the next few decades. Apart from the personal and social costs such as morbidity, mortality, discrimination and social exclusion, there are significant health and social care costs associated with the treatment of obesity and its consequences, as well as costs to the wider economy arising from chronic ill health. The House of Commons Health Select Committee estimated that the total annual cost of obesity and overweight for England in 2002 was nearly £7 billion. This total includes direct costs of treatment, the cost of dependence on state benefits, and indirect costs such as loss of earnings and reduced productivity.

The Committee estimated that the direct healthcare costs for the treatment of obesity alone and its consequences were between £991 million and £1,124 million in 2002, equating to 2.3–2.6% of NHS expenditure (2001/2002).<sup>46</sup> These figures are the best publicly available estimates and therefore the figure of £1 billion was used as the baseline for obesity-attributable direct healthcare costs in the Foresight quantitative modelling exercise.<sup>1</sup>

The National Audit Office has highlighted significant indirect costs due to the higher levels of sickness and absence from work that obese people suffer, reducing productivity and imposing costs on business.<sup>47</sup> The Health Select Committee estimate of lost earnings attributable to obesity was £2.3–3.6 billion per year, accounting for an annual total of 45,000 lost working years.<sup>2</sup> Subsequent work suggests that the total impact of obesity on employment may be as much as £10 billion.<sup>2</sup>

The costs of decreased household incomes, earlier retirement and higher dependence on state benefits that arise from obesity-related conditions also need to be taken into account. A recent estimate suggests that the costs of welfare (incapacity and unemployment benefits) for the obese may currently be between £1 billion and £6 billion.<sup>2</sup> These costs will be compounded as the weight problems of children and teenagers lead to increased levels of chronic disease, mental health and other social costs.<sup>13</sup> Furthermore, these figures are likely to be an underestimate of the full costs as those for social care provided by local authorities are not included. In addition, there is growing evidence that obesity may reduce the wage levels of those in employment.<sup>2,48,49</sup>

### Predicting future costs<sup>1</sup>

For the purposes of this project, the microsimulation model forecast costs solely on the basis of anticipated additional morbidity arising from increasing prevalence of overweight and obesity. Factors other than BMI, including the costs of disease, were fixed at current levels. The cost comparisons use the Health Select Committee's estimate of the current total costs attributable to overweight and obesity, namely £7 billion per year, of which £1 billion is the direct health service costs attributable to obesity alone.<sup>46</sup>



Based on the Foresight projections of BMI to 2050 (see Section 2.2), the potential future annual health service costs of diabetes, coronary heart disease and stroke are predicted to rise significantly, assuming that all variables other than BMI remain at current levels (see Table 2.2). The total NHS costs used at year zero of the simulation (2004) were taken from government statistics; further details are given in the report, Tackling Obesities: Future Choices – Modelling Future Trends in Obesity and the Impact on Health.<sup>1</sup> In 2007, the total annual cost to the NHS of diseases for which elevated BMI is a risk factor is estimated at £17.4 billion, of which overweight and obesity is estimated to account for £4.2 billion. As BMI is the only variable in the model, all the additional costs in 2015, 2025 and 2050 are attributable to overweight and obesity (see Table 2.2). The increasing prevalence of overweight and obesity predicted by the model is projected to add £5.5 billion (at current prices) to the annual total cost of the NHS by 2050. Factoring in the estimate that currently £4.2 billion of the £17.4 billion is attributable to overweight and obesity, the total attributable to overweight and obesity by 2050 is £9.7 billion.<sup>1</sup>

**Table 2.2: Calculating future costs of elevated BMI (£ billion/year)<sup>1</sup>**

	2007	2015	2025	2050
Total NHS costs of diabetes	2.0	2.2	2.6	3.5
Total NHS costs of coronary heart disease	3.9	4.7	5.5	6.1
Total NHS costs of stroke	4.7	5.2	5.6	5.5
Total NHS costs of other related diseases	6.8	7.4	7.8	7.8
Total cost (all related diseases)	17.4	19.5	21.5	22.9
NHS cost increase above current, due to elevated BMI (overweight and obesity)	–	2.1	4.1	5.5
NHS costs attributable to elevated BMI (overweight and obesity)	4.2	6.3	8.3	9.7
NHS costs attributable to obesity alone (see Table 4 in Modelling Future Trends) <sup>1</sup>	2.3	3.9	5.3	7.1
Wider total costs of overweight and obesity, taken at 7x direct costs (figures include rounding effects)	15.8	27	37.2	49.9
Projected percentage of NHS cost @ £70 billion	6.0%	9.1%	11.9%	13.9%

If the ratio of total costs of overweight and obesity to health service costs of obesity remains similar to 2001 (i.e. 7 to 1), by 2050, an overall total cost of overweight and obesity per annum of £49.9 billion at today's prices can be anticipated.

Later in this report, Section 7 considers the question of what interventions might help contain these potentially escalating costs with a report on the use of the microsimulation to examine what levels of reduction in BMI might make an impact.

### Summary of key points

- Several health conditions are associated with overweight and obesity, including type 2 diabetes, hypertension, coronary heart disease, stroke and cancer.
- 
- Being overweight has become the norm for adults.
  - In 2004, 23.6% of adult men and 23.8% adult women were obese.
  - In 2003/2004, the mean BMI of UK adults was 27kg/m<sup>2</sup>, the healthy range being 18.5–25kg/m<sup>2</sup>.
  - The rates of obesity have more than doubled in the last 25 years.
  - The rates of obesity are estimated to rise, by 2035, to 47% and 36% for adult men and women respectively. By 2050, 60% males and 50% females could be obese.
- 
- The total annual cost to the NHS of overweight and obesity (i.e. the treatment of obesity and its consequences) was estimated in 2001 at £2 billion, and the total impact on employment may be as much as £10 billion.
  - By 2050, the NHS cost of overweight and obesity could rise to £9.7 billion, with the wider cost to society being £49.9 billion (at today's prices).



### 3. Causes of obesity

This Section draws upon the reviews of the scientific literature conducted for the Foresight project. It offers an overview of the evidence base for the causes of obesity and considers biological, behavioural, social, environmental and economic aspects of this issue.



## Section 3: Causes of obesity

At first glance, the cause of obesity seems simple. Over a period of time, energy intake exceeds energy expenditure. But this simplistic view, which is widely held to be true, hides the intricacies inherent in how we acquire and use energy. In fact, the causes of obesity are complex and multifaceted.

Although there are many reasons why an individual may become obese, it is now generally accepted by health and other professionals that the current prevalence of obesity in the UK population is primarily caused by people's latent biological susceptibility interacting with a changing environment that includes more sedentary lifestyles and increased dietary abundance.

The specific causes of obesity at an individual level are many and varied. They differ between population groups and across a person's life course, with the accumulation of excess fat, and therefore weight, being the end result of a variety of causal pathways. This variability is an important feature in that it points to a range of different solutions. Indeed, the multifactorial condition of obesity is inherently unsuited to a 'one size fits all' approach. The concept of a family of 'obesities' is a useful way of recognising this complexity.

Evidence from research on obesity from medicine, the life sciences, the social sciences and economics tells us a great deal about these different causes. However, to date, most of this work has not generally been well integrated across the different disciplines. Consequently, there is a continuing debate about the relative importance of each cause or variable. In addition, the interactions between different variables are poorly understood. A critical aim of the Foresight Tackling Obesities project has been to review and integrate evidence across disciplinary boundaries, rather than to focus on single disciplines. The systems mapping work described in Section 5 is one outcome of this approach. In this section, we consider the evidence base for the causes of obesity.

### 3.1 Biology

At the heart of obesity lies a homeostatic biological system that struggles to maintain energy balance to keep the body at a constant weight. This system is not well adapted to a fast-changing world, where the pace of technological progress has outstripped human evolution. Since the identification of the *ob* gene in 1994, research into the genetic determinants of body weight has grown exponentially.<sup>4-8</sup> Much has been learnt from animal models including transgenic models (animals bred with specific genetic characteristics).<sup>6</sup> This research continues to act as a foundation for the development of novel drug targets for the treatment – and perhaps in the future, the prevention – of obesity and also possible improvements in related metabolic disorders such as type 2 diabetes.<sup>4,5,7</sup>





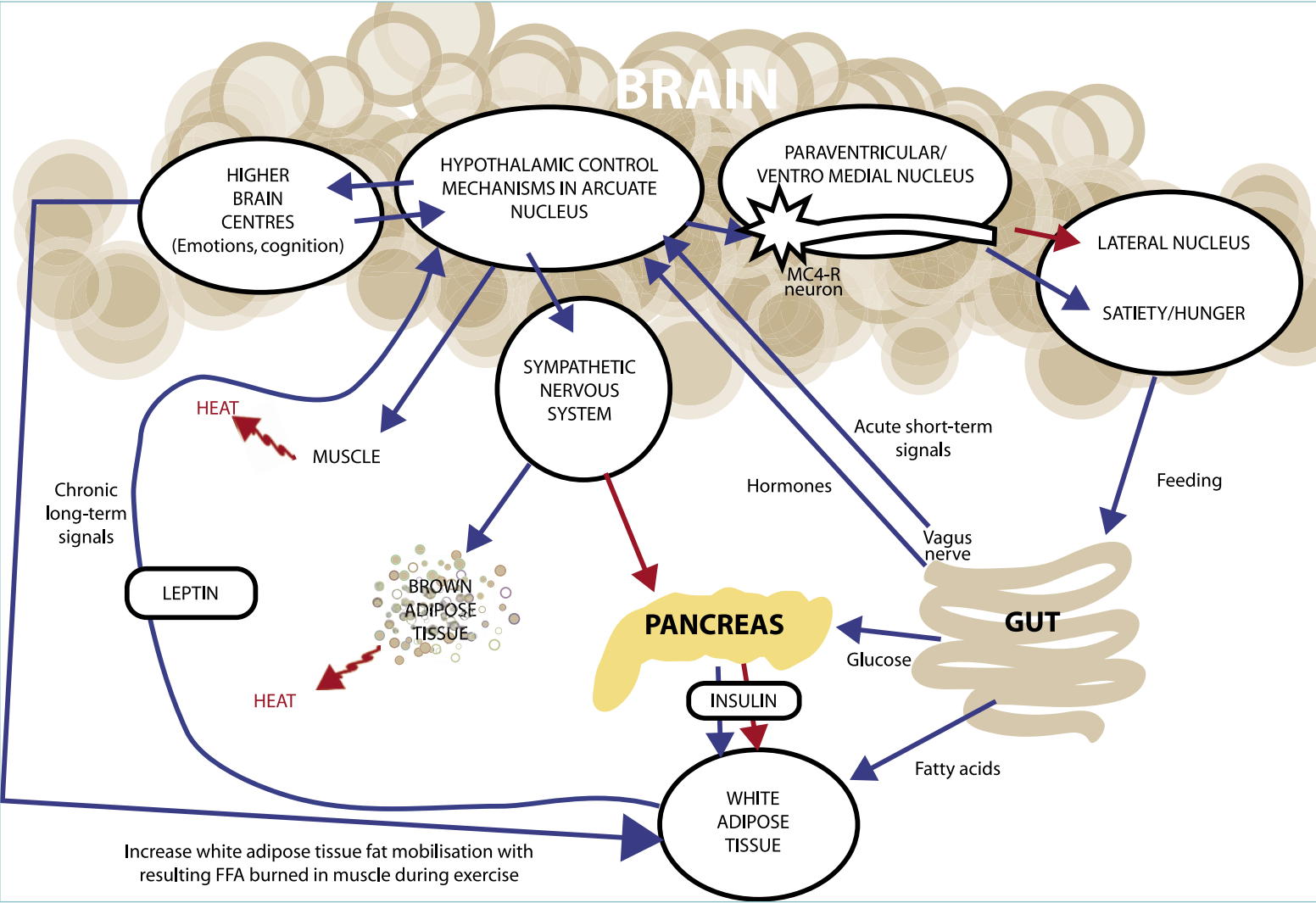
Studies in humans have now identified a number of specific genes associated with obesity. Obesity caused by these genetic factors may be severe and linked to excess weight gain from the first few months of life. Recently published research into the variation in the FTO gene illustrates how genes may also contribute to an increased risk of weight gain without actually determining obesity levels. Analysis of the function of these genes, through research both on animals and humans, has identified critical hormonal and neural pathways and feedback loops, especially for the hormone leptin and also the melanocortin system.<sup>4-7</sup> Figure 3.1 summarises the links between emotional cues to eat, food ingestion and absorption. It also shows the stimulation of gut hormones and the release of insulin, control mechanisms from the hypothalamus in the brain, and how adipose (fat) tissue and muscle use nutrients for energy. Adipose tissue in turn plays a pivotal role in appetite regulation through the release of the hormone leptin.

Longer-term control of energy intake is provided by feedback loops which come in part from fat (adipose tissue) itself.<sup>5</sup> Leptin is a good example of one of the molecules involved in the control of energy intake.<sup>7</sup> At first thought to prevent obesity, it is now believed that its main role is to increase food intake when body weight is low. When fat stores are low, levels of leptin fall and hunger and food-seeking behaviour are stimulated. An increase in body fat, however, stimulates the secretion of leptin, which circulates in the bloodstream, crosses the blood-brain barrier and acts centrally to increase satiety (see Figure 3.1). This in turn reduces the overarching drive to eat, leading to a period of negative energy balance, and reduction in the secretion of leptin from fat. In this way, the system returns to equilibrium.<sup>7</sup>

Some constitutionally lean individuals may have a finely tuned appetite control system that precisely matches energy intake to meet energy needs. Other individuals may have a poorly tuned control system in which food intake is persistently above energy needs, making them more susceptible to obesity. Until relatively recently, food scarcity ensured that this predisposition was not as apparent. However, in the modern world, especially in developed countries, where there is a surplus of energy-dense, low-cost food, this latent metabolic sensitivity is exposed and will lead to weight gain unless overridden by conscious control.<sup>7,8,21</sup> New research using functional magnetic resonance imaging (fMRI) to look directly at the activities of the brain has revealed the sensitivity of neural networks to external stimuli.<sup>8</sup> It shows how sensory factors such as the sight, smell, palatability and availability of food can increase appetite to such an extent that it overwhelms innate control mechanisms, a phenomenon described as 'hedonic' hunger.

There is, however, a paradox called the 'asymmetry of appetite'. There is little evidence that there is a reverse side of the coin, that is, situations where energy intake is spontaneously lower than energy needs (although in conditions such as cancer and acute infections, the accompanying release of cytokines and other

Figure 3.1: The regulation of energy balance in the human body – the complexity of appetite and weight control





peptides (the acute-phase response) is associated with poor appetite and weight loss<sup>50,51</sup>). This asymmetry of appetite begins to explain why it is so easy to put weight on and so difficult to take it off.

Food is a fundamental biological necessity and the body has evolved to make sure that its needs are met. The hunger drive is very powerful and compels humans to search out food. By contrast, there is limited sensitivity to abundance. The feelings of having had enough (satiety cues) are weak and easily overridden by external factors such as the sight of food or how it tastes.<sup>7,8,21</sup> A practical example is the contrast between the difficulties of skipping a meal or in not eating before the next mealtime, compared to the ease of succumbing to a dessert or cheese board; even though we may already feel full after eating a main course.

In contrast to the mounting evidence showing the importance of controlling energy intake to avoid weight gain, research into the metabolic aspects of energy expenditure in humans has yielded little to explain the dysregulation of energy balance.<sup>52</sup> Numerous studies involving thousands of people worldwide have failed to find evidence to support the widely held belief that obese people must have slower metabolic rates, either burning energy more slowly than thin people, or being metabolically more efficient. In fact, the converse appears true. Energy expenditure while resting actually increases with body weight, reflecting the metabolic costs of maintaining a larger body size. After adjustment for differences in body size and composition, there is a remarkable similarity in energy expenditure between individuals.<sup>52</sup>

Evidence from research also argues against any difference in basic physiology between the slim and the obese, or any mechanism that somehow protects lean individuals from weight gain by the stimulation of specific metabolic pathways when faced with an energy excess.<sup>52</sup> Studies conducted in controlled experimental conditions in which lean and obese individuals are over- or underfed show similar rates of weight gain or loss.<sup>13</sup> This evidence suggests that physiological differences between people are not the root cause of obesity. However, this does not rule out the development of new drugs to increase energy expenditure as part of obesity treatment.<sup>52</sup>

Our understanding of the causes of obesity owes much to advances in basic biological science. However, research studies on specific aspects of the biological system are often undertaken in isolation, limiting a fuller understanding of the relative importance of different metabolic pathways and their interactions and redundancies within the system. Many pathways are not yet amenable to manipulation, especially in humans, and it is still difficult to reliably predict the critical points for effective intervention. An added problem is that our understanding of gene–environment interactions in this area is in its infancy.<sup>4</sup> However, this is a topical area of research, not least with respect to developments in nutrigenomics, the science of personalised nutrition.<sup>53</sup>

### 3.2 Impact of early life and growth patterns

The pattern of growth during early life is one determinant of the future risk of obesity, although the precise mechanisms involved are yet to be fully explained.<sup>9,20</sup> A baby's growth rate in the womb and beyond is in part determined by parental factors, especially with regard to the mother's diet, and what and how she feeds her baby. Conditions in early life may therefore continue to have an impact on health risks in adult life, illustrating one aspect of the intergenerational component of obesity.<sup>9,20</sup>

There is evidence that the period soon after birth is a time of metabolic plasticity. Factors in the environment, such as nutrition, can have long-lasting consequences in that they appear to set the baby on a particular developmental trajectory. There is strong evidence, for instance, that low birth weight is associated with increased risks of heart disease and diabetes and, while there is less evidence of a direct link between birth weight and obesity, weight gain in early life appears to be critical.<sup>9</sup> Some low-birth-weight babies may be especially susceptible to catch-up growth (that is, rapid weight gain), while others experience this as a direct consequence of their diet. Breast-fed babies show slower growth rates than formula-fed babies and this may contribute to the reduced risk of obesity later in life shown by breast-fed babies.<sup>20</sup> Weaning practices are also thought to be important, given the association between the characteristic weight gain seen in early childhood at approximately five years of age (early adiposity rebound) and later obesity (see Box 3.1). Despite the uncertainties surrounding this evidence, and the need for additional research, the work suggests that early life is a critical period for healthy development.

#### Box 3.1: Adiposity rebound

The adiposity rebound is the period of time in early childhood when the amount of fat in the body falls and then rises again, which causes BMI to do the same. The age in individuals when BMI is at its lowest is related to the timing of obesity, in that children with an earlier rebound tend to be fatter later. For this reason, it has been suggested that the adiposity rebound is a 'critical period', and that the same association does not apply at other ages. But, in fact, the age at adiposity rebound reflects just two things – the level of BMI and how fast BMI is rising. In children with an early rebound, BMI tends to be both high and increasing quickly, which inevitably predicts a higher BMI later on. The same association applies at all ages in childhood, so the adiposity rebound may not be so critical. However, it is certainly an important period for the development of dietary habits,<sup>21</sup> which, experience shows, are resistant to subsequent change.



### 3.3 Behaviour

Eating and physical activity are two critical behaviours with the potential to influence energy balance in the body. Eating behaviour is shaped by the drive and opportunities to eat. As a result, energy intake may vary from zero to several thousand calories a day. Physical activity is the behavioural component of energy expenditure. It is a function of individual metabolic predisposition, modulated by the prevailing environment. Although behaviour has historically been considered as a product of free will, it is increasingly recognised as being constrained by individual circumstances. Nonetheless, research into individual variability in matters of diet and activity may reveal important determinants of obesity.

Observational studies of human behaviour in this area are hampered by the lack of robust, objective measures of dietary intake and physical activity and by behavioural and attitudinal measures in large populations.<sup>22,54,55</sup> Despite the absence of definitive evidence, disproportionate attention has been given to often sterile debates as to which is more important as a cause of obesity, poor diet or lack of exercise? It is now widely accepted that there are subtle shifts in both diet and physical activity that influence obesity trends and, at a population level, may be below the limits of detection of current methodologies.<sup>54,55</sup> There is no doubt that positive changes in diet and activity are likely to result in health benefit, both in relation to, and independent of, body weight.<sup>35,55</sup>

#### 3.3.1 Food intake and activity behaviours – the evidence base

While long-term records of dietary intake based on household food purchases are available, by contrast, historical data on physical activity are generally lacking.<sup>54,55</sup> It is, however, generally accepted, at least for adults, that, as society has changed, there have been systematic reductions in energy expenditure, as a consequence of fewer manual jobs, increases in car ownership and the rise of labour-saving devices for use at home and work.<sup>35</sup> Despite evidence of reductions in walking and cycling to school, the impact of similar changes on physical activity in children is less clear. Other factors may also be relevant, such as the increased fears of parents about unsupervised outdoor play for children.<sup>35</sup>

Surveys involving self reported physical activity do not reveal a clear link with population prevalence of overweight<sup>11</sup>. Physical activity outside of the job environment is difficult to measure, and questionnaires tend to focus on overt exercise. This type of activity accounts for a very small proportion of total energy expenditure and is likely to play only a minor role in preventing obesity, although positive benefits on wider disease risk should not be ignored.<sup>35,41,55</sup> Clearly, given the general increase in sedentary employment and the longer hours worked in the UK over the past decades, there are limited opportunities for other forms of activity during the working day. Attention has therefore focused on the importance of energy expended during routine daily activities as a contributor to overall energy

expenditure. The lack even of limited opportunity for activity for many people has implications for transport policies and other aspects of the built environment.<sup>35,55</sup> Sedentary behaviours have emerged as a specific risk factor, especially TV viewing<sup>35</sup> (which may also be a marker for inter-individual differences in eating behaviours). Some success in enhancing weight control has been shown by reducing sedentary behaviour.<sup>55</sup>

Recent technological developments in the objective measurement of activity levels will improve the evidence base for the role of physical activity in energy expenditure.<sup>31</sup> For example, accelerometers, which measure the number of steps a person takes are likely to lead to a rapid increase in knowledge over the next few years.<sup>31</sup> These devices are also being used to help identify opportunities to increase levels of physical activity.<sup>55</sup>

Measuring dietary intake in daily life outside the laboratory remains problematic, but by combining data from different kinds of research, a number of specific dietary risk factors for obesity have been identified.<sup>54</sup> They include foods with a high energy density, diets high in fat and low in fibre, and the consumption of sugar-rich drinks, the effects of which may be magnified if a person habitually consumes large portion sizes.<sup>54</sup> These risk factors provide promising targets for behavioural interventions and are consistent with other strategies for the prevention of chronic disease.<sup>54</sup> However, research to test the impact of dietary change are hampered by poor compliance and the difficulties of measuring actual, as opposed to reported, intake.<sup>54</sup> There are opportunities for interventions by the food industry through reformulation of existing products and innovation to provide healthier options. Unless physical activity increases to boost energy demands, dietary habits will need to be reformed to meet the nutritional needs of a largely sedentary population.<sup>32</sup>

Research is increasingly turning to the social and cultural context within which food and activity-related habits develop.<sup>15,21,24</sup> Social and cultural factors influence family dynamics, school policies, urban design and the impact of the media.<sup>21,35,56,57</sup> Most of this research is presently conducted at a population level, and more investigation is needed to explain the variability in obesity between individuals.<sup>21</sup> A focus on socioeconomic and ethnic disparities might help to bridge widening health inequalities.<sup>14</sup>

### 3.3.2 What motivates people's decisions and choices?

Research in social psychology research tells us a great deal about how people make their decisions.<sup>22</sup> What motivates and determines health-related behaviour is complex (see Box 3.2), but in modern societies, there is a psychological conflict between what people want (e.g. fatty, sweet foods) and their desire to be healthy and/or slim. Mixed feelings and beliefs about healthy lifestyle choices complicate individual choices. For instance, most people know that eating fatty foods in





excess is generally bad for them while taking exercise is generally beneficial. Yet they tend to enjoy eating foods that are high in calories or excessive salt and find it difficult to find the time to exercise. No one escapes this psychological conflict or 'ambivalence'.<sup>58</sup> People who are highly ambivalent will carefully scrutinise any relevant information before making a decision. They take note if messages are overly simplistic and identify flaws more readily. They may then form more negative attitudes towards recommended behaviours – evidence shows examples of messages failing accordingly. Ambivalent people tend to respond to messages in a polarised fashion – extremely positively or negatively.<sup>22,24,58</sup>

Box 3.2 outlines other important dimensions to behaviour that serve to further complicate this issue, such as overcoming existing habits, the role of different types of beliefs, the degree of control or perceived control an individual has over their environment and their perceived vulnerability to risk.<sup>22</sup>

It is also critical to consider the wider cultural and social context to individual's behaviours such as the influence of organisational cultures, social processes and the media. Indeed, while society focuses on individual behaviours as a cause of obesity, organisational behaviours play a substantial but often unconsidered role in cuing the behaviour of individuals. For example it is organisations that make the decisions about the range of snacks in a workplace, the availability and contents of vending machines, and whether employees receive incentives to use cars but no incentives to use bicycles.

We have emphasised the importance of habits, both organisational and individual but some patterns of behaviour, such as fashion, do change quickly and what may be acceptable or common practice at one moment may take on different associations as time passes. For example what may be elite consumption in one period (cigarettes around 1900) later take on other connotations of social class.

### Box 3.2: Additional psychological factors influencing behaviour change<sup>22</sup>

#### **Habits**

Habits are behaviours that are repeated, often fairly automatic and sometimes difficult to control. They are triggered by environmental cues and decoupled from the original reason for the behaviour. Changes in attitudes and intentions have less of an impact when a habit is formed. People suffer from 'tunnel vision' or reduced motivation to acquire new information, particularly if it is inconsistent with their habitual behaviour.

#### **Beliefs**

Beliefs are an important influence on behaviour. They include:

- beliefs about consequences, including perception of personal vulnerability
- beliefs about expectations of others, social norms and the motivation to comply with these
- belief (and perceived importance) about what will help or hinder behaviour.

Beliefs can also be classified in terms of the relative importance of positive and negative outcomes (e.g. increased longevity associated with physical exercise vs decreased longevity associated with smoking) and the relative importance of material costs and benefits vs emotional costs and benefits. For some behaviours the degree of positive outcome is most important, for others the creation of a less negative outcome. For risky behaviours, there is growing evidence that emotional factors have a dominant role that may be at odds with material or factual information.

### **Translating intention into action**

People often find it difficult to translate into action good intentions based on a long-term goal and benefit. There is a risk of failing to start or failing later on if there is an actual or perceived lack of time, forgetfulness and initial reluctance as short-term costs loom large. Evidence suggests that prior planning and thinking through possible distractions can help overcome these risks of failing as people become 'perceptually ready' to respond when temptation occurs. Distractions, stress and environmental influences are critical at this stage and can help or hinder maintenance of new behaviours.

### **Automatic attitudes vs self-reported attitudes**

Automatic attitudes are those that people are unable or unwilling to retrieve from memory themselves. These often conflict with explicit or 'self-reported' attitudes. For example, people may say they dislike chocolate cake, yet measures of their automatic attitudes show the opposite. Automatic attitudes are generally good predictors of food behaviours. Also their measurement has revealed evidence of anti-fat bias, even when participants in an experiment denied any bias when asked outright.

### **Moral climate**

The moral climate reflects a shared belief that something is inherently 'right' or 'wrong'. Moral norms are predictive of behavioural intentions ahead of attitudes, subjective norms and perceived behavioural control. There is evidence that the effect that attitudes have on some behaviours is in part determined by moral considerations.



### 3.4 The living environment

The term 'obesogenic environment' refers to the role environmental factors may play in determining both energy intake and expenditure. The term was first coined in the 1990s in the context of a hypothesis that might explain the current obesity epidemic. It has been defined as the 'sum of the influences that the surroundings, opportunities or conditions of life have on promoting obesity in individuals and populations'.<sup>59</sup> The term embraces the entire range of social, cultural and infrastructural conditions that influence an individual's ability to adopt a healthy lifestyle. For example, specific environmental factors may shape the availability and consumption of different foods or the levels of physical activity undertaken by populations, thus limiting choices.<sup>29</sup> At the same time, the effect of technological development has been to continually engineer physical effort out of the environment. Cars, television and computer games are examples of technologies that have had such effects in recent decades.<sup>31,60</sup> In adults, the risks of being overweight or obese are associated with time spent sitting down when at leisure.<sup>35</sup> There is currently a lack of conclusive evidence on how and to what extent obesity is encouraged by the environment, but some trends and themes are emerging.

#### 3.4.1 Technology

It is not generally possible to infer a direct relationship between obesity and any single technological development. This is because patterns of using technology are so closely bound to social norms and lifestyle choices that teasing out the part played by one technology alone is extremely difficult. Similarly, while there are clearly many ways that technological developments will influence nutrition and health in the future, it is unlikely that we will be able to identify any specific cases that will drive us towards particular positive or negative outcomes.

In general, as indicated, the advancement of technology has tended to engineer physical effort out of the environment in the past few decades. This trend is widely apparent in the UK, in a built environment that decreases and disincentivises the need to walk, and in the decline of manual occupations. The same effect is evident in households that have more home appliances and which show increased use of online shopping. There is no reason to suppose that the direction of this trend will change in response to new technologies.<sup>31</sup>

#### 3.4.2 Opportunities for physical activity

Over the past 30 years, physical activity has declined significantly in the UK. For example, in England, the average distance walked per person per year for transport purposes fell from 255 miles in 1975/76 to 192 miles in 2003. Distances cycled fell from 51 miles per person per year to 34 miles over the same time period, while car use increased by over 10%. Although the average commuting

distance is increasing, one-fifth of all journeys of less than one mile are made by car.<sup>35,60</sup> The proportion of the population in an occupation requiring substantial physical effort has also declined.<sup>11</sup>

To what extent does the environment influence how much exercise we take? Evidence comes from research that has focused on perceived environmental measures and objective environmental measures. The factors considered by studies of how people perceive their environment can be grouped into seven categories – safety, availability and access, convenience, local knowledge and satisfaction, urban form, aesthetics, and supportiveness of neighbourhoods. Importantly, no consistent pattern of associations between these categories and overall activity has been found.<sup>29</sup>

An association between the perceived categories and walking was also lacking. Other research that has examined the relationship between convenience of local neighbourhoods and walking reported positive associations. The contribution of how we perceive our environment in explaining how active we are, or how much we walk, is small and less important than sociodemographic variables. Although the overall quality of these various studies is not high, a recent meta-analysis suggests that, in general, our perceptions of the environment have significant but modest associations with physical activity. However, it may be that these findings are affected by reverse causality, whereby those already engaging in higher levels of physical activity perceive their environment differently to people who are more sedentary in their lifestyles.<sup>29</sup>

Associations of objectively measured environmental variables with physical activity have received less attention. These variables can be classified into five categories – deprivation, availability and access to key destinations, urban form, aesthetics and quality, and supportiveness. Deprivation and poverty were found to be associated with low levels of leisure-related physical activity in a number of studies. Research has focused mainly on the relationship between access to particular places, such as beaches and parks, and being active. Here, there is a relatively modest but positive association of, for example, high land-use mix (i.e. variation in how the land is used within an area such as housing, industrial, recreational and retail) and good access to services with higher levels of walking.<sup>29</sup>

The association between environmental characteristics and physical activity, with obesity as an outcome, has not been well studied. Nevertheless, the general picture emerging is that residents of highly walkable neighbourhoods are more active and have slightly lower body weights than their counterparts in less walkable neighbourhoods, as do those living in areas with high land-use mix. Perceptions of social nuisances in the local neighbourhood increase the risks of obesity, while good access to leisure centres and living in a suburban environment reduce the risks.<sup>29</sup> Some research suggests an association between participation in physical activity and the density of recreational sports facilities in a



neighbourhood. However, it seems that access to these facilities is socially patterned, with fewer opportunities for those in the most deprived neighbourhoods.<sup>35</sup>

An important question is whether the environment exerts its greatest effect on people for whom physical activity is already important, who have the confidence to participate and who are surrounded by like-minded individuals. At present, there is scant evidence on whether the environment might have different effects on people who have contrasting levels of physical activity and body weight.<sup>29</sup> Will modifications to the environment lead to more activity in the sedentary or will the main effects be on those who are already active?

Although the evidence suggests that the environment influences levels of physical activity and obesity, the mechanisms remain unclear.<sup>29</sup> There is a need for more research that examines the relationship between environmental characteristics and overall activity levels. But changes to the environment alone are unlikely to solve the problems of increasing obesity and declining levels of physical activity, though they are an important element in doing so. Indeed, the design of the urban environment offers significant opportunities to simultaneously to pursue goals of environmental sustainability and healthy lifestyle. We return to this point in Section 8.

### 3.4.3 Food and drink access and availability

Environmental influences on diet often involve physical ease of access to food and drink, for example, from supermarkets for home consumption, from takeaways and from restaurants. As eating habits become more unstructured, the availability of and access to 'food on the go' is an important consideration. Evidence in this area is limited and has tended to focus on retail access. Studies in the USA suggest that the availability of high-quality, reasonably priced 'healthy' food is constrained for those who live in low-income neighbourhoods and that this limitation may be associated with poor diet and obesity. However, similar findings are not consistently observed elsewhere. The differences observed between the USA and other countries may reflect other influences such as the greater degree of residential segregation based on social class and race, which could influence patterns of food and drink purchase and consumption.<sup>29,56</sup>

Further work is required to examine how aspects of the built environment or building design influences people's food habits e.g. the proximity of shops to schools or the location of vending machines. Studies using postcode mapping and global positioning systems or other technologies to track movements of individuals in their locality within buildings will provide a wealth of additional detail in relation to the impact of the environment, access to and availability of food and drink, and the risk of obesity.<sup>29,56</sup>

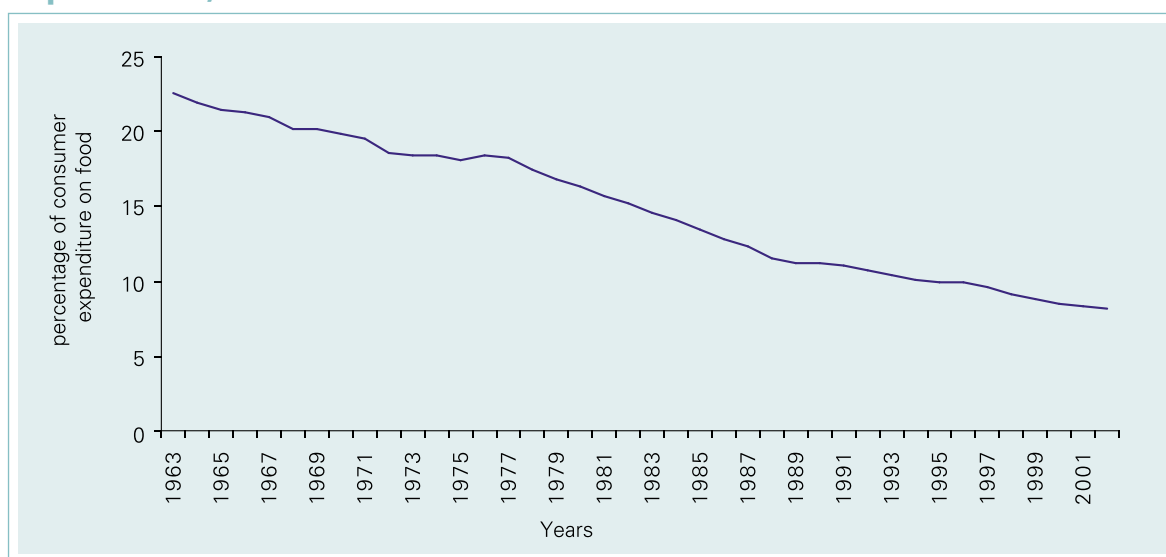
### 3.5 Economic drivers of food and drink consumption<sup>11</sup>

The economic drivers of consumption are plentiful and wide-ranging and have not been analysed in depth here. However, some key points are discussed below.

#### 3.5.1 The price of food and drink

An indicator of economic progress and one important factor in improving population health has been the lower price of food and drink as a proportion of household expenditure. In developed economies and in urban areas of many developing economies, there are now plentiful sources of relatively cheap foods. The amount of household income devoted to food supplies has fallen on average to 10% in the UK (see Figure 3.2), although it is important to note that it exceeds 23% among lower-income households and is below 15% in higher-income households.<sup>11</sup>

**Figure 3.2: The declining share of food in UK consumer expenditure, 1963–2002<sup>11</sup>**



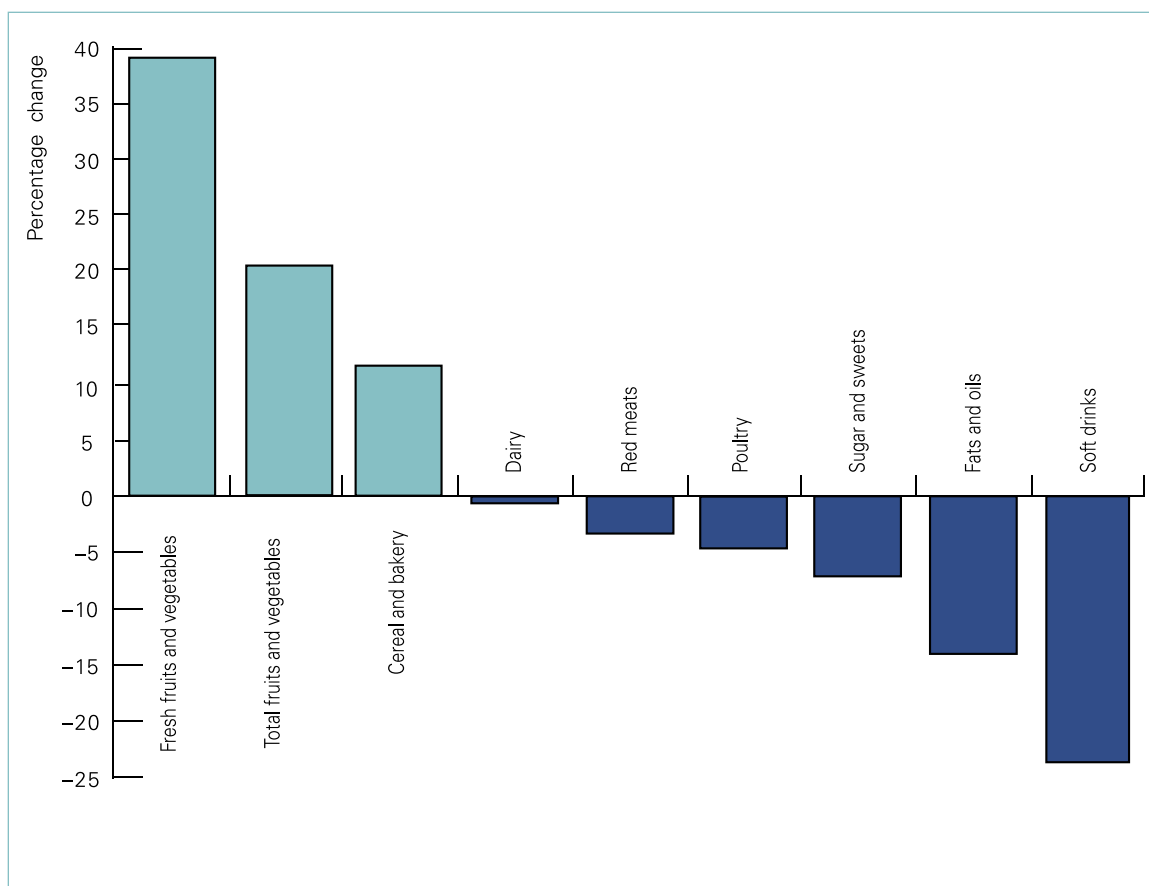
Source: Office for National Statistics.

Over the past 30 years, the price signals indicating the relative price of a healthy diet and particular nutrients have become more complex. Although it is impossible to say consumers buy their food on price alone, price does frame the context in which consumer responses are made. Cheaper food sources tend to be more energy-dense and nutrient-poor, that is, they provide plentiful calories, especially in the form of fats and sugars, but relatively low levels of vitamins and minerals. US data provide evidence for the differential effects of price changes on different components of the diet. US studies of changes in the real purchasing costs of different foods show a similar tendency for the costs of fruits and vegetables to have increased as a component of food budgets, while fats and oils, starches and sugars have decreased (see Figure 3.3).<sup>11</sup>





**Figure 3.3: Price changes differentially affecting dietary components (US data).<sup>11</sup> Changes in food process, 1985-2000 (real dollars).**

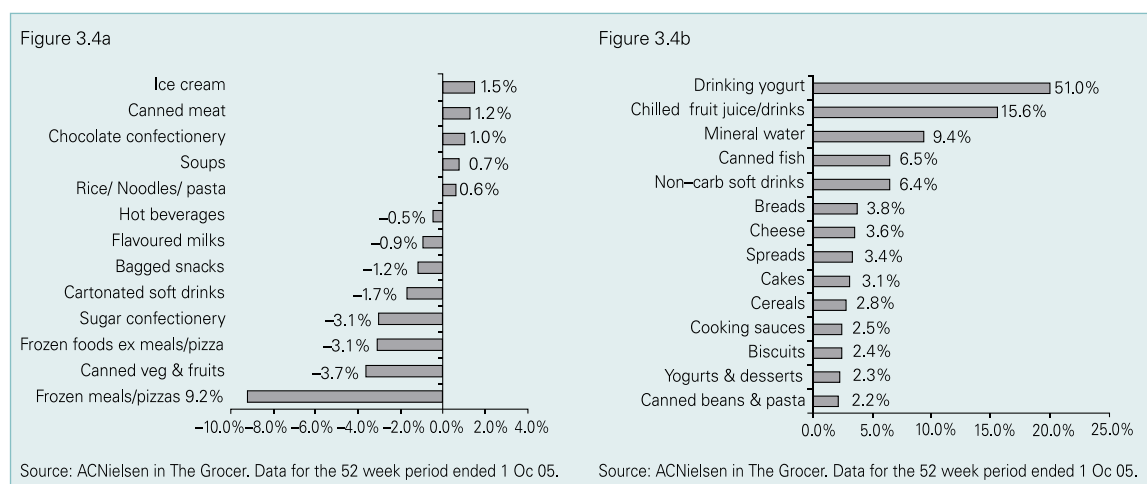


Source: Institute of Agriculture and Trade Policy.<sup>61</sup>

With declining prices in the major non-perishable commodities, manufacturers have developed and invested in a much greater range of food products from raw ingredients. Investment in mass-produced items such as soft drinks can show significant returns, and reduced costs ensure that products formerly only available to a small section of the population are now available to many more. This shift from direct domestic consumption to indirect consumption of processed foods is illustrated by the trends in UK sugar utilisation where the substantial decline in household purchases has been matched by an increase in sugar being used in manufactured food and beverage products (e.g. soft drinks, snacks, confectionery).<sup>11</sup>

Convenience food markets continue to enjoy strong growth (for example, in 2004, sales of refrigerated complete meals were up 10%).<sup>62</sup> However, there are signs of a trend towards 'healthy products' (see Figure 3.4). Eighteen of the 24 fastest-growing food and drink categories across the globe are related to consumer perception of health and wellness. Conversely, food products perceived as less healthy by consumers are tending to show signs of weakness.<sup>62</sup>

**Figure 3.4: UK food sales data, 2005,<sup>62</sup> showing that categories of food and drink usually perceived as less healthy have come under significant pressure (3.4a), while categories perceived as healthy grew well above market average (3.4b)**



The relationship between the prices of different foods and their consumption, both within a food category and across categories (where a price change in one category leads to a consumption change in another) has long been considered important when linking agricultural policies to food markets and consumer purchases. The relationship between food prices and consumption patterns, however, is complex, with elasticities likely to vary with income level, age group and numbers of people in a household (especially single vs multiple), and the cross-price elasticities can be affected more by the prices of non-food items, such as housing costs, than by other categories of food.<sup>11</sup>

### 3.5.2 Food marketing

Promotional marketing using a wide variety of techniques stimulates total market growth as well as brand switching. This includes pricing (e.g. special offers, discounts), positioning (e.g. checkout displays for impulse purchases), the presentation of the product itself (including packaging, formulation, additives) and specific promotional activities (including advertising, sponsorships etc.). Other factors include accessibility issues (e.g. distribution and availability in lower-income communities) and market segmentation (e.g. whether supplied through institutional catering, commercial catering, supermarket or corner shop).<sup>11</sup>



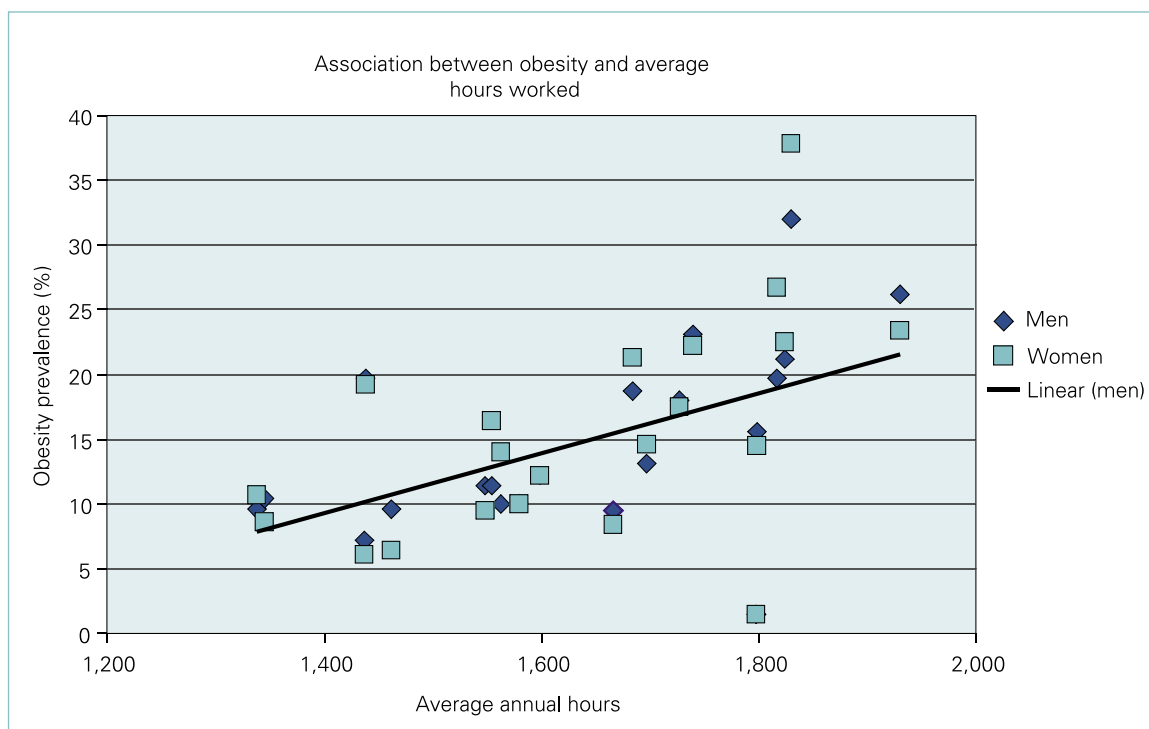
### 3.5.3 Purchasing capacity and impact on eating patterns<sup>11</sup>

The ability of the population to purchase food and drink has been increasing as the costs of these commodities have fallen. As income increases, people also tend to spend a greater share of additional income on dining out than on foods prepared at home. US studies show that a 10% increase in income leads to a 4.6% increase in a household's away-from-home food expenditures compared with a 1.3% increase in at-home food expenditures.<sup>11</sup>

### 3.5.4 Impact of working practices

Working patterns and practices have been shown to influence patterns of food consumption. For example, the availability and value of non-labour time has been linked to changes in consumption and obesity.<sup>11</sup> Figure 3.5 illustrates this relationship by comparing average hours worked and the prevalence of obesity.


**Figure 3.5: Association between obesity and average hours worked (data taken from across 21 countries of the Organisation for Economic Co-operation and Development<sup>11</sup>)**



Source: IOTF.<sup>63</sup>

### Summary of key points

- The causes of obesity are complex and multifaceted, pointing to a range of different solutions.
- At the heart of this issue lies a homeostatic biological system that struggles to maintain an appropriate energy balance and therefore body weight. This system is not well adapted to a changing world, where the pace of technological progress and lifestyle change has outstripped that of human evolution.
- Human biology, growth and development early in life, eating and physical activity behaviours, people's beliefs and attitudes and broader economic and social drivers all have a role to play in determining obesity.



## 4. Tackling obesity: the evidence and the uncertainty

This Section draws upon the reviews of the scientific literature conducted for the Foresight project. It offers an overview of the evidence base for obesity prevention and treatment and considers the lessons that can be drawn from other countries around the world and the approach to other health concerns in the UK.

## Section 4: Tackling obesity: the evidence and the uncertainty

As Section 3 showed, obesity is a complex, multifaceted condition that has no easy or obvious solution. However, rigorous analysis of the evidence for its causation, prevention and treatment has identified a number of key issues to guide strategy development.

In this section, we consider the evidence base for the determinants of obesity and its treatment and prevention. While recognising that the adverse consequences of obesity provide the principal motivation for intervening, detailed discussion of the mechanistic links between obesity and ill health or the role of weight management in the treatment of these conditions is outside the scope of this report. We begin by considering prevention in the context of the life course, behaviour change and changes in the built environment.

### 4.1 Prevention

The wide range of evidence that relates to obesity is heavily biased towards its causes rather than strategies for prevention or treatment. Controlled studies are few in number and limited in scope<sup>19,37,55</sup> and most are confined to controlled research settings. Few interventions have been successful in reducing the prevalence of obesity. Even the most promising have not yet been widely replicated or delivered at a scale that offers a clear option for public health strategies.<sup>19</sup> A few societies have made significant and successful efforts to intervene in other areas such as heart disease (e.g. the North Karelia project in Finland, see Section 4.3.1). The Fleurbaix-Laventie Ville-Santé community-based intervention, which focused on actions to improve diet and increase physical activity in children, is a current example that shows promise. It involves both public and private sector initiatives, with particular emphasis on consistency of messages on chosen topics for consecutive 3–4-month periods (e.g. walking, eating more vegetables etc.). The practical experience gained in this study and other community-based interventions is informing the basis of a much wider programme of work (EPODE) involving similar activity in more than 130 towns in France and two towns each in Belgium and Spain, although no data on this wider programme are currently available.<sup>64</sup>

This current lack of evidence for success is not surprising since any such undertaking would require several years of evaluation.<sup>13</sup> The need for large-scale research studies involving teams with diverse skills over long periods of time is unlikely to be met by existing funding mechanisms or data-gathering processes.<sup>13,36</sup> Finding and implementing solutions to address the greatly increased prevalence of obesity in the UK is likely to require unprecedented





change. It will also necessitate greater involvement of partners outside traditional health sectors. These future developments will require multidisciplinary approaches.<sup>19</sup> stimulating effective behaviour change<sup>24</sup> and establishing new social norms.<sup>21</sup> They require the creation of a supportive environment<sup>29</sup> and, critically in the case of children, parental engagement.<sup>21</sup>

Given the pressing need to tackle obesity, it is likely that interventions to prevent obesity will have to take place when the evidence is neither complete nor perfect. Instead, the evidence base needs to develop alongside the delivery of novel interventions, informed by the available evidence and strengthened by expert advice.<sup>10</sup> This approach establishes a virtuous circle of policy development, implementation and evaluation. Importantly, it builds practical experience and allows interventions to be refined over time. However, it also requires willingness to accept the risk that some interventions may fail or need to be refined and enhanced as their effects become better understood.

#### 4.1.1 A lifelong approach


The evidence to date indicates a number of points in the life course where there may be specific opportunities to influence behaviour (see Figure 4.1). These relate to critical periods of metabolic plasticity (e.g. early life, pregnancy, menopause), times linked to spontaneous changes in behaviour (e.g. leaving home, becoming a parent), or periods of significant shifts in attitudes (e.g. peer group influences, diagnosis of ill health).

Breast-feeding and early growth patterns provide the only period in which there is clear evidence to support the concept of a critical period of development associated with long-term consequences.<sup>9,20</sup> Other stages of life, however, may offer good opportunities to modify behaviour. For example, there is some limited evidence that behaviours, such as liking fruit and vegetables, can be established<sup>21</sup> in early childhood, and it is important to note that the most significant predictor of child obesity is parental obesity (obesity in a parent increases the risk of childhood obesity by 10%<sup>23</sup>). Meanwhile, in older adults, effective interventions associated with modest weight loss have been shown to reduce the healthcare costs arising from associated chronic diseases such as diabetes.<sup>65,66</sup>

#### 4.1.2 Opportunities arising from future technological development<sup>31</sup>

How technology is used is conditioned by society and it is possible to foresee radically different outcomes in the future, depending on the individual and societal values that prevail. Technology is certain to create new options. For some, it will be part of their efforts to make effective changes to their lifestyle; for others, it will play a part in providing temporary fixes that are doomed to fail in the long term.<sup>31,32</sup>

**Figure 4.1: Critical opportunities for intervention during an individual's lifecourse.** It is critical to note that there is no one point in the life course where intervention is particularly successful but that progress through life offers a number of naturally occurring opportunities such as metabolic plasticity or behaviour change.



<u>Age</u>	<u>Stage</u>	<u>Issue</u>
	Preconception In utero	Maternal nutrition programmes foetus
0—6 months	Post-natal	Breast-vs bottle-feeding to programme later health
6—24 months	Weaning	Growth acceleration hypothesis
2—5 years	Pre-school	Adiposity rebound hypothesis
5—11 years	1st school	Development of physical skills Development of food preferences
11—16 years	2nd school	Development of independent behaviours
16—20 years	Leaving home	Exposure to alternative cultures/behaviour/lifestyle patterns (e.g. work patterns, living with friends etc.)
16+ years	Smoking cessation	Health awareness prompting development of new behaviours
16—40 years	Pregnancy	Maternal nutrition
16—40 years	Parenting	Development of new behaviours associated with child-rearing
45—55 years	Menopause	Biological changes Growing importance of physical health prompted by diagnosis or disease in self or others
60+ years	Ageing	Lifestyle change prompted by changes in time availability, budget, work-life balance. Occurrence of ill health.

For people who want to be healthier and who want to change their lifestyle, technology will make it easier as measurement and feedback systems become more refined and personalised.<sup>31</sup> These systems have the potential to be linked into a wide range of lifestyle support services through community, public and private providers.

Use of food technology, chemistry and material sciences offers opportunities to develop structured foods that are inherently healthier. For example, processed foods could be structured to control the rate of release of certain nutrients or slow the rate of stomach-emptying, which would limit the amount of food that people could consume.<sup>32</sup> These developments will require new approaches to food processing and manufacturing.



However, for those who, for a variety of reasons, do not want to tackle their excess weight, there is unlikely to be a technological development that will overcome the broader societal drivers of the obesogenic environment.

### 4.1.3 Opportunities in behaviour change<sup>22</sup>

#### Providing information

Prevention of obesity in the future will require significant behaviour change at all levels, from organisations that have an influence on individual behaviour to individuals themselves. Within the health domain, there have been repeated attempts to persuade people to curb unhealthy behaviours such as smoking, heavy drinking, unsafe sex, and drug abuse.<sup>22</sup> Elsewhere, large-scale campaigns have been mounted to promote safer driving habits through speed reduction or to increase community and environmental responsibility. Some of these campaigns have been influential and have made a contribution to behaviour change. They may provide insights into the behavioural challenges posed by the obesogenic environment.<sup>22</sup>

Evidence from research on social marketing suggests that it is unlikely that the type of public information campaigns that urge people to avoid certain foods and to exercise more frequently will be enough to adequately address the problem of obesity.<sup>22,67,68</sup> Interventions that go beyond information campaigns to simultaneously inform, shift motivation and provide the necessary skills are more likely to lead to behaviour change.<sup>69</sup> However, achieving behaviour change is complex and the social and psychological factors already outlined (see Section 3.3) should be considered when designing any approach to influencing behaviour so that the risks of unintended effects are minimised and impact maximised. Evidence suggests that large campaigns can have the opposite effect to that intended if they are not properly tested beforehand. For example, when anti-racism messages were presented to a group of people who are highly ambivalent towards ethnic minorities, the messages resulted in more negative responses and views from the group than they gave prior to exposure to them.<sup>24</sup>

Achieving behaviour change is not straightforward. For example, those who do not want to drink and drive need to plan other means of transport, designated drivers, or even overnight accommodation. These decisions necessarily entail more planning. Giving up smoking is also far from simple. Effective strategies to cope with cravings include nicotine replacement and the avoidance of cues that have habitually prompted smoking. Similarly, tackling obesity involves a variety of short- and longer-term goals, including what may be challenging alterations to diet, changes in shopping behaviour, increases in exercise, different choices of transport, reductions in alcohol consumption (including binge-drinking) and so on.<sup>22</sup>

## Habits and the environment

Research shows that people and their environment interact to determine behaviour and the potential for behaviour change.<sup>70–74</sup> There is also evidence that there are difficulties in making healthy choices in some environments.<sup>75,76</sup> These studies illustrate the considerable psychological effort needed to combat the temptation of an unhealthy lifestyle and how freedom of choice can sometimes, counter-intuitively, make it *more difficult* to resist temptation.<sup>77,78</sup> Stress<sup>79,80</sup> and habit formation also impede the ability to resist temptation,<sup>81</sup> and this problem is particularly apparent for healthy eating behaviour.<sup>82</sup> Yet, choice, stress and habit are all inescapable aspects of modern life. Cumulatively, they make it hard to resist unhealthy options, especially when such options are so abundant. Evidence suggests that there is greater chance of changing behaviour in situations where existing habits are temporarily broken, such as when people undergo major changes in their lives (i.e. becoming a parent, taking a new job, moving house or attending a new school). People are more susceptible to new information at such times.<sup>22</sup> But whether it is effective in the longer term depends on whether they experience appropriate environmental change together with strategies that help them sustain their new behaviour.

## Maintaining behaviour change

A key feature of behaviours that promote public health is that they will only deliver gains for the individual and the population if they are maintained. However, the role of habit and limited personal control over behaviours that have a cumulative day-to-day impact on health over many years are not well understood.<sup>83</sup> Greater understanding is needed of how behaviours are maintained and the role that habit plays in their maintenance.

The role of habit has been important in identifying two broad types of interventions in behaviour change.<sup>84</sup> One type focuses on the determinants of behaviours, while the other focuses on the behaviour itself. The first group of interventions shapes conditions that promote and sustain desirable habits and encourage the forming of new ones. They may relate to infrastructural change, food provision or education. They include economic or regulatory incentives that reinforce actions through associated rewards, which, if suitably timed, can facilitate habit development. The second group of interventions aims to change or extinguish problematic behaviour by focusing on the individuals at risk. Both types of interventions are complementary, reinforcing the need for a combined approach.<sup>84</sup>

Generic campaigns to effect behaviour change may have different effects on individuals from diverse socioeconomic and cultural backgrounds. It is also important to identify unexpected negative consequences such as a disproportionate impact on low-income groups.<sup>85</sup> For example, promoting cooking



with fresh vegetables has the potential to increase health inequalities if costs to low-income families are not taken into account. This means not only identifying those at risk but also understanding their awareness, attitudes, perceptions and beliefs about health.

An individual's perception of their own vulnerability is critical to whether they will change their behaviour, more so than their perception of the severity of the risk. Research has shown that because people do not want to feel vulnerable, they are more likely to convince themselves that they are not at risk.<sup>86,87</sup> Provision of information is unlikely to prove effective under these circumstances.

Social psychological research suggests public campaigns might benefit from an interactive open-ended style, where individuals are encouraged to reflect and come up with their own answers, as self-generated persuasive arguments tend to lead to greater change. However, campaigns need to be maintained and supported by environmental change, otherwise it is likely that environmental cues will trigger old habits.<sup>22</sup>

#### 4.1.4 Opportunities in the built environment<sup>88</sup>

Provision of facilities for sport and formal exercise is an important part of a strategy to counter obesity. However, their lower usage by people of lower socioeconomic status, combined with the need to increase total activity levels across society, not merely among those motivated to engage in sports, suggests additional action needs to be taken.<sup>35</sup> There are other ways to increase physical activity through designing opportunities for health and activity into architecture and urban design.

Expert opinion suggests there are barriers and opportunities for changes to the way we configure the built environment. Better use could be made of existing planning regulations and design innovations (facilitated by better sharing of best practice), and much could be achieved by embedding impact on health as a criterion for planning considerations.<sup>88</sup> However, there is also a desire for new policy levers and better leadership and policy implementation. A detailed evidence base may take time to develop, but interim evaluation of promising case studies and use of current and planned 'big developments' as natural experiments could quickly provide useful pointers to shape future research. Designing activity and health into the regeneration occurring as part of the development for the 2012 Olympics is one such example.<sup>88</sup>

Promotion of 'active transport' (e.g. walking and cycling) is one way of increasing activity. But without complementary broader environmental changes to tackle issues such as commuting distances, its impact could be limited.<sup>17,18,35</sup> It is critical to consider the broader environment, including the distance to frequent destinations such as shops, workplaces and schools, along with the diversity of

land uses in a neighbourhood (residential, commercial, industrial). High connectivity and land-use mix have been used to indicate the walkability of the environment. There is also evidence of a relationship between the perceived and actual safety, greenery, aesthetics and upkeep of neighbourhoods and physical activity.<sup>35</sup> As well as the space between buildings, the design and layout of buildings themselves can support physical activity with, for example, prominent and appealing staircases rather than escalators or lifts.

Evidence on the impact of the built environment on food choices is currently limited, but knowledge will accumulate in the future. A precautionary approach would ensure that everyone has access to healthy, competitively priced food. Greater attention also needs to be afforded to the provision of food within buildings, whether places of employment or leisure. Public sector institutions could play a leadership role here.<sup>88</sup>

Section 3.4 suggested that the existing level of scientific evidence linking changes in the environment to changes in obesity levels is low. However the evidence base linking environmental change to more general positive influences on health and well-being is well established. It is highly unlikely that any of the measures suggested by this research, such as enhancing walkability or reducing car use, would have a detrimental effect on public health or the prevalence of obesity.<sup>88</sup>

## 4.2 Treatment

The effective treatment of overweight and obesity is challenging. Randomised control trials confirm that lifestyle interventions of dietary restriction and increased physical activity are successful as primary treatments. However, maintaining weight loss is often difficult. Nevertheless, such interventions take time to have an effect when the overweight or obese person seeks a rapid solution to their problem. This delay in visible benefit in the face of continuing challenges from modern living explains the high attrition rates from weight loss programmes. Moreover, the majority of treatments are hampered by the physiological mechanisms, which favour weight maintenance after modest weight loss. However, long-term interventions show that sustained changes in diet and physical activity can lead to modest but sustained reductions in body weight, of approximately 5%, over many years.<sup>89,90</sup> These interventions also lead to improvements in co-morbidities, especially the risk of type 2 diabetes and overall reductions in the cost of healthcare.<sup>28</sup>

Anti-obesity drugs may be effective as adjunctive therapy to diet and physical activity in those subjects who struggle to lose weight despite following an appropriate weight loss programme, most particularly those individuals who face or have developed medical complications as a result of their obesity. There are currently two classes of anti-obesity drugs:





- lipase inhibitors that work within the bowel to restrict fat absorption
- centrally acting drugs that suppress appetite.

An example of the first group is Orlistat, which works by ensuring that patients reduce fatty foods in their diet to avoid diarrhoea. Examples of the second group are Sibutramine and Rimonabant. Evidence from random controlled trials of one- or two-year duration confirm that anti-obesity drugs induce weight loss in the region of 5–10% in the majority of patients during the first six months of treatment, and this is generally maintained while the drug is taken.

Discontinuation of the drug appears to lead to weight regain. One of the difficulties is extrapolating the results from clinical trials of carefully selected patients to the circumstances commonly found in actual clinical practice. There is a need for additional trials of anti-obesity drugs in the clinical setting and of more than two years' duration, but this should not be at the expense of general prevention strategies.<sup>28</sup>

Advances in bariatric surgery (a portfolio of surgical techniques to reduce stomach volume in the obese) means that this is now a well-recognised and effective intervention for obesity in circumstances where the individual has a BMI of 40. Weight losses of 10–30% and substantial reductions in new cases of diabetes and cardiovascular mortality can be expected. Modern surgical techniques have enabled all types of gastric restriction surgery to be performed laparoscopically (i. e. using keyhole techniques). This has resulted in very low rates of operative morbidity and mortality and a short post-operative hospital stay for patients. However, those treated by surgery require life-long medical follow-up. Although this is a large weight reduction for an individual, the impact on the mean weight in the population is small, because the number of individuals for whom surgery is appropriate is small.

Community-based intervention studies in the UK have also shown short-term encouraging results (see Box 4.1 for examples). The use of medicines at the same time as dietary restriction and increased physical activity may produce significantly greater weight loss while the treatment is continued.<sup>30</sup>

Currently, only a small proportion of obese people receive optimal care because of limitations in resources (including trained staff). As a result, clinical management practices may prioritise the treatment of co-morbidities over weight loss. Alternatively, associated medical complications are attributed to obesity and the patient is simply told to lose weight. There is a need to identify individuals most likely to benefit from specific treatment of their obesity. BMI is a useful measure for population surveillance but it has limited sensitivity at an individual level. Instead, it needs to be combined with information on the distribution of body fat, as well as other risk factors including family history, to make better risk assessments.

In the short term, significant progress could be made by the implementation of policies based on existing knowledge of treatment strategies. Future research on the treatment of obesity needs to focus on improving the success of behavioural interventions and using drug therapy more effectively.<sup>28</sup> While there are established public–private mechanisms for investment in the latter, behavioural interventions have, historically, been poorly supported. This will not be reversed quickly, given the paucity of trained researchers in this area. Crucially, treatment should not be divorced from prevention. The maintenance of weight loss and the prevention of weight regain is a critical yet under-researched component of treatment.<sup>28</sup>

#### **Box 4.1: Examples of targeted interventions currently being used in the UK for treatment of overweight and obesity in children and adults**

**MEND (Mind, Exercise, Nutrition, Do it)** is a community-based programme, intended for children aged 7–13 and designed to produce a sustained reduction in childhood obesity. The nine-week programme, initiated by Great Ormond Street Hospital and University College London, works through weekly group meetings that address behavioural models of change, increasing daily physical activity and healthy eating. The pilot was effective in a small number of children and the programme has now been expanded as a commercial entity to 310 sites. <http://www.mendprogramme.org>

**WATCH IT** is a community-based intervention programme based in Leeds, West Yorkshire, that is provided to selected families with children aged 8–16. Health trainers who work with the families to induce changes in lifestyle are supervised by dietitians, psychologists, sports physiologists and a paediatrician. Preliminary results suggest benefit to the children and their parents in terms of weight control and improvements in quality of life. <http://www.cdhpp.leeds.ac.uk/services/watch.php>

**Traffic Lights** is a randomised, controlled effectiveness trial, comparing intervention to usual care. It is a family-based behavioural treatment programme, provided to groups of 6–8 children plus a parent/carer (or two), with 15 sessions over six months. Clinicians supported by a team of health professionals focus on nutrition and physical activity, and use behaviour modification techniques and cognitive behavioural approaches to improve self-esteem.

**Carnegie Camps** – Carnegie Weight Management is a non-profit organisation established at Leeds Metropolitan University to undertake interventions, education, training and research to successfully treat overweight and obese children. The programme includes the Carnegie International Camp, an



eight-week summer holiday camp for children aged 11–17, which provides an environment that aims to support and engage the children. They receive individual attention and experience different activities to increase their confidence and skills in order to achieve successful weight loss and weight management. The Carnegie Club is a 12-week community healthy lifestyles programme run by trained weight management specialists. The Club's aim is to involve whole families in a variety of physical activity and education sessions to enable them to lead a healthier lifestyle. <http://carnegieweightmanagement.com/home/welcome.html>

**Counterweight** is a primary care weight management programme that aims to achieve and maintain medically valuable weight loss (5–10%) in adults (18–75 years). It incorporates a structured pathway and guidance for the management of obesity in primary care settings and includes training for GPs and practice nurses. The programme recommends initial changes in lifestyle to individuals or groups, and secondary interventions may include the use of anti-obesity medications, referral to a dietician, psychologist and/or a secondary care service. Patients are followed up at least quarterly for 12 months after the programme and reviewed annually thereafter. <http://www.counterweight.org/>

**Commercial weight loss programmes** – Although some of the major companies were established in the 1960s, it is only in the last decade that the weight loss industry, currently valued at about £2 billion, has been successful. Companies usually offer a combination of methods to form a weight loss programme for adults. These include: dietary supplements, own-brand foods or meal replacement products, food planning and menu guides, and food calorie guides (e.g. the Weight Watchers points system). Physical exercise is normally mentioned in the programmes but is rarely a focus. Nearly all of the main companies base their approach on group support schemes, with people attending regular local group meetings to offer each other support and encouragement. The groups are often led by someone who has completed the scheme, with ranging levels of additional training. Partnerships between Public Care Trusts and the commercial sector for the management of obesity are gradually beginning to emerge.

### 4.3 Policy

Governments in many countries including the UK have recognised obesity as a critical issue and are making it a priority for health policy. In England, the 1992 Health of the Nation national strategy for public health introduced a target to reduce the proportion of obese men aged 16–64 from 7% in 1986/87 to 6% in 2005 and obese women from 12% in 1986/87 to 8% in 2005. A 1996 review of this target by the National Audit Office showed that proportions of obese adults had continued to rise and that childhood obesity was becoming an increasing

concern. In 2004, a target for childhood obesity was introduced to: ‘halt the year-on-year rise in obesity among children aged under 11 by 2010 in the context of a broader strategy to tackle obesity in the population as a whole’. Local government has also begun to make obesity a priority through a variety of obesity-related targets in Local Area Agreements.

There are many competing theories as to ‘what really matters’ among the many causes of obesity. These multiple theories are grounded in a number of disciplinary traditions including sociology, physiology, psychology, economics and anthropology. Each prioritises different aspects of the problem, has its own approach to evidence and implies different solutions, thus promoting both caution and confusion.<sup>13</sup> This disagreement over causes and contributory factors, when combined with the multi-level nature of modern governance, creates a complex set of challenges for policy.

The situation has been described as one of ‘policy cacophony – where noise is drowning out the symphony of effort’.<sup>13</sup> Compounding the uncertainty over determining appropriate policy responses are the difficulties of timing and the lack of evidence on which to base effective interventions. The problem of obesity has been developing over a long period, and solutions will take time to have an impact. It has also been suggested that current policies do not cover the range and depth of the multiple, concurrent interventions needed. If new policies are to be effective, they must embrace the policy remit of numerous government departments and other important sectors such as the food industry in an integrated fashion. If policies are developed in isolation, there is a very high risk that positive action in one area might be undermined by well-intentioned but opposing forces in another.

More research into wider economic and social determinants of health is needed to help policy makers make sense of the complexity associated with the causation and management of obesity (e.g. effects of food marketing on dietary patterns, cross-price elasticities, the impact of food labelling and the causes of reduced physical activity). Meta-analyses of the effectiveness of policy innovations are also needed. This approach has been followed in Australia, where the Melbourne ACE-Obesity model<sup>11,91</sup> is assessing and comparing the cost-effectiveness of a wide variety of obesity-related interventions to support decision making in policy development.

Of course, the viability of government policies isn’t just a matter of what works in theory but what works in a manner that society finds acceptable.<sup>13,25</sup> A significant factor is the relative priority given by society to policies that promote public health. Finding opportunities to increase the emphasis given to public health may be critical. In practice, goals for obesity-related policies are often closely aligned to the policy goals of sustainable development. Many participants in the Foresight Tackling Obesities: Future Choices project drew parallels between the issue of obesity and the issue of climate change (see Box 4.2). Investment in policies for



obesity prevention and in investing in the capability to deliver them could have benefits not only in major reductions in health-related costs but also in broader societal benefits arising from improved well-being and quality of life.<sup>13</sup> This is discussed further in Section 8.

#### Box 4.2: Obesity – the ‘climate change of public health’?

Many participants in the Foresight Tackling Obesity: Future Choices project have suggested that obesity shares a number of features with the issue of climate change – both are complex in causation and solution, with questioning of the evidence, yet they both demand firm and swift action.<sup>13,16,88</sup>

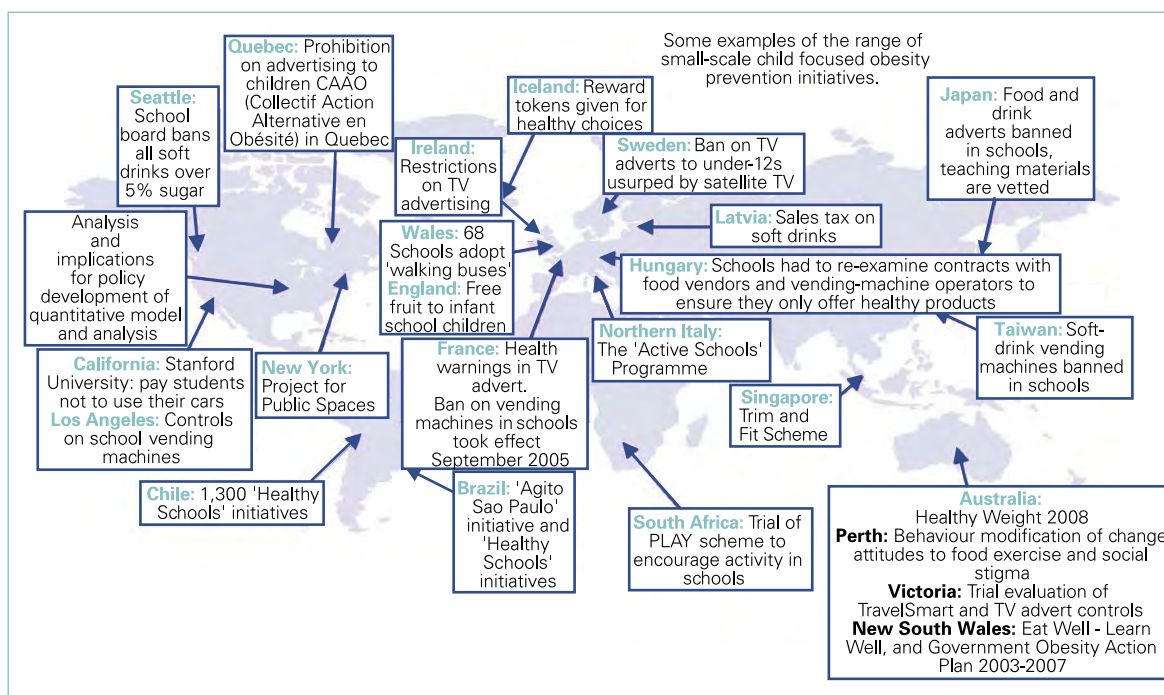
A number of parallels can be drawn:<sup>13</sup>

- 1** Failure to act at an early stage is already having significant and undesirable consequences.
- 2** The policy discourse is vibrant but is not yet being matched by a requisite, measurable change in the right direction by society, governments and the economy.
- 3** The environmental determinants remain widely misunderstood and under-researched, while policy drifts towards individualised responsibility.
- 4** There is a danger that the moment to act radically and coherently will be missed and that the possibility of reversing population-wide obesity will be lost.
- 5** In addition, unlike climate change, obesity is being normalised, even as the trend accelerates and the evidence grows. Many actors, individuals and institutions recognise their roles but feel powerless or uncertain about how to act. However, there is an opportunity to create greater synergies between these two issues where action to tackle both issues has mutual benefit.<sup>25,88</sup>

#### 4.3.1 Lessons from other countries<sup>11</sup>

The prevalence of obesity varies across Europe. The UK is now one of the leading countries in terms of population weight gain, although the largest national weight increases among children have been in Malta, Greece and Spain, countries previously celebrated for their healthy Mediterranean diets.<sup>13</sup> Hundreds of initiatives to combat obesity are being introduced worldwide, but they have not been evaluated in a way that enables any definitive conclusions to be drawn about their effectiveness (see Figure 4.2). No population-wide policy intervention focused on the broad range of determinants of obesity has been attempted,<sup>11,13</sup> and it remains unclear how promising small-scale initiatives should be scaled up for whole-population impact.

**Figure 4.2: Examples of child-focused interventions to tackle obesity.**<sup>11</sup> Many initiatives are being introduced world-wide, some examples of child-focused interventions are shown here.



Reviews of the evidence from other countries suggest that, although specific actions can sometimes be useful, without overall coherence in policy and clear political drivers, they are most unlikely to deliver the required level of change. Even at a micro-social level, this appears to be the case. As a rule, reviews of interventions in school settings suggest that a 'whole school' approach (meal services, vending, class teaching, physical education, out-of-school activities) is more likely to be successful than one targeting individual children. In principle, the greater the environmental change, the better the chance of a sustainable change in health behaviour.

Systematic reviews of the reported effectiveness of interventions around the world reveal few scientifically conducted trials that have shown a direct effect on BMI or obesity prevalence.<sup>37</sup> Those trials that have shown an impact are limited to easily controlled settings such as schools and workplaces, where individuals and small groups can be observed. This is not to say that interventions in other settings are necessarily not effective; rather, that they have yet to be conducted and evaluated in such a way that their effect can be identified. More attention needs to be paid to assessing the impact of interventions that are harder to assess scientifically, such as changes in marketing or food pricing or changes in access to resources that engage people in enjoyable physical activity. A number of research projects are showing initial promise, but none are in the UK (see Section 4.1). The UK has recently introduced significant societal interventions





(e.g. restricting advertising to children and intervention in school meals), but there has not yet been a rigorous evaluation of their impact.

The one strong example of a successful population intervention, with a focus on the related health issue of heart disease, is the Finnish North Karelia project in the 1970s (see Box 4.3). However, it has been suggested by those involved that it would not be possible to reintroduce the intervention because of a lack of control over key policy levers and the reduced coherence of society, and that such interventions would have to be approached and organised in a different way.<sup>11,13</sup>

#### Box 4.3: The North Karelia Project – Finland<sup>92</sup>

This programme, aimed at reducing levels of heart disease, began in early 1972 and ran (evolving over time) for 20 years. A community-based prevention programme intended to tackle critical causal risk factors and their relationships with community lifestyles, it involved all sectors of the community and citizens themselves. Most emphasis was placed on influencing the dietary and smoking habits of the population, but physical activity, weight, diabetes, alcohol consumption and psychosocial factors were also taken into account.

The intervention combined general health education (through media, campaigns and meetings), local health service measures, training of personnel and environmental changes (smoking restrictions, collaboration with food manufacturers and retailers, promotion of vegetable growing) with close evaluation of outcomes. Central to the project was inclusion of expert advice, scientifically sound evaluation, co-ordination of activity and media information. Practical aspects of the programme were carried out by bodies within the communities themselves.

#### Impact

Changes over the 20-year period were substantial. Death rates from coronary heart disease fell dramatically. By 1992, the coronary heart disease mortality for men was 59% lower than at the start and significantly different to the population elsewhere in Finland. Trends in stroke and cancer mortality also showed a downward turn, with impacts on life expectancy and diminished mortality.

#### Conclusions

- A comprehensive, determined and community-based programme can have a substantial positive effect on risk factors and lifestyles.
- Such changes are associated with favourable changes in chronic disease rates and in the health of the population.
- A major national demonstration programme can significantly reduce chronic disease.

Cross-European interviews with a range of stakeholders<sup>93</sup> suggested that a set of local and national policies to address obesity is needed, encompassing education, information, food pricing and availability, and environmental planning. Further, if such policies can show wider health and social advantages they are more likely to be accepted.<sup>11,93</sup>

#### 4.3.2 Lessons from other health issues

Analyses of other public health issues could offer insight into the kinds of interventions that might or might not work for obesity.<sup>94–96</sup> One of the important lessons from efforts to reduce smoking and alcohol consumption is the lengthy lag time between obtaining evidence from research for harmful effects, and action taken in terms of behaviour change, or in terms of the public acceptability, of public health interventions. Controls on smoking provide an interesting case study with respect to the acceptability of different types of interventions (see Box 4.4).<sup>95,96</sup> Over the last 50 years, policy makers have moved from the basic provision of information and advice, through the facilitation of healthier options (e.g. through use of nicotine replacement), active discouragement of the unhealthy behaviour (e.g. taxation, advertising restrictions) and finally to regulatory action (e.g. bans on smoking in public places).

##### Box 4.4: Timeline of changes in smoking intervention

In 1962, the Royal College of Physicians of London published a report, *Smoking and Health*,<sup>97</sup> that made seven recommendations for policy. Increasing public awareness about the dangers of smoking along with shifting public attitudes have led to changes in government policy that have enabled these recommendations to be taken forward in the intervening 40 years.

Royal College of Physicians recommendation	Public health actions
<b>1</b> More education of the public, especially school children, concerning the hazards of smoking	<b>1962</b> – £50,000 for three-year campaign <b>1998</b> – Tobacco White Paper committed £50 million over three years for education
<b>2</b> More effective restrictions on the sale of tobacco to children	<b>1962</b> – Rejection of proposal to raise minimum age from 16 to either 17 or 18 <b>2007</b> – under consideration
<b>3</b> Restriction of tobacco advertising	<b>1962</b> – Voluntary measures by advertising media and tobacco industry while keeping threat of legislation in reserve <b>1997</b> – New Labour Government includes complete ban in manifesto
<b>4</b> Smoking bans in public places	<b>2007</b> – Introduction of smoking ban in public places in England



<p><b>5</b> Increase in tax on cigarettes, perhaps with adjustment of the tax on pipe and cigar tobacco</p>	<p><b>1962</b> – Rejected due to ‘unfairness to poor and women’  <b>1990s</b> – Increase in ‘headline’ tax on tobacco products</p>
<p><b>6</b> Informing purchasers of the tar and nicotine content of the smoke of cigarettes</p>	<p><b>2001</b> – EU Directive on product regulation for tobacco products (tar and nicotine yields)</p>
<p><b>7</b> Investigating the value of anti-smoking clinics</p>	<p><b>1962</b> – Ministry of Health encouraged health authorities to initiate trials  <b>1999</b> – Important element of NHS reforms</p>

Campaigns relating to alcohol have successfully reset social norms with respect to drinking and driving. However, this has not been accompanied by a decrease in overall alcohol intake.<sup>56</sup> Parallel, broadly based environmental interventions to support and facilitate behaviour change are also required (see Box 4.5).

Action on diet (including high-calorie and alcoholic drinks) and physical activity is far behind. Social marketing techniques can contribute to raising awareness, influencing public opinion and resetting social norms<sup>67</sup> but, alone, they are insufficient.<sup>68</sup> Here, as with smoking and alcohol, most observers accept the need for campaigns to coexist with parallel environmental interventions to support and facilitate behaviour change. The priority is not to be over-reliant on any single approach.<sup>96</sup>

**Box 4.5: Effectiveness of different strategies for reducing inappropriate alcohol consumption<sup>96</sup>**

<p><b>Little or no effectiveness</b></p>	<ul style="list-style-type: none"> <li>• <i>Provision of educational and public information</i> fails because they are generally short-term and less intensive than the drink industry’s advertising of alcohol.</li> </ul>
<p><b>Moderate effectiveness</b></p>	<ul style="list-style-type: none"> <li>• <i>Advertising controls</i> – Advertising alcohol increases overall consumption and encourages positive beliefs about drinking. Hard-hitting counter-advertising is also moderately effective.</li> </ul>
<p><b>Effective</b></p>	<ul style="list-style-type: none"> <li>• <i>Limiting availability through taxes and other influences on price</i>, for example, a 10% price increase would cut mortality from cirrhosis in men by 7%.</li> <li>• <i>Minimum purchase age laws</i> – Extensive evidence from the USA shows that increasing the minimum age for purchase to 21 has a health impact.</li> <li>• <i>Alcohol-specific sales outlets</i>, i.e. restricting sales by grocery stores and supermarkets. When New Zealand allowed sales by these outlets, wine consumption increased by 16%.</li> <li>• <i>Limiting hours of the day and sale</i> – Late opening in particular increases consumption.</li> <li>• <i>Regulation of drinking environments</i> – Larger drinking premises increase capacity and also drunkenness; restrictions on size and location would be effective.</li> <li>• <i>Drink-driving countermeasures</i> – Practices such as sustained random breath tests by police so that every driver is stopped at least once every two years and lowering permitted blood-alcohol levels from 0.05% (most of Europe) to 0.02% as in Sweden.</li> </ul>

### Summary of key points

- There are significant gaps in the evidence base for effective interventions for obesity prevention.
- Currently, there are few interventions that successfully reduce the prevalence of obesity and none on a population scale, but there are some international examples that are beginning to show promise.
- It is likely that action will be needed when evidence is neither complete nor perfect.
- A 'magic pill' or technological fix for obesity that is sustainable and cost-effective is unlikely.
- There are opportunities to be found in building on our understanding of behaviour change and through changes to the built environment to increase everyday activity levels.
- Lessons can also be learnt from progress with other health concerns such as smoking and excess alcohol consumption.



## 5. A complex system

This section draws upon the Foresight systems mapping work to examine the complexity of the determinants of obesity, their interrelationships and implications for intervention.



## Section 5: A complex system

The common perception is that if only people ate less and did more, the problem of obesity would be solved. The evidence described in Sections 3 and 4 shows that this deceptively simple analysis masks the real challenge of achieving that solution. There is an underlying complexity to obesity, which means that tackling it will be difficult and will require a multifaceted approach. Obesity is the consequence of interplay between a wide variety of variables and determinants related to individual biology, eating behaviours and physical activity, set within a social, cultural and environmental landscape.

We used a systems mapping approach (that is, a method of conceptually representing a system – a ‘system’ being defined as ‘a structured set of objects and/or attributes together with the relationships between them’<sup>98</sup>) to capture this complexity and to help unravel some of the interrelationships and relative importance of various determinants. System maps or causal loop models are often used to improve insight into the underlying structure of complex issues. System maps are sometimes referred to as ‘influence diagrams’ as they show how variables coexist and provide a tool to guide decision making on interventions in the modelled system. Maps can help to visualise and communicate current relationships and constraints that may influence the future behaviour of a system at a particular moment in time.

Our obesity system map was designed as a conceptual representation of the interdependencies of relevant variables that currently determine the energy balance of an individual or group of people in the UK. It was constructed using detailed advice from a large group of experts drawn from several disciplines. At this point, Foresight’s obesity system map arguably represents the most comprehensive ‘whole systems’ view of the determinants of energy balance that exists.<sup>17,18</sup> The map has been used to identify key determinants and relationships and to visualise how future scenarios and options for policy responses might affect the obesity system<sup>17,18</sup> Additional work is needed to continue to update and refine the map as a strategy development tool for policy making and other potential users.

### 5.1 Structure of the obesity system map

The obesity system map is made up of a large number of determinants or ‘variables’. Some of the variables are fairly straightforward and measurable (e.g. ‘ambient temperature of the indoor environment’ – the temperature of homes and offices), while others are psychological, cultural or environmental variables that are more difficult to quantify (e.g. ‘walkability of the living environment’). The map shows the relationships between these variables, symbolised by arrows, and





whether they are positive or negative (see Appendix 4 for a detailed description of how to interpret the system map).

The obesity system map has 'energy balance' (energy intake vs energy expenditure) at its heart. Around this centre are a peripheral set of 108 variables that directly or indirectly influence energy balance. These variables are clustered in seven themes. Apart from the physiological cluster, most of the variables can be considered on an individual, family, group or societal scale. For example, the 'level of physical activity' can be considered for a particular individual or as an average for the whole population

### 5.1.1 The core 'system engine'

The core of the system map is a central dynamic 'engine' of three interlocking feedback loops that drive the energy balance equation of an individual or group of people (see Figure 5.1):

- **a core balancing loop**, or, more precisely, a combination of two overlapping balancing loops, biological in nature and revolving around the activity of body weight maintenance. This loop embodies the underlying homeostatic control system, which regulates body weight. Homeostasis is the process by which the body strives to preserve constancy and balance. People burn calories, reducing their level of available energy. A physical need for energy replenishment is created, which triggers a process of energy accumulation (seeking and eating food) in order to restore energy levels. Energy conservation can also be triggered, for example, by reducing the level of physical activity. These actions then raise the level of available energy, bringing the system back into energy balance. If individuals are successful in maintaining this energy balance, the physical need, and therefore the drive to accumulate or conserve energy, becomes less acute. The system remains in balance.
- **a reinforcing loop (or lock-in)**. The core balancing loop may be overridden if people (individually, or as a family, group or society) increase the time and effort they give to acquiring and/or conserving energy, such as eating while watching television, or if the process of conserving energy becomes easier, such as driving to work rather than walking. Patterns of energy accumulation, in terms of eating more, and energy conservation are then reinforced, becoming more ingrained (at a biological, social and institutional level) and a fixed path or 'lock-in' may develop. These established energy patterns then continue independently of the presence of a physical need for that energy. The evolutionary driver, that of food scarcity is short-circuited and the reinforcing loop takes over, driving an incessant process of accumulation and conservation. In this way, the system that regulates appetite can easily be overridden in

individuals by manipulation of the sensory properties of food (see description of asymmetry of appetite in Section 3) and at a macro level, where the production of food is primarily driven by economic drivers in the developed world.<sup>11</sup>

Importantly, this lock-in is only revealed when individuals are in a situation of energy abundance. If food was scarce, the lock-in would probably be an effective and efficient survival strategy as it would stimulate activities to acquire energy and to preserve it.

- **a conscious-control loop.** A third balancing loop is superimposed on the core and lock-in loops: a cognitively driven effort that reflects the ability of humans to make decisions which can override biological, social or cultural factors. When individuals or a group are in a situation of energy abundance, the importance of the physical need for energy goes down and the conscious control of eating increases to keep the system in balance. As this conscious control goes up, the strength of the lock-in and the effort to acquire and preserve energy are reduced.

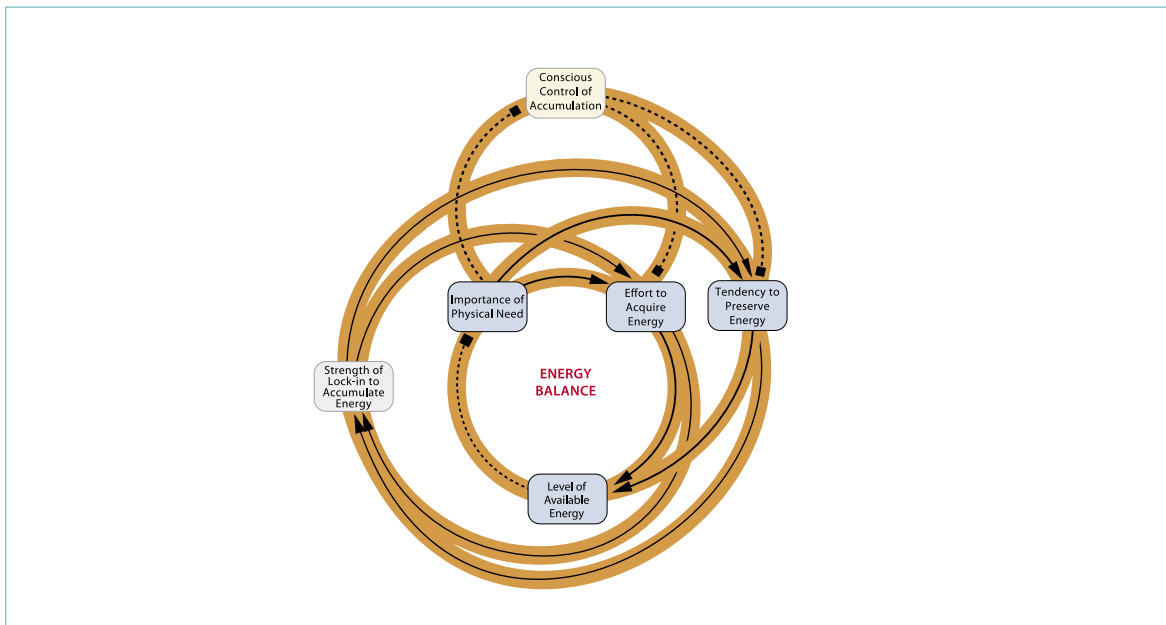
The system map's core engine with its three loops, encapsulates the basic dynamic underlying the problem of obesity. An energy gap triggers an innate biological tendency to acquire and/or preserve energy and the success of these activities brings the energy equation in balance. But these activities can become self-sustaining and a lock-in develops that continues to drive these acquisition/preservation strategies despite the absence of a physical need. This positive feedback cycle can be countered by a balancing loop driven by a conscious control of weight gain. This suggests that, to tackle obesity, it may be necessary to reinforce the core balancing loop and conscious-control loop or to break the lock-in to energy accumulation and conservation.

The engine is centred on energy balance. Variables are represented by boxes; positive causal relationships are represented by solid arrows and negative relationships by dotted lines. The central engine consists of six variables and three main feedback loops:

- a core balancing loop linking four variables: 'level of available energy', 'importance of physical need', 'effort to acquire energy' and 'effort to preserve energy'.
- a reinforcing loop or 'lock-in' linking both 'effort to acquire energy' and 'effort to preserve energy' positively to 'strength of lock-in to accumulate energy'. A strong lock-in, in its turn, reinforces both the 'effort to acquire energy' and the 'tendency to preserve energy'. This reinforcing loop effectively bypasses the role of the 'importance of physical need' variable from the core balancing loop.



Figure 5.1: Obesity system map central engine<sup>17,18</sup>



- a third balancing loop (conscious control). The variable 'conscious control of accumulation' is negatively driven by the 'importance of physical need'. When, in a situation of energy abundance, the importance of physical need for energy decreases, the conscious control of accumulation should increase to keep the system in balance. As conscious control increases, the 'strength of lock-in to acquire energy' is decreased, as is the effort to acquire and preserve energy.

### 5.1.2 Thematic clusters within the obesity system map

The obesity system map contains seven key subsystems or themes (see Figure 5.2):

- The **physiology cluster** contains a mix of biological variables e.g. genetic predisposition to obesity, level of satiety and resting metabolic rate. It also contains an important reinforcing loop that endeavours to maintain the appropriate body composition from one generation to another.
- The **individual activity cluster** consists of variables such as an individual's or group's 'level of recreational, domestic, occupational and transport activity', 'parental modelling of activity' and 'learned activity patterns'. The links between the variable 'level of physical activity' and the 'level of fitness' indicate that a

particular level of fitness is required to engage in physical activity – the higher the level of fitness, the easier it is to engage in physical activity, and vice versa.

- The **physical activity environment cluster** includes variables that may facilitate or obstruct physical activity such as ‘cost of physical exercise’, ‘perceived danger in the environment’ and ‘walkability of the living environment’. It also includes variables that reflect cultural values associated with activity patterns, such as ‘reliance on labour-saving devices’.
- The **food consumption cluster** includes many characteristics of the food market in which consumers operate and reflects the health characteristics of food products, such as the level of food abundance and variety, the nutritional quality of food and drink, the energy density of food, and portion size.
- The **food production cluster** includes many drivers of the food industry such as ‘pressure for growth and profitability’, ‘market price of food’, ‘cost of ingredients’ and ‘effort to increase efficiency of production’. It also includes variables reflecting the wider social and economic situation in the UK, such as ‘purchasing power’ and ‘societal pressure to consume’.
- The **individual psychology cluster** contains variables that describe a number of psychological attributes from ‘self-esteem’ and ‘stress’ to ‘demand for indulgence’ and ‘level of food literacy’. It also contains variables related to the kind of parenting style prevalent in families with children: ‘level of parental control’ and ‘level of children’s control of diet’.
- The **social psychology cluster** captures variables that have influence at the societal level, such as ‘education’, ‘media availability and consumption’ and ‘TV watching’. It also includes variables related to societal attitudes to weight such as ‘social acceptability of fatness’ and ‘importance of ideal body-size image’.

Detailed analysis of the different clusters of the system map can help make intervention seem more manageable. But it is important to remember that the system is highly interconnected. Intervening in ‘food consumption’ has an impact on ‘physical activity’ and ‘individual psychology’. This is illustrated by the way individuals can exhibit compensatory behaviour either through metabolic compensation pathways or psychological traits such as allowing themselves an energy-dense snack as a ‘reward’ after exercising or because they think they have already expended the calories by exercising. This connectivity must be taken into account if unexpected impacts of interventions or loss of impact due to mitigating effects elsewhere are to be minimised.

## 5.2 Key variables and intervention points

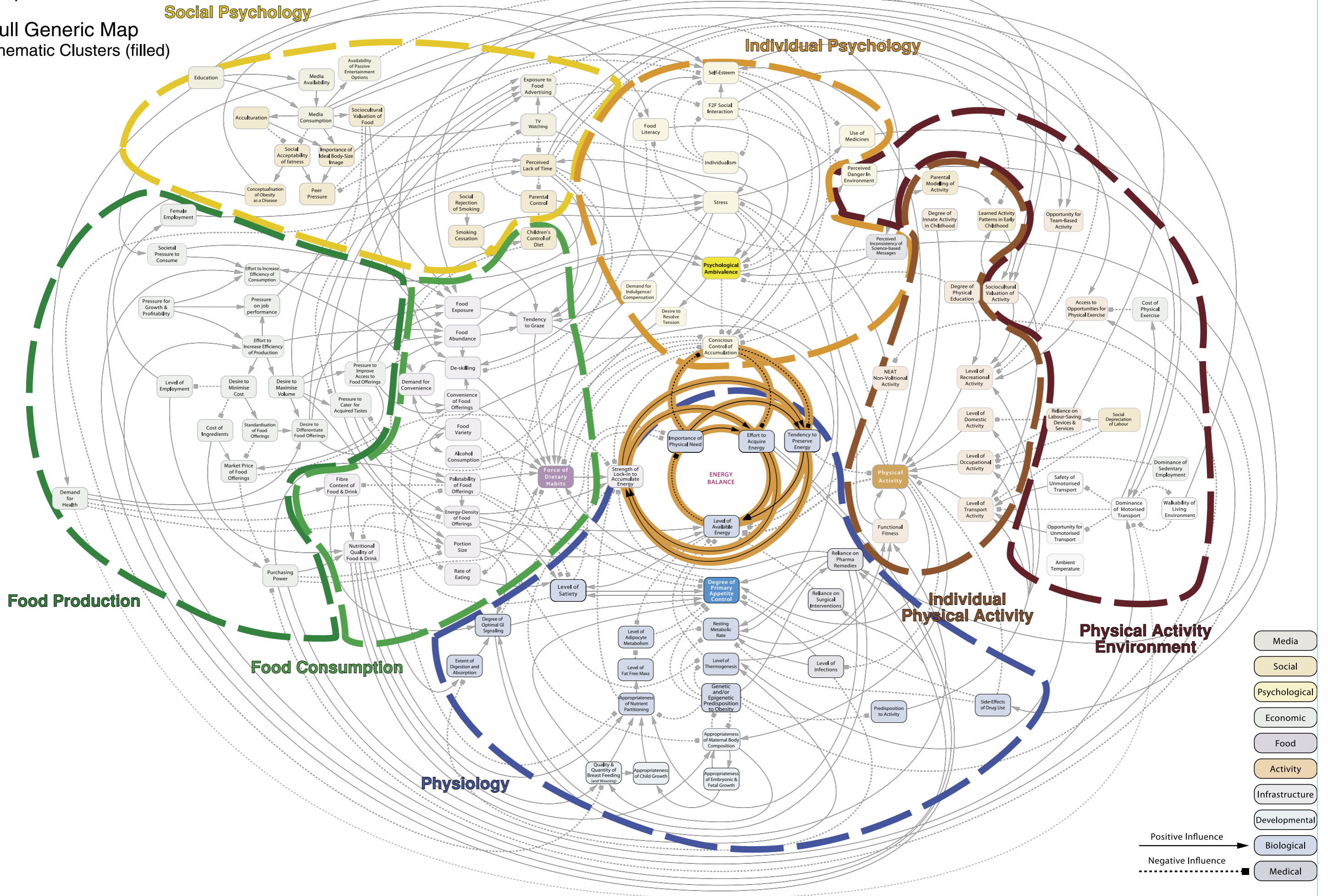
The anatomy of the system map, with its large number of variables and many causal linkages, provides a confirmation of the complex nature of this issue. It suggests that only a long-term, broad and diversified approach will stem the rising prevalence of obesity. Intervention in just one area may precipitate compensatory



**Figure 5.2: The full obesity system map with thematic clusters (see main text 5.1.2 for discussion)<sup>17,18</sup>** Variables are represented by boxes, positive causal relationships are represented by solid arrows and negative relationships by dotted lines. The central engine is highlighted in orange at the centre of the map.

Map 5

Full Generic Map  
Thematic Clusters (filled)



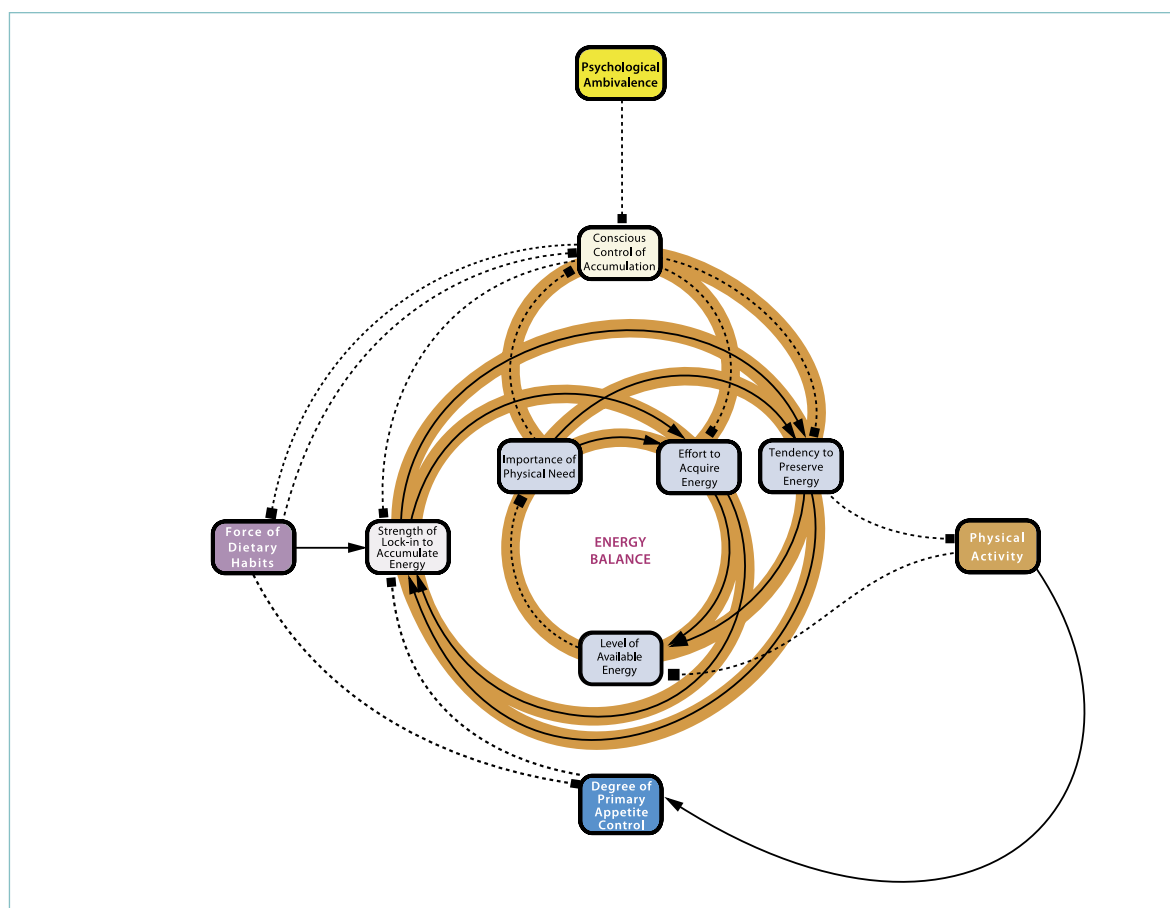


changes elsewhere that dampen the effect. It also shows why unintended consequences from specific interventions may occur, given the complex interdependencies. The nature of many of these variables also makes clear that change will be a long-term endeavour. Despite this complexity, the map can suggest key variables and points of intervention that might have greater impact than others if addressed as part of an integrated strategy.

### 5.2.1 Key variables<sup>17,18</sup>

The system map shows that the central ‘energy balance’ engine is primarily driven by four key variables (see Figure 5.3), one from each of the four main areas of the map (physiology, food, activity and psychology), which are themselves driven by a complex network of interdependencies:

**Figure 5.3: The four key variables in the obesity system map and their relationships to the central engine.**<sup>17,18</sup> The key variables are ‘level of primary appetite control’, ‘force of dietary habits’, ‘level of physical activity’ and ‘level of psychological ambivalence’. Variables are represented by boxes, positive causal relationships are represented by solid arrows and negative relationships by dotted lines. The central engine is highlighted in orange at the centre of the map.





- **the level of primary appetite control in the brain** – reinforces the dominance of the system to regulate biological appetite over energy expenditure within the physiology cluster of the map
- **the force of dietary habits that keeps individuals or groups from adopting healthier alternatives** – represents the accumulated consequences of multiple variables within the food cluster of the map, from the energy density of food to the portion size.
- **the level of physical activity** – dominates other energy expenditure mechanisms that are less easily modified within the activity area of the map
- **the level of psychological ambivalence experienced by individuals, groups or organisations in making lifestyle choices** – symbolises the convergence of many motivations and social drivers on individual, family, group and societal behaviours within the psychological areas of the map.

Each of these variables is associated with many arrows in both directions, which implies that they act as conduits of dispersed changes in the obesity system into the core engine. Hence, they are prime targets for potential policy interventions.

### 5.2.2 Identifying additional intervention points

Exploring the variables that lie close to the centre (i.e. those that are one or two steps away from the core engine and directly connected to the four key variables) yields a group of additional potential intervention points in the obesity system. These can be analysed for their utility, which needs to be assessed and prioritised according to, for example, feasibility and effectiveness. Other intervention points can be identified by considering the number of arrows entering and emerging from a variable and seeking those with many connections. There is also a need to ensure a balance of interventions by acting on variables right across the map.

The variables listed in Table 5.1 offer starting points for potentially effective interventions. However, assessing the effectiveness of a given intervention hinges on having knowledge about the relative impact and strength of the causal connections between these variables and the core engine. For example, strong linkages imply that even small changes in the tail variable (i.e. the variable at the tail of the arrow) will have some impact on the dependent variables. Weak linkages do not propagate these small changes as effectively. Only limited data could be gathered on the relative strength of the causal linkages, reflecting the limitations in the evidence base, but further refinement is possible as evidence accumulates.



**Table 5.1: Key additional intervention points on the obesity systems map<sup>17</sup>**

These additional intervention points were identified by analysing the variables that have multiple connections or strong linkages with the four key variables and the central system engine.

Target variable or interconnection	Additional intervention point
Directly reduce the level of lock-in to accumulate and preserve energy	<ul style="list-style-type: none"> <li>• Increase satiety/degree of primary appetite control</li> <li>• Minimise generational effects by optimising maternal body composition and improving the quality and quantity of breast-feeding</li> </ul>
Increase physical activity levels	<ul style="list-style-type: none"> <li>• Enhance the walkability of the living environment</li> <li>• Reduce the dominance of sedentary employment</li> <li>• Mitigate the dominance of motorised transport</li> <li>• Improve access to opportunities for physical exercise</li> </ul>
Reduce the force of dietary habits	<ul style="list-style-type: none"> <li>• Decrease portion sizes</li> </ul>
Reduce the level of psychological ambivalence	<ul style="list-style-type: none"> <li>• Reduce the level of perceived information inconsistency around health messages</li> <li>• Integrate health into the sociocultural valuation of food</li> </ul>
Additional leverage points	<ul style="list-style-type: none"> <li>• Education</li> <li>• Changing people’s potential to graze (snack and eat on the move)</li> <li>• Increasing purchasing power</li> <li>• Decreasing stress levels</li> </ul>

Figure 5.4 shows an initial attempt to assign weightings to the linkages on the system map, where the strength of the linkages are represented by different thicknesses of the arrows. The central, driving function of the core engine and key variables is clear and strong links are scattered across the system map.

It is important to note that few of the linkages between the central engine and peripheral variables appear to be very strong and, as a result, there are no uninterrupted cascades of high-impact linkages connecting peripheral variables with the central engine. This reinforces the view from Sections 3 and 4 that there is no single solution to obesity and that no single intervention is likely to produce a very high impact on the prevalence of obesity.

### 5.3 Different maps for different population groups

Section 3 described how some causes of obesity are important for some individuals and not others. Therefore some people have an increased genetic predisposition, while others risk obesity because of social or environmental circumstances. Ideally, submaps for different population subgroups, based on, for example, gender, socioeconomic class, life stage or ethnicity, would be constructed, indicating the relative strength and importance of variables and linkages. Maps could also be developed to consider different social settings and

localities. This would encourage the development of targeted policy measures directed at combating obesity in particular groups or settings. However, the data are currently too sparse and fragmented to support reliable variants of the generic map. Therefore, in this study, a submap has only been drawn to show a preliminary view of key influences for children in order to demonstrate the principle (see Figure 5.5). The system map needs to be continually refined and updated to reflect new evidence as it arrives.<sup>17,18</sup>

Variables are represented by boxes, positive causal relationships are represented by solid arrows and negative relationships by dotted lines. The central engine is highlighted in orange at the centre of the map.

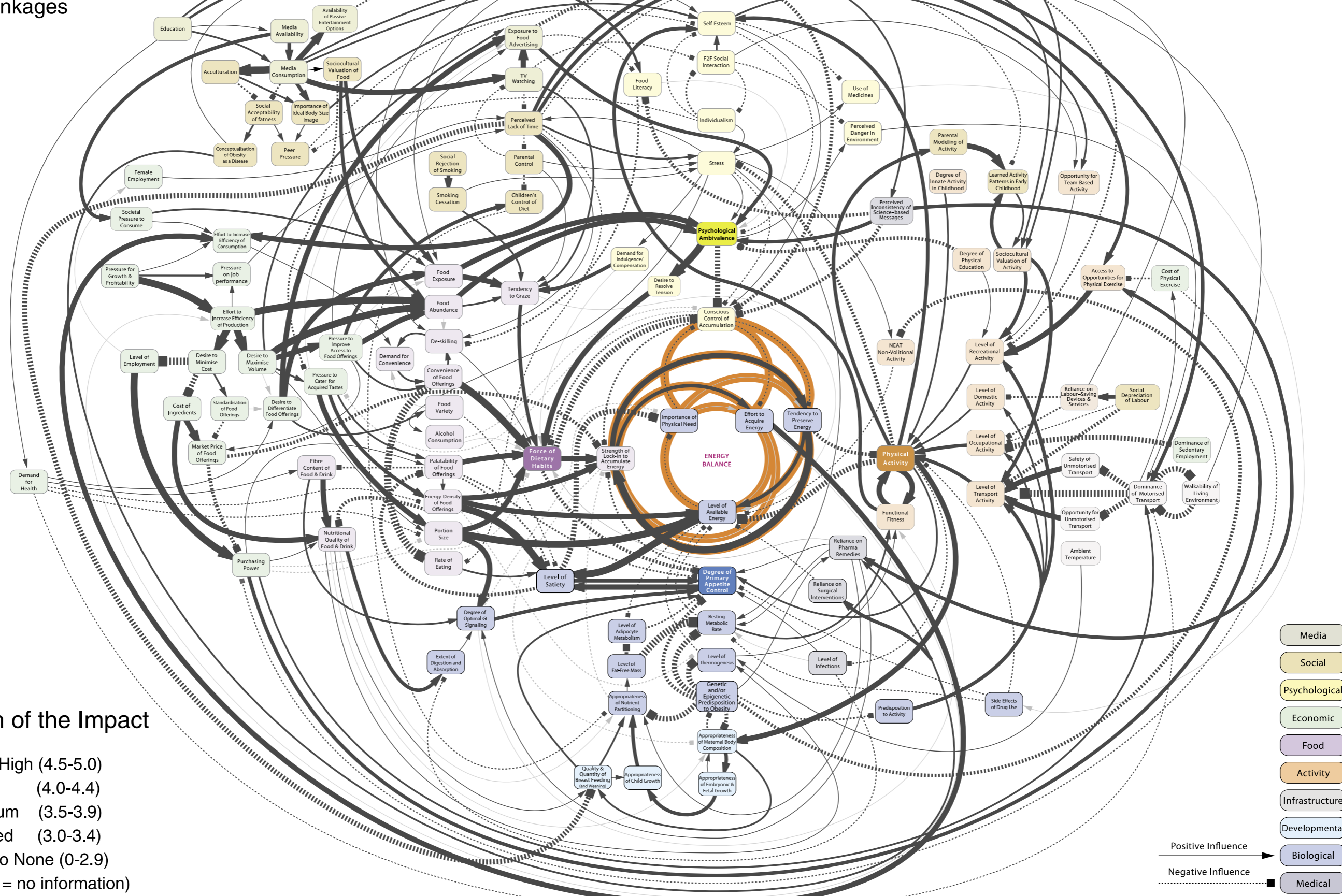
### Summary of key points

- The Foresight obesity system map is unique and provides insight into the complexity of and interrelationships between the determinants of obesity. It suggests possible intervention points.
- At the heart of the map is the 'core engine', which encapsulates this problem. An energy gap triggers an innate biological tendency to acquire and/or preserve energy and the success brings the energy equation into balance. But these activities can become self-sustaining and a lock-in develops that continues to drive acquisition and preservation of energy despite the absence of a physical need. This drives the system out of balance and leads to increased body weight. This lock-in can be overridden by conscious control, though this doesn't always occur, as the forces driving energy accumulation are very strong.
- The core engine is surrounded by four key determinants of obesity: the level of primary appetite control, the force of dietary habits, the level of physical activity and the level of psychological ambivalence.
- Numerous obesity determinants link to these variables from genetic predisposition, level of recreational activity, the walkability of the living environment, energy density of food, cost of food ingredients, levels of self-esteem, education and media consumption.

**Figure 5.4: The full obesity system map indicating the strength of the relationships between variables (see main text for discussion).<sup>17,18</sup>** A qualitative scale of 0–5 was used (a rating of 5 meaning that small changes in the tail variable lead to large changes in the head variable). Linkages were assigned a rating where possible or left 'grey' where there was no information (see key). Variables are represented by boxes, positive causal relationships are represented by solid arrows and negative relationships by dotted lines. The central engine is highlighted in orange at the centre of the map.

Map 27

Weighted Causal Linkages



Strength of the Impact

- Very High (4.5-5.0)
- High (4.0-4.4)
- Medium (3.5-3.9)
- Limited (3.0-3.4)
- Low to None (0-2.9)
- (grey = no information)

- Media
- Social
- Psychological
- Economic
- Food
- Activity
- Infrastructure
- Developmental
- Biological
- Medical

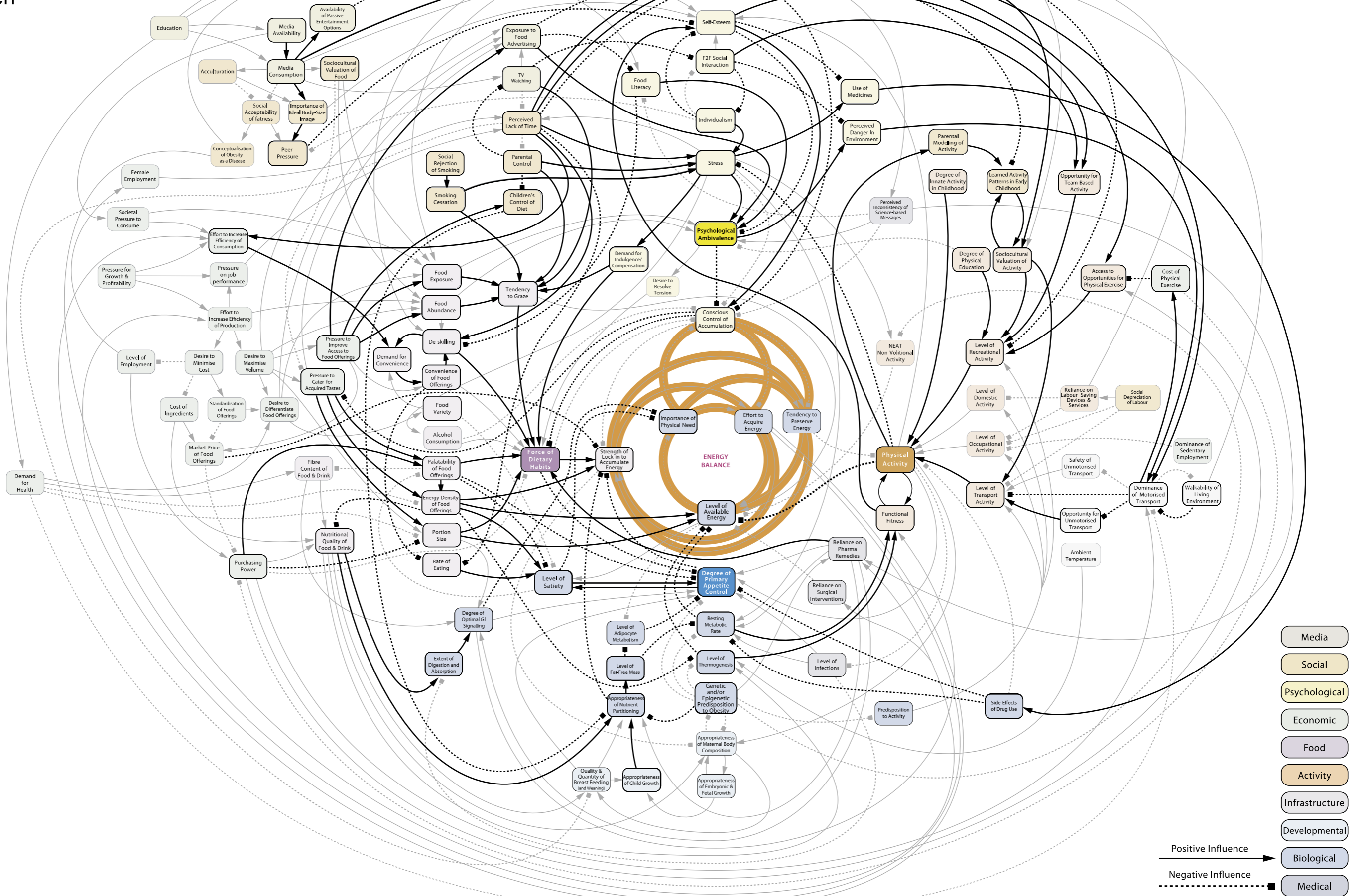
Positive Influence →  
Negative Influence - - - - -




Figure 5.5: The obesity system map highlighting the interconnections of particular relevance to children (see main text, section 5.3, for discussion)<sup>17,18</sup>

Map 34

Segmented Map:  
Children







## 6. Visualising the future: scenarios to 2050

A defining feature of Foresight's work is looking ahead to understand better the longer term uncertainties, and the opportunities and obstacles that future worlds might present. This Section sets out four scenarios of the future generated for the Foresight project to explore the impact of external drivers of change on obesity. It then provides some comment on future issues from the food chain industry and considers the impact of future technology development.



## Section 6: Visualising the future: scenarios to 2050<sup>16</sup>

The obesity system map described in Section 5<sup>17</sup> provides a direct analysis of the variables involved in generating weight gain that can lead to obesity. Any policies to combat obesity will need to make use of the key intervention points offered by these variables. To be effective, policies will need to act over the long term and take account of the broader social, economic and political context. A set of scenarios for the future was therefore developed to explore possible alternative contexts within which the variables identified in the system map are likely to act in the future. As a first step, key external drivers for change and uncertainties that will influence the future of obesity were identified. They were then used to create the scenarios within which society in the UK may try to respond to obesity.

### 6.1 Drivers for change

In the process of scenario development, 29 drivers for change, identified as having particular importance for the obesity issue (see Table 6.1), were introduced into the scenario storylines. Each scenario explores very different attitudes to obesity, business models of the food industry and community structures.<sup>16</sup>

**Table 6.1: Drivers of change with relevance to obesity identified during the process of scenario development**

<b>Health</b>	<b>Science and technology</b>
<b>1</b> Attitudes to obesity	<b>16</b> Attitudes to science
<b>2</b> UK health system	<b>17</b> Science and technology breakthroughs
<b>3</b> Value of health	<b>18</b> Breakthroughs in the social sciences
<b>Leadership</b>	<b>Education and information</b>
<b>4</b> Trust in leadership	<b>19</b> Access to information
<b>5</b> Who's in charge?	<b>20</b> How we learn
<b>6</b> Balance of geo-power	
<b>The shape of society</b>	<b>Values and behaviour</b>
<b>7</b> Ageing	<b>21</b> How we associate
<b>8</b> Social diversity	<b>22</b> Time horizons long-term versus short-term mindsets
<b>Resource constraints</b>	<b>The economy</b>
<b>9</b> Environmental crises	<b>23</b> Changing economy <i>distribution of income and employment patterns</i>
<b>10</b> Environmental limits to growth	<b>24</b> Psychological impact of economic instability

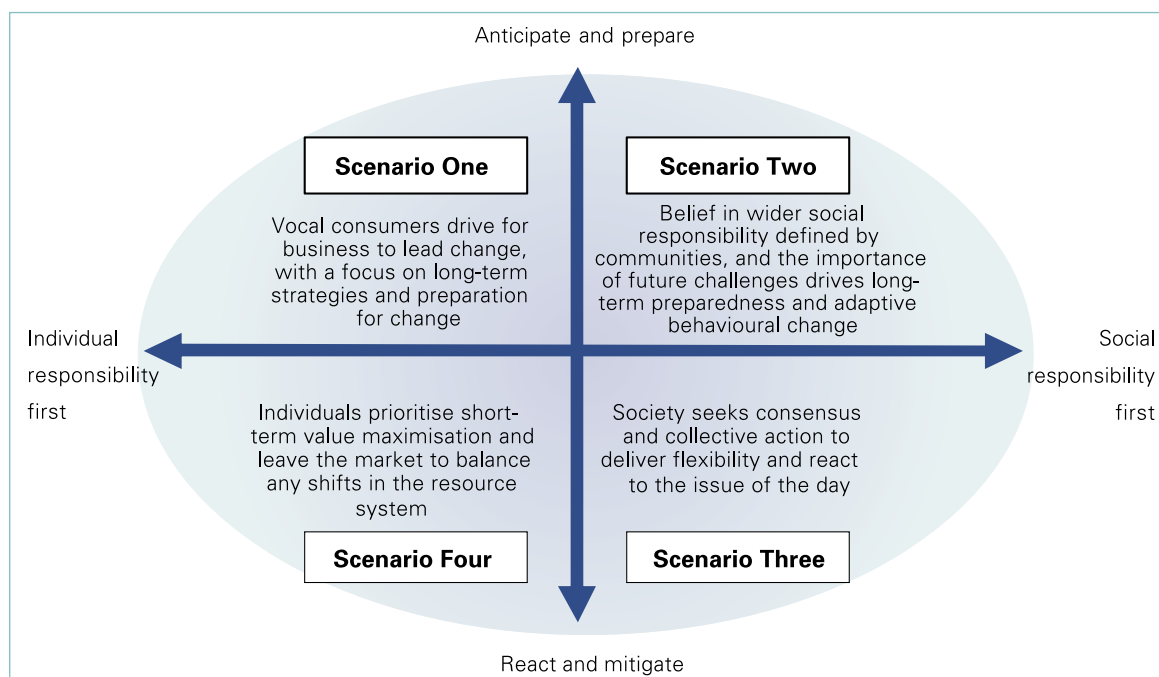


Health	Science and technology
<b>11</b> Energy dislocation <i>change from a carbon to a non-carbon economy</i>	<b>25</b> New business models <i>profit may not be the maximiser of the future</i>
Food production and retail	Our living environment
<b>12</b> The role of food <i>including sustenance; health; social status; social interactions; parental role of food; emotional role of food</i>	<b>26</b> The built environment
<b>13</b> Agricultural system	<b>27</b> Mobility
<b>14</b> Consumer choices	<b>28</b> Future of the home
<b>15</b> Changing shape of the food industry	<b>29</b> Localism

## 6.2 The scenarios in brief

The project scenarios are based on two critical uncertainties identified through analysis of the drivers for change: first, uncertainty associated with people’s **values and behaviour** – ranging from a more individualistic society to one where greater community responsibility is taken; and, second, uncertainty over what strategic **approach should be taken to meet challenges** – ranging from a nation that takes a long-term approach to prepare in advance and reduce anticipated risks to one that has a shorter-term approach that emphasises the ability to react to definite challenges and problems as they arise, focusing on managing the impact. The four scenarios are summarised in Figure 6.1.

Figure 6.1: Summary of project scenarios



- **Scenario One – an individualistic, market-driven society that adopts a more long-term and sustainable view.** Active consumers drive business to lead change, with Government taking a supporting role. This market-driven world is generally successful in economic terms and meets major external challenges through a focus on long-term planning and sustainability. Inefficiencies still exist when the markets' sometimes uncoordinated and proprietary-focused approach to challenges leads to duplication of effort and delays in achieving change filtering through to the market place. Furthermore, those without the financial capacity to access it have little opportunity to contribute to, or benefit from, changes in the market place.

Individuals are responsible for their own health management, with a focus on a life-long view and individually tailored solutions. People invest in prevention and seek to be 'better than well'. Education is seen as a critical means of empowerment in accessing health information and services for those who are unhealthy.

The drive for personal health by individuals is met by market-responsive providers and retailers, facilitated by Government. The NHS is focused on acute medicine, while the private sector largely covers elective surgery and the promotion of 'wellness'.

- **Scenario Two – a society where social responsibilities are prioritised, and communities and Government implement plans to meet long-term challenges.** This scenario enables system-wide changes to be considered. Implementation may be uneven as different groups and communities take responsibility for themselves and put different plans in place. Society seeks to limit inequalities, although those who do not take personal responsibility when they can (for example, for their own health) cannot expect automatic support. Living well is seen as a civic duty because of the need to consider the consequences of not doing so for society. It is seen as an individual's responsibility to live a healthy lifestyle and to encourage the same in others. Those who opt out of this responsibility are marginalised.

There is a strong focus on prevention rather than treatment and this is made easier by 'building in' health to many aspects of life. There is a sense of generational responsibility, with care for the elderly within the family given priority and supported by the community. Public provision of healthcare is still a priority, but resources are stretched and there is overt rationing of more expensive treatments and procedures considered as luxuries. There is uneven provision of treatments between communities, which, over time, leads to mounting tensions.

- **Scenario Three – a society where communities take the lead and focus on tackling difficulties as they arise.** A greater sense of community and desire for inclusiveness alleviates many inequalities, although gaps still exist between communities. Central government has an important leadership role on the immediate issues of concern but societal demands for consultation mean



decision making is slower in the absence of a crisis. 'Middle of the road' solutions are favoured over higher-risk (but potentially more effective) alternatives. There is a desire for firm evidence before committing to action (problems and more immediate results being easier to observe). Excellent rapid response mechanisms are developed to cope with challenges and pressing concerns. Towards 2050, national debates begin to question whether opportunities to implement longer-term strategies have been missed.

This scenario is characterised by a belief that everyone deserves and should receive an adequate level of healthcare, but this creates a high expectation from the public. As the scenario period progresses, there are increasing tensions about the sustainability of adequate healthcare as chronic health conditions increase. Attention is focused on those who already need treatment rather than those who are at future risk. Those patient groups who are the most vociferous (and have the greatest numbers) get the largest share of resource while patients with rare conditions are automatically disadvantaged.

There is mixed public and private healthcare delivery, but there is a strong emphasis on access for all. Government turns to communities to help implement and deliver public health policies. There is strong emphasis on acute care facilities such as intensive care and accident and emergency, while prevention and public health generally is largely neglected.

- **Scenario Four – an individualistic, market-driven society that reacts to problems when and where they occur.** Flexible, entrepreneurial innovation drives the economy to help society react to immediate changing needs. Personal responsibility is paramount and success is possible, but inequalities are widening. Over time, the market, although reacting rapidly to immediate problems, demands or changes, has not responded to the build-up of fundamental issues relating to the environment and resources.

Good health is a symbol of status, as is appearance. There is high personal responsibility, either through savings or insurance, to fund personal healthcare and self-reliance is the critical driver for all social services. There is a focus on treatment and managing the consequences of individual actions. Only the poorest receive the bare minimum healthcare package provided by Government. Employers increasingly offer access to gyms and healthcare facilities as part of their employment packages, as well as medical treatments and life management classes, in their efforts to attract the best employees. For the well-off, there is a wide range of effective medication to prevent weight gain and a growing self-help culture. This is facilitated by communications technologies and services that guide consumers through healthcare decisions and the high volume of available information and advice.

A number of themes and tensions also run through the scenarios: the degree to which the UK changes fundamentally to meet long-term challenges or focuses on managing immediate problems, the level of inequalities, and the locus of

responsibility within society. These alternative socioeconomic models create different contexts for the responsibility for looking after one's health, attitudes to well-being and for the ways in which society responds to or is willing to accept actions and policies (especially but not necessarily confined to government policies) aimed at challenges such as obesity.

There was strong consensus from those involved in building the scenarios that some form of shock or dramatic event would be needed to create significant change. None of the scenarios are dependent on a specific shock, as this would make them easy to dismiss as a possible future (i.e. if the shock did not occur or was not considered credible). However, the consensus reflected the shared view (or 'black optimism') of the participants in an expert workshop that significant and possibly difficult changes were required to reduce the prevalence of obesity.

### 6.3 Prevalence of obesity in the scenarios<sup>16,25</sup>

The scenario storylines were shaped to describe the critical dynamics of the four selected futures. Each of the scenarios describes how that particular society might influence the prevalence of obesity, which was not predetermined. Having developed the scenarios, the impact of each of the four futures on obesity, assuming there were no further interventions, was scored by participants in an expert workshop with regard to three key population indicators: the prevalence of obesity in the population, the prevalence of childhood obesity, and socioeconomic differences in prevalence of obesity (see Figure 6.2).

None of the participants took the view that the prevalence of obesity would decrease in any of the scenarios. However, they considered that, under some conditions, the rate of increase in the prevalence of obesity would vary. Critical factors in this assessment were the relative priority given to the prevention as opposed to treatment of health conditions within each scenario, and the level of health inequalities. The lowest rate of increase in obesity was seen in Scenario Two, which has lower levels of inequality and where prevention approaches were prioritised.<sup>16,25</sup>

### 6.4 Using the scenarios

The scenarios provide a tool with which to discuss alternative views of the future and allow users to identify their underlying assumptions. Different groups were asked about their views on the scenarios and the drivers for change.

#### 6.4.1 Views from groups within the food industries<sup>33</sup>

Interviews with leading figures in the food and drinks industry (manufacturers, retailers, regulators and trade organisations) and its primary influencers (such as media and financial communities) were undertaken to determine their views on



**Figure 6.2: Qualitative assessment of how the trajectory of obesity trends changes in the four scenarios relative to today's trajectory (i.e. assessment in terms of overall population obesity, childhood obesity and socioeconomic differences; each indicator is assessed using a qualitative scale of 0–3<sup>16,25</sup>)**



the future of the food industries and on how the different scenarios would affect their business.

The food industries make up a diverse, complex and competitive environment. Food and drink is the single largest manufacturing sector in the UK, with a turnover of £70 billion. In recent years, concerns about food have moved from issues of safety towards a greater focus on nutrition. Some city analysts are now considering the risk for companies if they were to become, for example, subject to litigation by consumers claiming their health had suffered due to the nutritional content of food and drink products.

Interviewees concluded that all the scenarios would require their business models to undergo change to a greater or lesser extent. Several highlighted retailers' responses to market changes as a critical driver of change to the manufacturer's business models. Views differed on the extent of use of new technologies and ways of managing the fragmentation of social groups seen in Scenarios One and Four. Scenario Two seemed a familiar environment to many, and respondents



commented on how there would be an increased emphasis on corporate social responsibility in this world. They observed that there would be increased pressure for regulation in Scenario Three, something not viewed positively, and that this scenario would not favour evidence-based decisions, despite the desire and motivation to wait for the evidence before action. Scenario Four favoured convenience, rapid product turnover and provided challenges for marketers in determining relevant market segmentation.

Key issues and themes from the interviews were:

- the importance of understanding consumer behaviour and encouraging behaviour change
- the opportunities available in developing food technologies (reformulation), which could help combat obesity – but these would only be realised if there was consumer demand. Technology should not be seen as a panacea
- the recognition of the importance of practical partnerships for developing and contributing programmes to effect changes in social behaviour and the need for a joined-up approach with common goals
- the need to avoid 'knee jerk' responses and regulation which may bring unintended consequences
- the critical importance of recognising the 'multifactorial' nature of the problem and that action to moderate food intake must be accompanied by changes in other elements of consumer lifestyle.

#### 6.4.2 Obesity, technology and lifestyle<sup>31</sup>

Future trends in technology and their impact on lifestyle, energy intake and expenditure were considered with experts in technology. The scenarios were used as a tool to illustrate the different potential uses of emerging technologies and how the uptake and nature of that use is shaped by social context, attitudes and values. As discussed in Section 3, although there is a shortage of evidence regarding how successful technology can be in supporting healthy lifestyle choices and in leading to sustainable weight, some promising examples are being developed that highlight the potential for technology to offer support.<sup>30</sup> For instance, the development of the Nintendo Wii platform builds physical activity into computer gaming.

**Scenario One** supports the development of individualised lifestyle services and healthcare insurance plans by business. Building technology into these services may enable consumers in the future to purchase personalised nutrition plans such as set breakfast/lunch/dinner menus provided by a private supplier. These could be combined with monitoring technology, which provides feedback on activity, nutritional intake and other health markers (such as cholesterol levels) to the consumers and programme providers. Plans could then be adjusted accordingly.



Such monitoring technology could be portable (e.g. a modified watch or phone) or built into everyday appliances such as the bathroom mirror.

In **Scenario Two**, embedded technology becomes particularly evident, with 'smart homes' and 'smart housing developments' as part of the large-scale infrastructure redevelopment scheme. Communities are completely networked, improving security and communication, and boosting the spread of 'virtual communities'. Global information-sharing and advances in data-processing technology support healthcare research in identifying those at risk of future health conditions and enable preventative advice to be more focused.

In **Scenario Three**, there is more emphasis on adding technology to existing systems and therefore uptake is more patchy. However, improved communication systems mean obtaining information is much easier. Virtual networks are also a key feature of this scenario, not only through computers but also new interfaces, such as 'intelligent clothing', which enable people to share real-time information and even to 'run virtual races' with competitors in different places around the world.

In **Scenario Four**, technology is mainly used to increase the volume of information people are exposed to, and the way they access it, by means of new marketing techniques and online services. Personal feedback systems and 'lab on a chip' technology are also an important feature supporting healthcare plans.

There are also a number of 'wild card' technological developments that, if realised, could have a radical effect on lifestyle, such as the use of cognitive technologies and neural interfaces to directly shape behaviour, and nanotechnological developments enabling real-time, closed-loop monitoring of metabolism and biomarkers and controlled drug delivery.

Technology can be a useful tool in providing support and feedback to people about their health but it does not, on its own, offer a solution. The critical factor is human behaviour. There is no guarantee that people will act on the feedback they receive and comply with their lifestyle plans.

### 6.4.3 Views of 10- and 13-year-old children<sup>26,27</sup>

Small groups of 10- and 13-year-old children were asked to express their views on health issues of the future and to think about how they would keep people healthy in the different scenarios. They produced a number of ideas for how to manage the health of their imaginary population, many revolving around technological solutions. A number of key issues and themes relevant to decision makers were identified and are summarised in separate reports on the perspectives of 10- and 13-year-old children.<sup>26,27</sup>

In the next section we discuss the use of these scenarios alongside the systems map as a tool to explore future policy options.

### Summary of key points

- The project generated four scenarios of the future looking forward to 2050. The scenarios focus on two critical uncertainties: first, uncertainty associated with people's values and behaviour, from a more individualistic society to one where greater community responsibility is taken; and, second, uncertainty over what strategic approach should be taken to meet the challenges in future societies that range from having a long-term focus to a shorter-term, more reactive, approach.
- The level of inequalities and the locus of responsibility also emerged as key themes and tensions for future responses.
- The prevalence of obesity does not decrease in any of the scenarios. However, the rate of increase in prevalence is different due to the relative priority given to prevention as opposed to treatment.

## 7. Managing the consequences

This Section sets out the results of the Foresight qualitative modelling exercise using the future scenarios to explore potential policy options. It goes on to report the outcomes of a quantitative modelling exercise which simulated the impact of hypothetical interventions on obesity for levels of chronic disease and NHS costs.



## Section 7: Managing the consequences

### 7.1 Qualitative modelling of options for policy responses to obesity<sup>25</sup>

A critical component of the project was to understand how different, plausible, futures could shape the obesity environment and impinge on the effectiveness of policy interventions aimed at tackling obesity. The scenarios described in Section 6 and the system map described in Section 5 were used as analytical tools to generate and test possible options as part of an integrated strategy for obesity.<sup>25</sup> The system map provided insights as to the key variables influencing obesity development and therefore suggested potential targets for policy intervention. The scenarios illustrated a range of UK societies that might emerge in the future in which the policies would need to be implemented.

From an initial set of 56 possible policy interventions, 17 were chosen as exemplifying the range and depth of interventions that might be needed to have a sustained impact on obesity (see Table 7.1). Experts and stakeholders then ranked the anticipated impact of these sample interventions by their effectiveness and achievability in each of the scenarios. Those involved in the process also highlighted critical issues around implementation. The detailed methodology of this qualitative modelling exercise is given in a separate report.<sup>25</sup> This section presents an overview of the results of the exercise.

The analysis suggests a number of responses that could create a positive impact in tackling the high prevalence of obesity and highlights a series of challenges to achieving sustained success. The policy interventions chosen for this exercise, and their anticipated impact on the prevalence of obesity in the different scenarios, are shown in Tables 7.1 and 7.2 respectively. The final list of options was not selected to represent a preferred set of responses but, rather, on the basis of whether they could meet a broad range of criteria:

- to target a diverse range of relevant areas of policy
- to target the obesity system map in different ways, acting on the key variables or levers within the map
- to act at different levels of complexity, ranging from targeted and specific, to broad and cross-cutting
- to provide insight on the more critical uncertainties such as the location of the fulcrum between obesity prevention and treatment, choices between targeted and population-wide interventions, and between enabling and more directive interventions.





















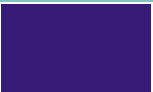








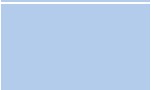











**Table 7.1: Options for policy responses used in the modelling exercise**

<b>The built environment and transport</b>	
<b>1</b>	Introduce health as a significant criterion in all planning procedures (including new build and upgrading of the current infrastructure)
<b>2</b>	Improve the perceptions of safety from the points of view of traffic and crime
<b>3</b>	Increase the 'walkability' and 'cyclability' of the built environment (urban and rural)
<b>Health</b>	
<b>4</b>	Focus on targeted interventions, such as when children are young, and targeting those most 'at risk'
<b>5</b>	Implement population-wide interventions i.e. focus on improving the health and well-being of the population as a whole
<b>6</b>	Focus on the health consequences of obesity, such as diabetes, rather than obesity itself
<b>Research</b>	
<b>7</b>	Invest in the search for a highly effective post-hoc solution to obesity – a 'magic pill'
<b>8</b>	Introduce toolkits to evaluate the success of obesity interventions and policies throughout the whole of the delivery chain
<b>Fiscal incentives</b>	
<b>9</b>	Introduce a tax on obesity-promoting foods
<b>10</b>	Use fiscal levers to make all organisations/institutions take some responsibility for the health of their employees (public and private sectors)
<b>11</b>	Use individually targeted fiscal measures to promote healthier living
<b>Education</b>	
<b>12</b>	Introduce programmes to increase food literacy and food skills
<b>Regulation</b>	
<b>13</b>	Control availability of and exposure to obesogenic foods and drinks
<b>Social structure</b>	
<b>14</b>	Take a directive approach to changing cultural norms in order to establish healthy living as the default within UK society
<b>15</b>	Invest in technology to support informed individual choice, including devices to help monitor diet and activity
<b>Family</b>	
<b>16</b>	Promote/implement a programme of early interventions at birth or infant stages
<b>17</b>	Penalise parents for the unhealthy lifestyles of their children






**Table 7.2: Summary of impact of policy responses across scenarios**









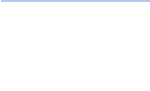



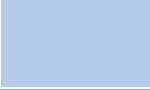
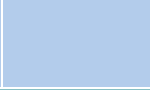
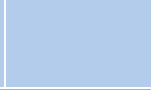
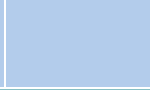

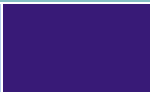

















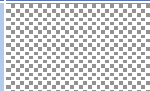
Key to impact levels: High impact (i.e. reduces obesity prevalence) ; Medium impact ; Low impact ; Negative impact (i.e. increases obesity prevalence) ; No impact .

Response options	Impact on obesity prevalence in scenarios			
	One	Two	Three	Four
<b>The built environment and transport</b>				
<b>1</b> Introduce health as a significant element in all planning procedures (including new build and upgrading of the current infrastructure)				
<b>2</b> Improve perceptions of safety both from the points of view of traffic and crime				
<b>3</b> Increase the 'walkability' and 'cyclability' of the built environment (urban and rural)				
<b>Health</b>				
<b>4</b> Focus on targeted interventions such as when children are young, and targeting those most 'at risk'				
<b>5</b> Implement population-wide interventions i.e. focus on improving the health and well-being of the population as a whole				
<b>6</b> Focus on the health consequences of obesity, such as diabetes, rather than obesity itself				
<b>Research</b>				
<b>7</b> Invest in the search for a highly effective post-hoc solution to obesity - a 'magic pill'				
<b>8</b> Introduce toolkits to evaluate the success of obesity interventions and policies throughout the whole of the delivery chain				



**Table 7.2: Summary of impact of policy responses across scenarios (Continued)**

Key to impact levels: High impact (i.e. reduces obesity prevalence) ; Medium impact ; Low impact ; Negative impact (i.e. increases obesity prevalence) ; No impact .

Response options	Impact on obesity prevalence in scenarios			
	One	Two	Three	Four
<b>Fiscal incentives</b>				
<b>9</b> Introduce a tax on obesity-promoting foods				
<b>10</b> Use fiscal levers to make all organisations/ institutions take some responsibility for the health of their employees (public and private sectors)				
<b>11</b> Use individually targeted fiscal measures to promote healthier living				
<b>Education</b>				
<b>12</b> Introduce programmes to increase food literacy and food skills				
<b>Regulation</b>				
<b>13</b> Control the availability of and exposure to obesogenic foods and drinks				
<b>Social structure</b>				
<b>14</b> Take a directive approach to changing cultural norms in order to establish healthy living as the default in UK society				
<b>15</b> Invest in technology to support informed individual choice, including devices to help monitor diet and activity				
<b>Family</b>				
<b>16</b> Promote/implement a programme of early interventions at birth or infant stages				
<b>17</b> Penalise parents for the unhealthy lifestyles of their children				

The top five policy responses assessed as having the greatest average impact on levels of obesity across the scenarios were:

- increasing walkability/cyclability of the built environment
- targeting health interventions for those at increased risk (dependent on ability to identify these groups and only if reinforced by public health interventions at the population level)
- controlling the availability of/exposure to obesogenic foods and drinks
- increasing the responsibility of organisations for the health of their employees
- early life interventions at birth or in infancy.

It is notable that there was no single response that was judged to be likely to generate a high impact on the prevalence of obesity in all the scenarios and that impact levels were also closely related to the dominant societal values in each scenario.

These observations highlight the critical interaction between specific interventions and wider societal values and reinforce the importance of implementing a mix of interventions targeted at a combination of different determinants of obesity.

This approach requires co-ordinated action across different areas of policy, balancing trade-offs where necessary. This is particularly relevant when considering how the implementation of some responses were dependent on other priorities for policy (e.g. changes to the built environment are more likely to be driven by concerns over vehicle congestion, energy usage and environmental sustainability). Therefore policies that are needed to tackle obesity have the potential to be met indirectly through interaction with other priorities for policy.

The analysis also revealed that there are a number of options for policy that are 'necessary but not sufficient' for tackling obesity. They have limited impact by themselves but are essential in supporting a comprehensive approach by enabling the impact or effectiveness of other interventions. Education-related interventions are one such example.

Intervention in early life generated the highest average impact across all scenarios. Greatest success was achieved in scenarios where a long-term approach prevailed (Scenarios One and Two). It was in these scenarios that it was possible to implement and sustain a life-course approach to prevention and that society was prepared to measure success over the longer term. Scenarios One and Two were also the scenarios where it was possible to plan across generations. In Scenarios Three and Four, where priority was given to short-term solutions, the impact of such approaches was less effective.



There was significant variation in the general level of impact in reducing the prevalence of obesity across the different scenarios. This highlighted a number of important issues:

- **How responses are implemented** will make a difference to the degree of achievement. Some scenarios would be particularly challenging because of existing social attitudes or norms, the complexity of the policy delivery system or other barriers. The mechanism of implementation would also vary considerably across scenarios (e.g. the balance between public and private sector delivery mechanisms), which suggests that different ways to deliver these policies may have to be found, working through other institutions or in partnerships. Unexpected implementation effects could also lead to undesirable results. For example, in the attempt to improve perceived safety in the built environment in Scenario Four, people reverted to using their cars and automated transport modes, further decreasing their levels of physical activity.
- **Social context and attitudes** to obesity affect the potential impact of a response and its acceptability to society. For example, some of the responses that ranked highly for impact may be socially unacceptable. A critical trigger for the different scenarios and outcomes of policy responses is how people feel about their lives, their fears, their attitudes and their sense of personal control.
- **Variation in health inequalities** (and social attitudes to the importance of inequalities) was a significant factor in determining the impact of different interventions, benefiting some groups while disadvantaging others. For example, a tax on high-fat foods might have a disproportionate effect on low-income families and might reduce their ability to buy healthier options such as fruit and vegetables. It is also important to note that, while interventions targeted at those most at risk were considered useful, they risked increasing the stigma associated with obesity. Conversely, increasing access to obesity treatment may normalise, through medicalisation, the acceptability of obesity, with potential, if unknown, consequences for influencing prevalence and disrupting efforts to stimulate preventive efforts.
- There is a **risk of unintended consequences from actions to combat obesity**. The analysis highlighted some circumstances where the prevalence of obesity was increased as a consequence of a policy. Examples included investing resources in the search for a 'magic pill' form of treatment, undermining the importance of individual responsibilities and healthy lifestyles. Efforts devoted solely to developing a long-term approach through focusing on children risked ignoring the short-term health costs of treating existing obesity and related ill health.

Whatever the blend of interventions proposed, careful implementation and social context appears critical for success. Often these unintended consequences or negative effects manifested among particular social groups were more due to extant inequality issues or were the result of perceptions of and priority given to



obesity. Therefore the potential for sustained action to tackle obesity was moderated (e.g. by shifting the focus to the consequences of obesity such as diabetes), rather than to obesity itself.

## 7.2 Quantitative modelling of the consequences of changing population BMI levels<sup>1</sup>

Section 2.2 presented an extrapolation of obesity prevalence to 2050 and the predicted associated health consequences and costs, derived from the quantitative modelling exercise commissioned for this project.<sup>1</sup> Here, the model is used to simulate successful, hypothetical interventions to constrain BMI growth in specified ways.

The modelling allows an assessment to be made of the relative impact on obesity-related disease prevalence if we were to successfully constrain population BMI growth in some way. From this assessment, the consequent trajectories of health service costs (not allowing for the cost of the intervention itself) can be estimated and compared to the baseline projections. It is important to note the modelling does not define the nature of the interventions to constrain BMI growth, but simply models the changed population BMI profile. Data on the impact of actual interventions are currently limited and additional investigation is required, but, as further quantitative data for effective population interventions become available, this can be integrated into the model and used to simulate the impacts of more specific, clearly defined interventions.

For the purposes of this report, the modelling provides preliminary insights into the relative long-term effects of population-wide and targeted approaches to responding to obesity. It also explores the degree of constraint on future BMI levels that would be needed to contain health and cost consequences over the next 40 years at close to current levels.<sup>1</sup>

### 7.2.1 Alternative BMI reduction strategies and their relative impact on health outcomes and NHS costs<sup>1</sup>

A selection of BMI growth constraints was simulated in order to compare the impact of a strategy to reduce average BMI across the population with the impact of a targeted strategy aimed at categories of potentially overweight or obese people. Success with a population-wide strategy was simulated in the model by reducing the predicted average BMI of the population (or of an age range within it) by a specified number of units. Success with a targeted strategy was simulated by capping the BMI of a specific age group of the modelled population so that a specified proportion of those who would otherwise have become obese did not do so. The model is technically capable of simulating interventions targeted by social class, gender or ethnic group, but these were not simulated for this project.



As well as permitting the comparison of population-wide and targeted approaches, simulations were chosen for their ability to demonstrate additional points. The whole-population simulations, for example, explored how great the reduction in projected population BMI levels might need to be in order to bring projected future health costs back down to current levels. The targeted BMI-reduction simulations, on the other hand, illustrated the impact if different proportions of the population at risk (25%, 50%) are targeted, enabling them to stay in the overweight category rather than becoming obese. Another targeted simulation examined the long-term impact of achieving success in halting the rise in childhood obesity from 2010.

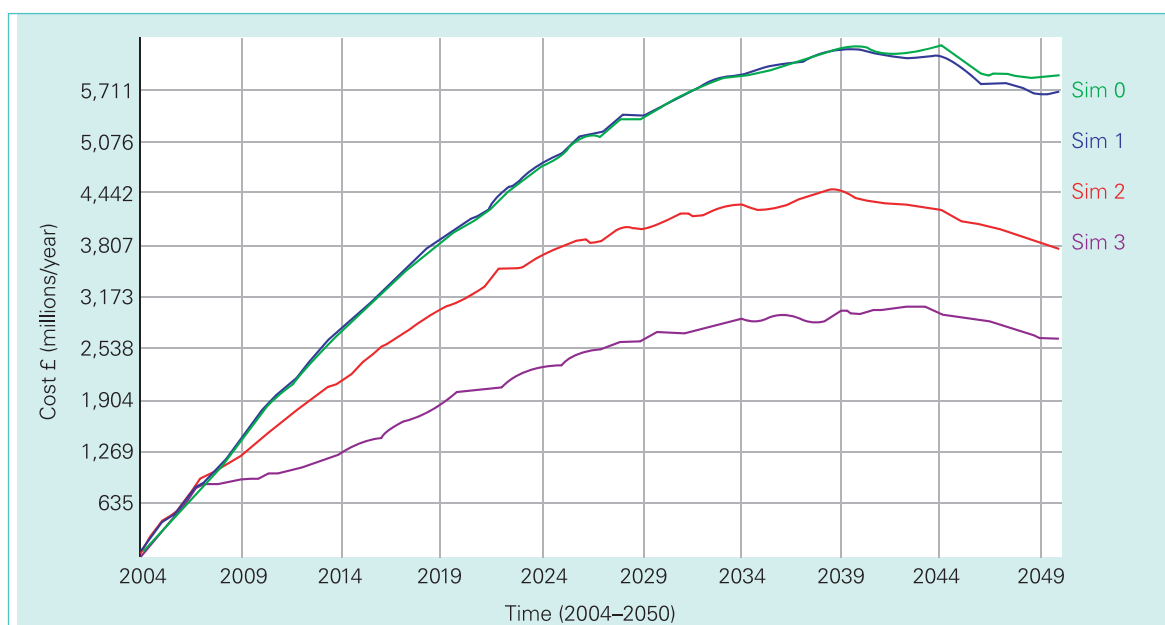
The dozen or so interventions that were simulated for this project are outlined in much greater detail in the report, *Tackling Obesities: Future Choices - Modelling Future Trends in Obesity and the Impact on Health*.<sup>1</sup> The simulations shed light on the scale of the challenge and also the timescales before benefits can be reaped from successful interventions. They also show what can be done using this demonstration microsimulation model. The discussion below highlights the key findings from them, with reference to the baseline extrapolations and three selected simulated interventions (see Table 7.3).

**Table 7.3: A sample of the simulated interventions. All interventions were initiated in 2008 and terminated in 2050<sup>1</sup>.**

Simulated intervention	Intervention effect on BMI
Simulation 0 Baseline	No intervention (baseline BMI trends)
Simulation 1 Childhood obesity focus	Capping BMI for children aged 6–10 from 2010 (equivalent to current UK Public Service Agreement target)
Simulation 2 Targeted approach	Preventing 50% of the population at risk of moving from overweight (BMI 25–30kg/m <sup>2</sup> ) into the obese category (BMI >30kg/m <sup>2</sup> ) from doing so. All age groups targeted.
Simulation 3 Population approach	Reducing mean population BMI by 4 units in those aged 18–100 (equivalent to a reduction in mean BMI from 27kg/m <sup>2</sup> to 23kg/m <sup>2</sup> )

Having simulated an appropriate average BMI reduction overall, or a BMI cap on a targeted part of the population, as indicated in Table 7.3, the model calculates the aggregate costs to the NHS, as described briefly in Section 2.3 (and more fully in the quantitative modelling report).<sup>1</sup> The obesity-attributable cost trajectories from 2004 associated with the baseline case and the three simulations in Table 7.3 are shown in Figure 7.1. The general shape of these graphs reflects the shape of the current age distribution of the population: the distinctive bump correlates to the post-war baby-boom reaching the age of their maximum disease burden at around 2040.

**Figure 7.1: The increase in BMI attributable NHS costs (above 2004 levels, at current prices) to 2050, in the baseline case and in each of the simulations in Table 6.3<sup>1</sup>**



The costs following successful intervention (Simulations 1, 2 and 3) differ from the baseline costs (Simulation 0) because the intervention's impact on BMI alters the obesity-related disease prevalence in the population. Many of the diseases are chronic and/or age-related, so the pattern of cost reduction will reflect the age groups in the population whose weight gain is constrained by the intervention, as well as the time lag between weight gain and the onset of disease.

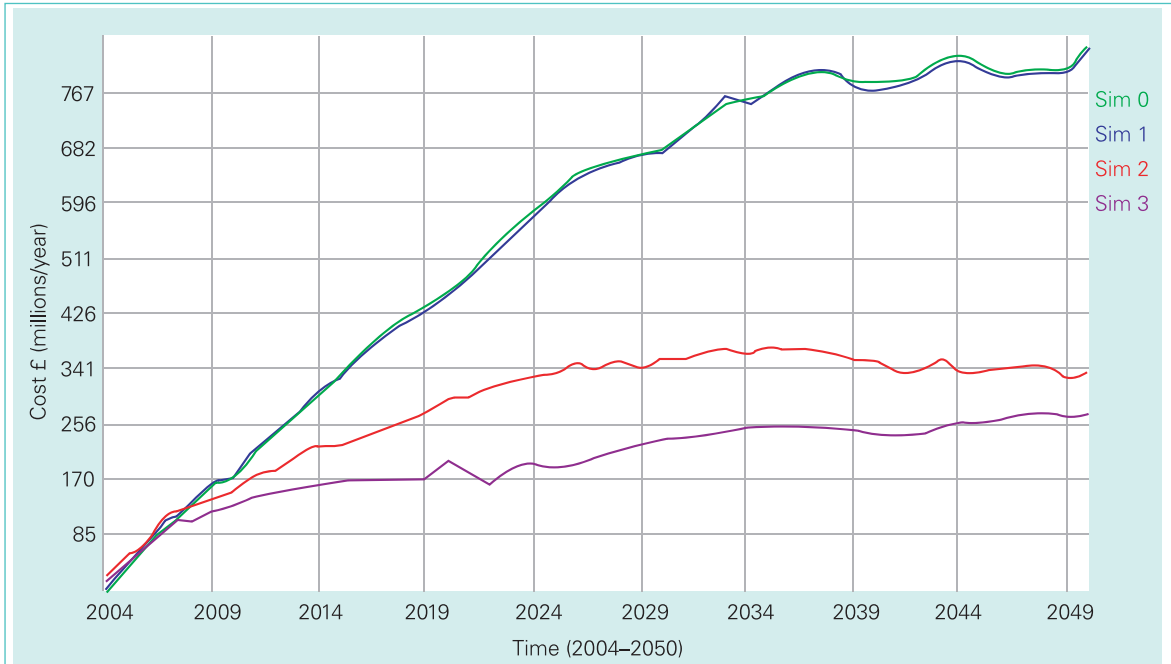
Irrespective of the intervention simulated, costs continue to rise over time as the legacy of BMI-related disease has an effect, but the rate of increase varies with the intervention. The pace of levelling off depends on the scale of the intervention and the age group that it affects. For example, interventions targeted at children, rather than the whole population, take longer to show a cost benefit as the avoidance of disease only becomes visible when they reach middle and older age.

However, the diseases that contribute to this aggregate picture have different profiles. Figure 7.2 shows the costs separately for heart disease, diabetes, stroke and arthritis.

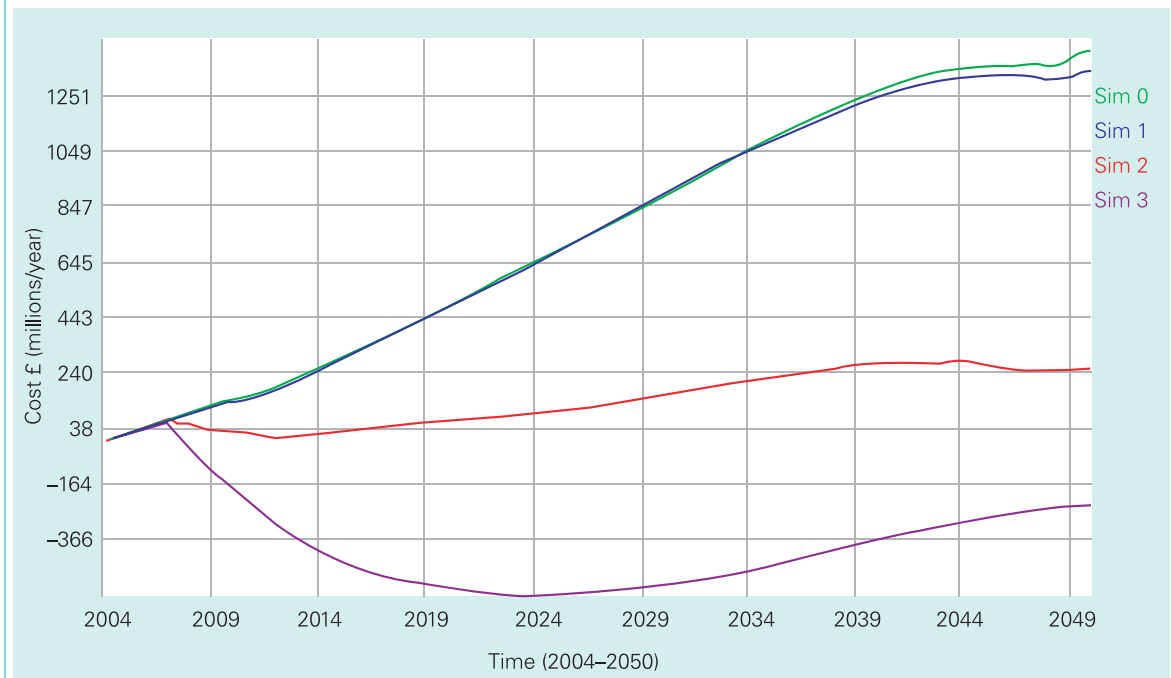
The prevalence of diabetes is particularly sensitive to variations in the population's BMI, hence the widely separated cost trajectories and the dramatic reduction in costs seen in Simulation 3, where the average population BMI is reduced. The cost profiles for arthritis and heart disease are very different in character as a result of the earlier onset and greater influence of BMI on arthritis than coronary heart disease. Arthritis is the only disease where the childhood intervention simulation (Simulation 1) shows a noticeable effect before 2050.



**Figure 7.2: The increase in BMI attributable NHS costs (above 2004 levels, at current prices) to 2050.** Costs shown for heart disease, diabetes, stroke and arthritis in the baseline case and in each of the three simulations from Table 6.3<sup>1</sup>

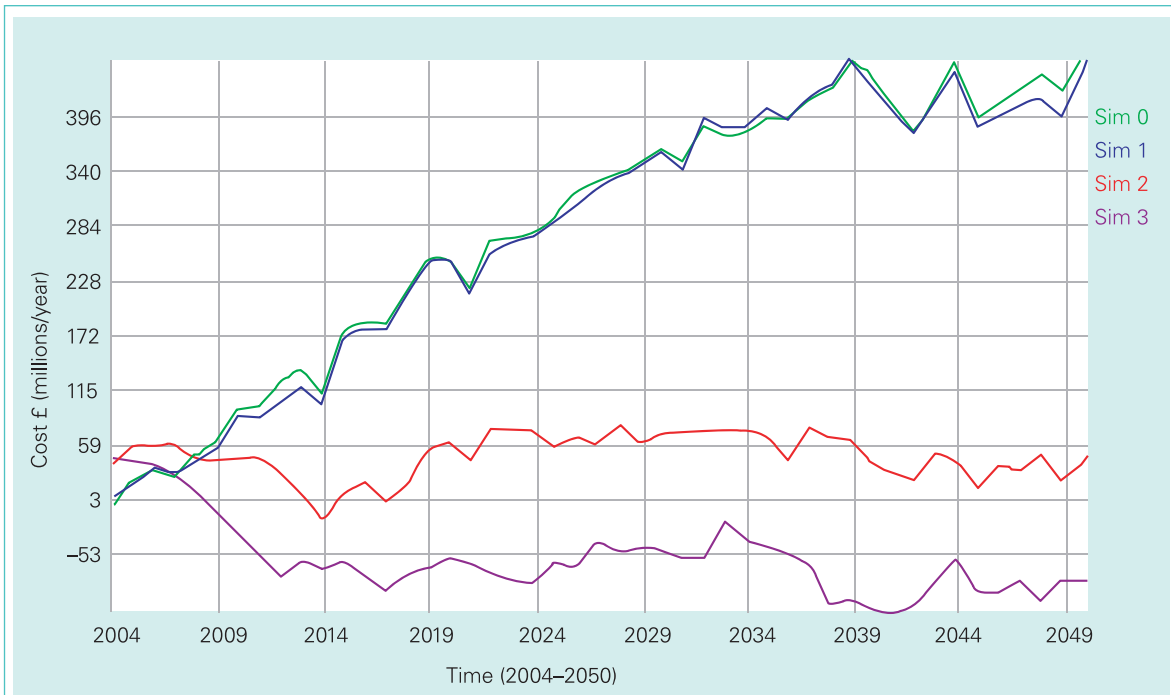


**Figure 7.2a: BMI attributable costs of chronic heart disease**

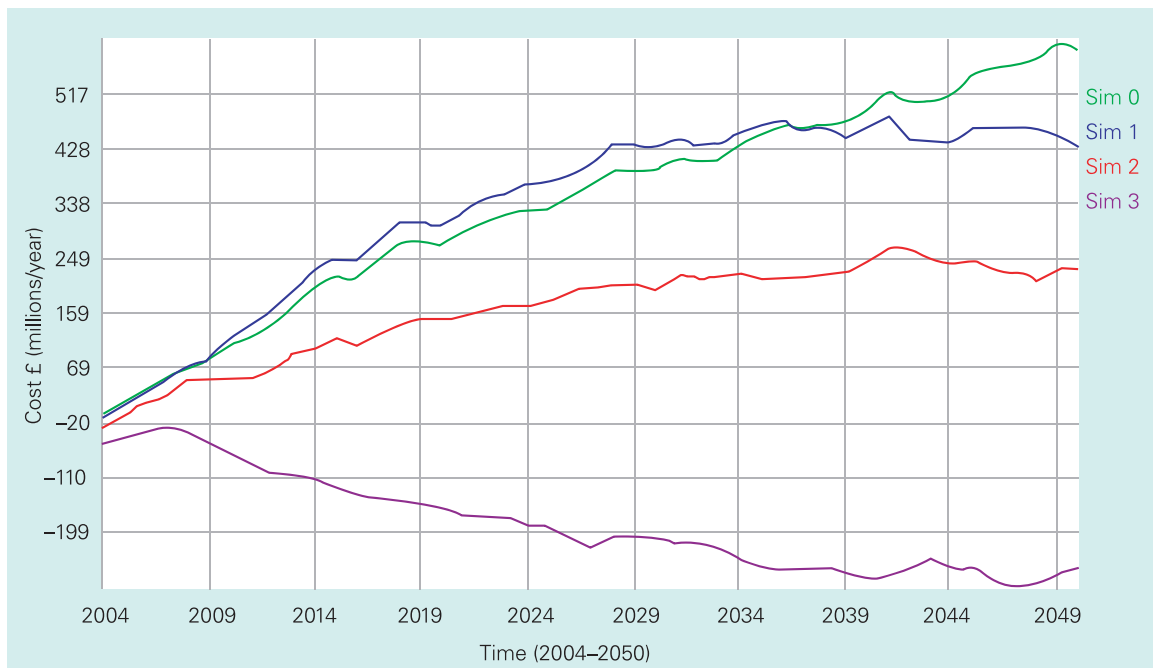


**Figure 7.2b: BMI attributable costs of diabetes**

**Figure 7.2: The increase in BMI attributable NHS costs (above 2004 levels, at current prices) to 2050.** Costs shown for heart disease, diabetes, stroke and arthritis in the baseline case and in each of the three simulations from Table 6.3<sup>1</sup> (**Continued**)



**Figure 7.2c: BMI attributable costs of stroke**



**Figure 7.2d: BMI attributable costs of arthritis**





The current UK obesity Public Service Agreement target focuses on halting the year-on-year rise in the prevalence of obesity in children under 11 (see Section 4.3). Simulating this target with the model (Simulation 3) demonstrates how the effect takes some time to fully manifest itself, with the financial benefits only being reaped in the last decade of the simulation period.

One striking indication from this modelling is the scale of success that would be needed to bring NHS obesity-related costs back down to levels close to today's by 2050. Achieving a reduction of four units in average population BMI (Simulation 3) is considered by experts to be very ambitious, yet it would still see more than a doubling in the NHS costs attributable to obesity by the end of the simulation period – some £2.5 billion (in current terms) compared to today's costs of around £1 billion.<sup>1</sup>

Additional 'population average' (adult and children, separately and combined) and 'targeted' simulations are discussed in the quantitative modelling report.<sup>1</sup> In drawing conclusions, it is important to remember that the simulations are theoretical rather than necessarily plausible in the size of their effect.<sup>1</sup>

### 7.3 Conclusions

Taken together, the simulations suggest that, even with highly successful strategies, direct obesity-related health costs will not be less than today's levels in the foreseeable future. Rather, the future increases latent in today's trends will, to some degree, be contained. However, these simulations have only considered the direct health costs. They have not explored the wider effects on quality of life and economic productivity, where benefits may manifest themselves before the impact of health treatment costs becomes evident. Additional data and further analysis would be required to examine this area fully.

Nonetheless, the baseline projections indicate that, left unchecked, the health costs associated with overweight and obesity will become insupportable. The relative impact of the simulations illustrates the scale of the changes in BMI that need to be achieved in order to have an impact on those escalating costs. A sustained approach is essential, given BMI effects across a lifespan and the time lags between weight gain and associated disease onset. The simulations also point to the need for a comprehensive strategy that targets those at immediate risk, as well as tackling the underlying upward drift in average population BMI. This in turn implies a mix of treatment – to provoke and maintain weight loss – and prevention to help stop those who are overweight becoming obese and to set more young people on a trajectory to healthy adult weight.

The priorities for 'success' will influence the mix of interventions. Immediate effects require interventions that make an impact on those most immediately at risk of manifesting disease – the over-50s. Highly successful targeted interventions, if they can be achieved, could make a more significant impact on

costs in the short to medium term than modest population-wide successes. Yet population-wide approaches, if successful, deliver sustained and long-term benefits and, in respect of diabetes, also have significant shorter-term impact.

The overarching conclusion from the quantitative and qualitative modelling is that the response to the challenge of obesity must be comprehensive, coherent and sustained. Section 8 develops the implications of this analysis.

### Summary of key points

- Experts and stakeholders were asked to rank the likely impact of different policy options for each of the Foresight project scenarios in a qualitative modelling exercise.
  - The exercise suggested a number of responses that could create a positive impact in tackling the prevalence of obesity. However, no single response generated a high impact on obesity prevalence in all scenarios.
  - Implementing a mix of interventions targeted at a combination of determinants of obesity is critical.
- 
- The quantitative simulation of changes in population BMI suggested that significant changes in population BMI would be needed before sizeable changes in chronic disease levels occur.
  - Even if highly successful, there would be a considerable time lag (20–30 years) before the benefits were seen in terms of chronic diseases levels and NHS costs.
  - A comprehensive strategy would also need to target those most at risk of immediate health consequences (the over-50s) as well as tackling the upward drift in average population BMI and preventing future obesity.

## 8 Building a Sustainable Response

This section draws on all the evidence collated by the project to suggest a way forward. It sets out the main challenges and offers a set of core principles on which to base a framework for action and a long term strategy.



## Section 8: Building a sustainable response

### 8.1 The way forward

The inherent human predisposition to gain weight in a world of abundant energy-dense food and drink and in conditions of reducing levels of physical activity has resulted in a major and increasing health problem. The prevalence of obesity has taken over three decades to build to its current levels and is set to persist for at least another 40 years. The evidence in this report of the Foresight Tackling Obesities: Future Choices project makes clear that the future scale and cost of the obesity problem will be very substantial if concerted action is not taken now. By 2050, 60% of males and 50% of females could be obese (Figure 2.5, p 35), adding £5.5 billion to the annual total cost of the NHS by 2050, with wider costs to society and business estimated at £49.9 billion.<sup>1,2</sup>

The scale of changes needed to prevent this prospect becoming reality is comparable to that required in the mid-19th century to prevent mass epidemics and the worsening health conditions in Britain's cities. Then, as the UK grappled with industrialisation and urbanisation, large-scale programmes of reform and investment in the country's water supply, sanitation and housing infrastructure were undertaken, primarily to improve the health of the public and reduce the risk of infectious disease.<sup>88</sup> Today, the problems are different in nature but the magnitude of the challenge is arguably similar. The prevalence of obesity raises fundamental questions about how we live our lives. A key challenge will be to reshape the wider environment, in which individuals go about their daily lives, and transform the growing interest in maintaining good health into an achievable goal for all.

Our analysis of the complexity of the 'system engine' driving the upward trend in obesity, together with the long-term projections of obesity prevalence, show that a comprehensive, long-term strategy to combat the problem is urgently required. The scenarios and system map developed in this Foresight project suggest that a broadly based, integrated strategy of preventive action offers a chance to mitigate a potential epidemic that could have serious social and economic consequences. Uncoordinated initiatives, however well intentioned, risk failure by underestimating the complex nature of the issue.

To date, no country in the world has developed a long-term strategy in which scientific evidence and policy analysis are effectively integrated to tackle the problem, although the need for such an approach is widely recognised. There are significant opportunities for the UK to take a leading role in Europe, and more widely, in developing such an approach that builds on existing work. In its favour,



the UK has a strong science base in relevant disciplines and robust surveillance schemes to evaluate progress.

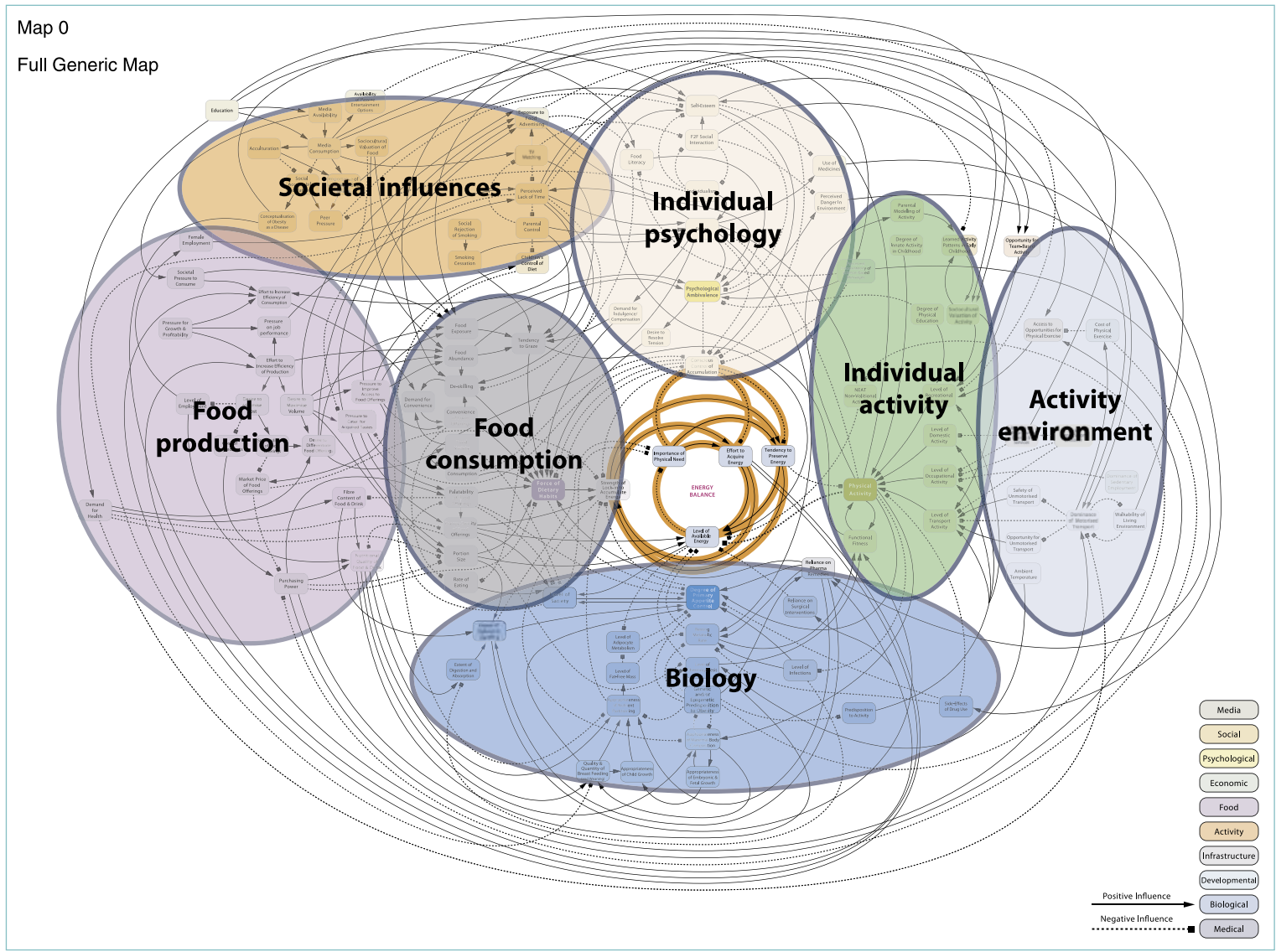
In this section, we first identify the main challenges to the development of a comprehensive strategy for the longer term. We then offer a set of core principles and guidance, which have emerged from our detailed analysis, on which to base a framework for action. Finally, we comment briefly on possible models for developing a long-term strategy.

### **8.1.1 What makes a successful response to obesity?**

Obesity arises primarily from a systemic shift in the wider environment, with corresponding effects on group and individual behaviour, against the backdrop of an obesity system where biological drivers favour weight gain. A sustainable response would create a scenario in which social and individual priorities favour healthy behaviours and where underlying biological mechanisms to control body weight are continually reinforced. A key feature of this response is that it places the concept of energy balance at the heart of a broad range of determinants of health, symbolised by the project's obesity system map (see Figure 8.1).<sup>17</sup> It



**Figure 8.1: The full obesity system map with thematic clusters (see Section 4 for discussion).** Figure highlights broader determinants of health such as drivers of food production and components of the physical activity environment.





recognises that body weight is conditioned by personal biology, pattern of diet and physical activity, beliefs and attitudes, psychology, and the wider environment, where societal influences – from the physical environment to the systemic properties of the food supply chain – exert their effects.

Taken together, the evidence presented in this report provides a powerful challenge to the commonly held assumption that an individual's weight is a matter solely of personal responsibility or indeed individual choice. Rather, the evidence supports the concept of 'passive obesity' (where obesity is encouraged by wider environmental conditions, irrespective of volition). As society has changed over the last three decades energy expenditure on physical activity has declined. Today, the majority of people in the UK are sedentary when at work and at home. Most are car owners. Patterns of food consumption have also changed markedly. Eating habits have become more unstructured, and low-cost, energy-dense 'food and drink on the go' is widely consumed. For a multitude of reasons, healthy lifestyles may be less available to those on low incomes.

Therefore, as a general rule, people do not 'choose' to be obese. Their obesity is mainly driven by a range of factors beyond their immediate control that in practice constrain individual choice. The commercial success of the weight loss market is testament to the belief invested in the power of individuals to control their own weight. However, the concomitant rise in obesity and the frequent weight regain common in those who have dieted successfully is evidence of the failure of a response built solely on this approach. Strategies based on personal motivation and individual responsibility alone do not provide an adequate response to the obesity problem.

To be successful, a comprehensive long-term strategy to tackle obesity must act in two complementary ways to achieve and maintain a healthy population weight distribution. First, an environment that supports and facilitates healthy choices must be actively established and maintained. Second, individuals need to be encouraged to desire, seek and make different choices, recognising that they make decisions as part of families or groups and that individual behaviour is 'cued' by the behaviours of others, including organisational behaviours and other wider influences.

The strategy needs to be planned and co-ordinated effectively by Government and must involve multiple stakeholders. The role of non-governmental organisations – businesses, employers and voluntary organisations – is also critical and in some cases may be the dominant influence. National strategic action must be coherent, with local strategies that reflect local conditions, needs and aspirations. In particular, the role of local bodies such as local government and local health authorities must be clearly defined and linked to sufficient resources and the necessary skills to implement effective responses.

## Policy challenges

### Treatment

Any comprehensive long-term strategy to address obesity must include both prevention and treatment. This project's focus has been primarily on prevention, which offers more scope to reduce the prevalence of obesity in the longer term. However, the NHS has a responsibility to treat the overweight and obese. Therefore any obesity strategy must incorporate a programme to address the needs of those with an established weight problem in order to prevent further deterioration in health. This is crucial because the prevalence of obesity will continue to rise for several decades, even after effective preventative strategies are put in place. The treatment of overweight and obesity will need to become an integral part of clinical practice.

To meet the increased demand, every health professional will need to be trained to identify those at risk from increasing body weight and be skilled in the initial management of the condition. For strategies to be effective, they must start in general practice and be linked to local expertise in acute NHS Trusts. They will need to be adequately resourced and linked to local strategic partnerships, thereby engaging professionals outside the immediate remit of health. Ready access for psychological referral and surgery, where appropriate, will also be important. Local initiatives should engage commercial weight loss organisations with evidence-based programmes for effective weight loss.

Obesity is a chronic relapsing condition and, to be sustainable, treatment should not be divorced from prevention. The maintenance of weight loss and the prevention of weight regain is a critical yet under-researched component of treatment.<sup>28</sup> The first goal in the treatment of obese patients is to prevent further weight gain. Subsequent to successful weight loss, a second goal is to prevent weight regain. We recognise that new treatments might be more efficacious in the longer term and might allow for treatment to play a greater role in managing the prevalence of obesity in the future. However, in the absence of strong candidates, and with the powerful forces driving passive obesity, any strategy in the meantime must be firmly based on prevention.

### Prevention – the need for multiple interventions

The scale of the challenge to prevent obesity is magnified by the complex nature of the condition. The scientific and medical evidence currently supports the concept of a family of obesities rather than a single form. The multiplicity and overlap of the causes of obesity argues against a dependence on fragmented solutions to address the issue. Focusing too heavily on one element of the obesity system, or on one population group, is unlikely to be successful in bringing about the scale of change required.<sup>1,25</sup>



A long-term, comprehensive strategy will need to incorporate a range of policies that must act in at least three dimensions:

- Systemic change is needed across the 'system map', focusing on initiatives aimed at behaviours and the cues for behaviours relating to food, physical activity and physiological and psychosocial factors
- Interventions designed to change a single factor may need to be conducted at multiple levels of governance i.e. at the individual, local, national and global levels.
- Different interventions, targeting the same process of behaviour change, will be needed across the life course.

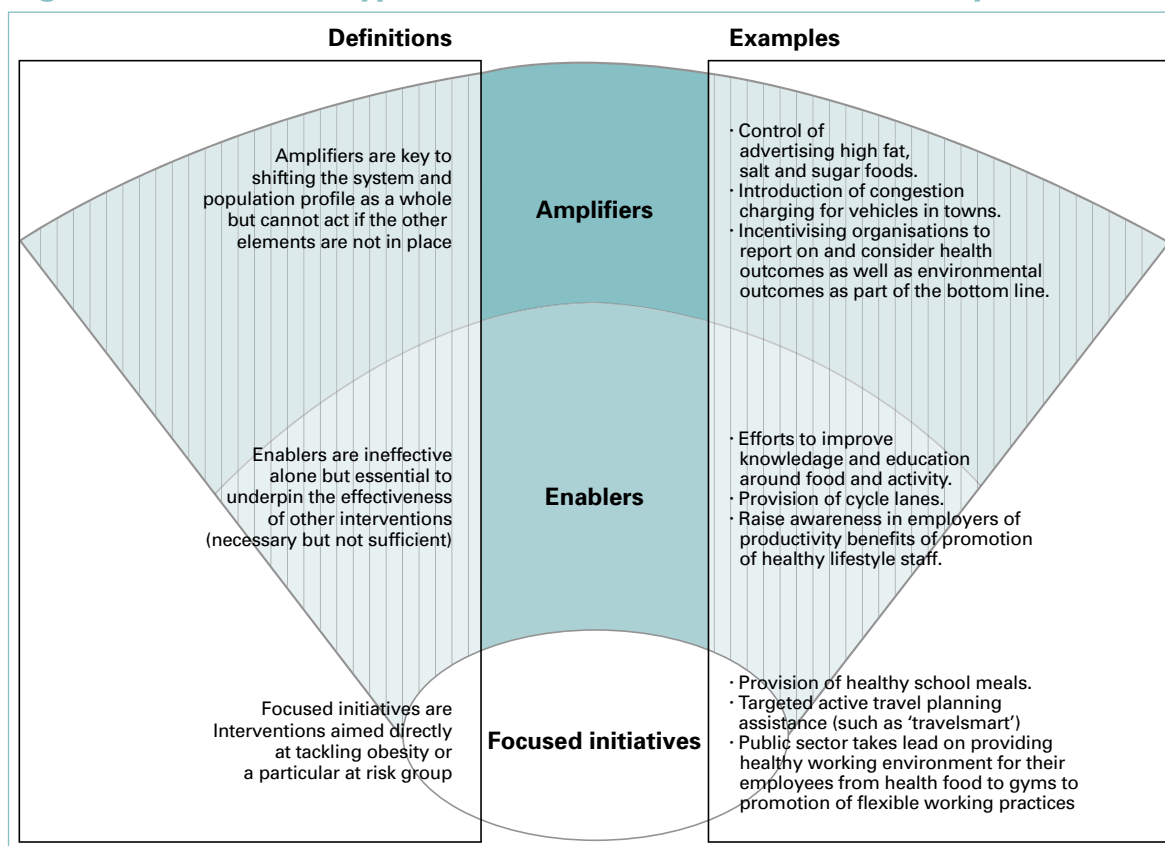
It is important to be realistic. The impact of individual interventions or initiatives in isolation is likely to be small, even if the overall impact of a combination of responses, explicitly linked to the system map, could be significant. The combined impact might be strengthened by implementing a range of policies that act as 'enablers' or 'amplifiers' of the core interventions (see Figure 8.2). Alone, such policies have little or no direct impact on obesity but may magnify the impact of other initiatives. Enablers are policies that act as essential underpinning elements of a comprehensive strategy, notably action on education and skills. Other policies may amplify impact, usually by shifting wider perceptions of obesity-related issues, and can drive social or cultural norms in a direction that elicits greater support for and adoption of other initiatives. Current examples include the restrictions on food advertising to children.

### Synergies with other policy issues

The encouragement of physical activity in daily life or modifying the nutritional balance of the diet might appear at first glance to be relatively simple to achieve. In fact, the scale of change required to make a significant impact at the population level would need to be very substantial, raising difficult and complex economic and social questions about how public policy can be reshaped across a number of very diverse areas, including food production, food manufacturing, retailing and marketing, healthcare, town planning, transport, education, culture and trade.

This is a formidable challenge for policy makers. Action through alignment with other major policy issues is therefore critical in order to maximise the engagement of a broad range of stakeholders. Some policies can act indirectly to reduce the prevalence of obesity through actions motivated by other policy priorities. For example, policies to reduce carbon emissions to mitigate climate change, such as increasing the cyclability and walkability of the built environment, have the potential to have a direct impact on the prevalence of obesity. Policies relating to climate change and health inequalities were identified as particularly critical partners in the development of a strategy to tackle obesity.<sup>12,14,16–18,20,25,35</sup> In both

Figure 8.2: Different types of interventions to tackle obesity



obesity and climate change, failure to act early will lead to serious consequences in just a few decades. Delays in agreeing remedies and acting on them raises the real possibility that reversal of the trends may become more difficult for both issues. Similarly, disagreement on the individual determinants of a complex issue contributes to the marginalisation of a multiple approach to change. Meanwhile, the visible consequences of obesity become normalised in the face of growing health risks and prevalence.

There is very considerable potential for identifying synergies and complementarities with other policy goals to strengthen the case for action and provide multiple benefits. Links with a number of policy issues need to be actively explored to provide the foundation for a long-term, comprehensive, integrated strategy (see Figure 8.3).

Examples of policies on sustainability and climate change that are relevant to obesity have been discussed above. There are many other possibilities:

- The promotion of healthy eating has a potentially positive role in **social inclusion** by helping individuals and families improve their food preparation skills, and their nutritional intake, with potential benefits on child development and behaviour; it could also help neighbourhood regeneration by improving local food sourcing. Promoting walking and cycling implies attention to local





**Figure 8.3: Examples of cross-cutting policy issues, where synergies can be found with obesity and public health**



environmental circumstances, boosting positive perceptions of neighbourhood security and community integration.

- The factors that promote social inclusion also apply to the enhancement of **well-being**. People who are physically active, with a full and engaged social life, and 'in control' of their diet and other consumption patterns are more confident and resilient; conversely, people who are inactive, isolated and who lack food skills are more vulnerable.
- Strategies to reduce the obesogenic environment and individual susceptibility to this environment may also help to increase **workforce productivity**. A fitter workforce is less likely to take time off due to sickness, and the confidence that comes from personal fitness may be an aid to raising workforce skills.

- Good nutrition and an active physical life are important components of healthy **ageing**. Older people are the heaviest users of health services and an active and engaged physical life can help maintain functional capacity and delay the onset of degenerative disease and disability. This will become increasingly important set against the trend towards an ageing population.
- The greater prevalence of obesity among poorer social groups implies that efforts to counter **health inequalities** must take account of obesity; conversely, action on obesity must take account of socioeconomic factors. Obesity is not exclusively a matter of social class and inequality. The suggestion that it is primarily a feature of lower-income groups would be to disguise the society-wide character of the epidemic. However, efforts to combat obesity in lower-income groups will have positive consequences for both health and inequality.
- Reducing obesity is one of the six overarching priorities in the Public Health White Paper, *Choosing Health*,<sup>99</sup> and is therefore a major point of focus for the NHS and wider **health reform**. Although this Foresight project has underlined the point that tackling obesity requires a society-wide response and not just a focus on the NHS, the NHS has an important role to play in the treatment and prevention of the problem and in setting and delivering local strategies.
- Finally, **children** are a critical area of policy overlap. The world of the child is framed by adults, and the increase in child obesity is indicative of problems of the adult world passed on to children. The scope of the measures taken to secure healthy children will be a key test, not only for any obesity strategy but also for child-specific policies.

Reducing the prevalence of obesity is therefore a major challenge for systems of governance and decision making, as well as for medicine and public health. Producing policy solutions that work across departmental boundaries or policy areas, and not just within them, to deliver a corrective population-wide shift is a massive task in itself. Obesity has a great deal in common with many of the challenges faced across public health and where many of the wider determinants of health are the same. The social, infrastructural and environmental factors that need to frame the planning and implementation of policies for obesity coincide with other public health issues, including the prevention and management of several chronic diseases, for example:

- acting when the degree of intervention needed for a significant impact on obesity prevalence may create tensions with broader societal aspirations
- providing strategic leadership and co-ordinating action when implementation is complex, which requires cross-government attention and responsibilities are dispersed
- making choices and policy trade-offs
- managing risks in the context of limited evidence



- stimulating behaviour change when a sense of urgency or policy priority in the wider community is lacking
- managing the risk of unexpected consequences of policy measures.<sup>22,25</sup>

### 8.1.2 Core principles for tackling obesity

This set of very demanding challenges will require diverse and well-thought-through policies across multiple sectors. It is beyond the scope of the Foresight programme to recommend specific policies. However, five core principles that are critical to the development of a coherent, comprehensive strategy for tackling obesity have been identified:

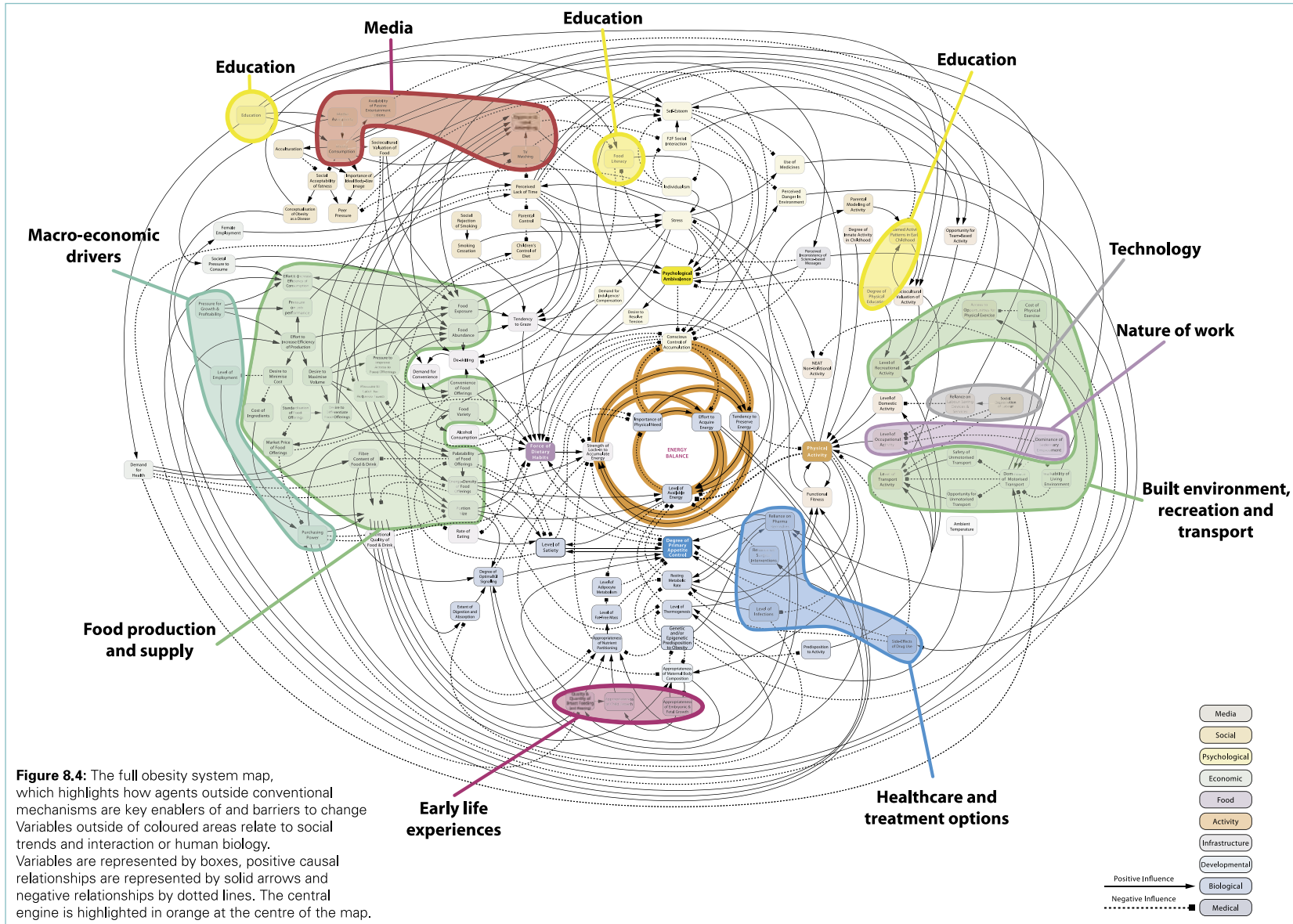
- 1 A system-wide approach, redefining the nation's health as a societal and economic issue
- 2 Higher priority for the prevention of health problems, with clearer leadership, accountability, strategy and management structures
- 3 Engagement of stakeholders within and outside Government
- 4 Long-term, sustained interventions
- 5 Ongoing evaluation and a focus on continuous improvement.

#### **1 Tackling obesity needs a system-wide approach, redefining the nation's health as a societal and economic issue**

The evidence identified in this project shows that the determinants that contribute to obesity are both diverse and far-reaching in their effects. Action is therefore needed to reshape not only the physical and dietary aspects of the environment but also the social, economic and cultural environments. Such a breadth of policy is essential if healthy behaviours are to become the easy, attractive and affordable norm.<sup>17,18,22,25</sup> Taking a 'whole systems' perspective and investing in prevention might provide the potential to achieve reductions in healthcare costs, based on our projections, but might also generate improved well-being and quality of life and lend support to other identified policy goals.

The situation may be complex but a fresh approach to how we protect the health of the nation can reveal new opportunities for change. The systems map suggests that agents beyond conventional mechanisms are key enablers and barriers of change (see Figure 8.4). Indeed, there are many historical examples of public health measures that were not strictly health interventions at all, but were social or environmental measures (such as the introduction of the London sewage system<sup>13,17,29,88</sup>).

**Figure 8.4: The full obesity system map, which highlights how agents outside conventional mechanisms are key enablers of and barriers to change**



**Figure 8.4:** The full obesity system map, which highlights how agents outside conventional mechanisms are key enablers of and barriers to change. Variables outside of coloured areas relate to social trends and interaction or human biology. Variables are represented by boxes, positive causal relationships are represented by solid arrows and negative relationships by dotted lines. The central engine is highlighted in orange at the centre of the map.



Variables outside of coloured areas relate to social trends and interaction or human biology. Variables are represented by boxes, positive causal relationships are represented by solid arrows and negative relationships by dotted lines. The central engine is highlighted in orange at the centre of the map.

## **2 Higher priority for the prevention of health problems, with clearer leadership, accountability, strategy and management structures**

Success in tackling obesity requires that the health of the population is seen as a priority both by government ministers and society and that other social and economic goals that may be acting counter to this aim are identified. For example current European legislation on the composition of some foods, which was originally intended to offer protection to consumers, now inhibits the innovation and reformulation that would benefit them, while the growth in the number of commercial and private vehicles on roads in the UK runs counter to efforts to encourage walking and cycling. Similarly, offering a greater choice of schools for children may mean they have to travel further by bus or car, reducing opportunities for walking and cycling.

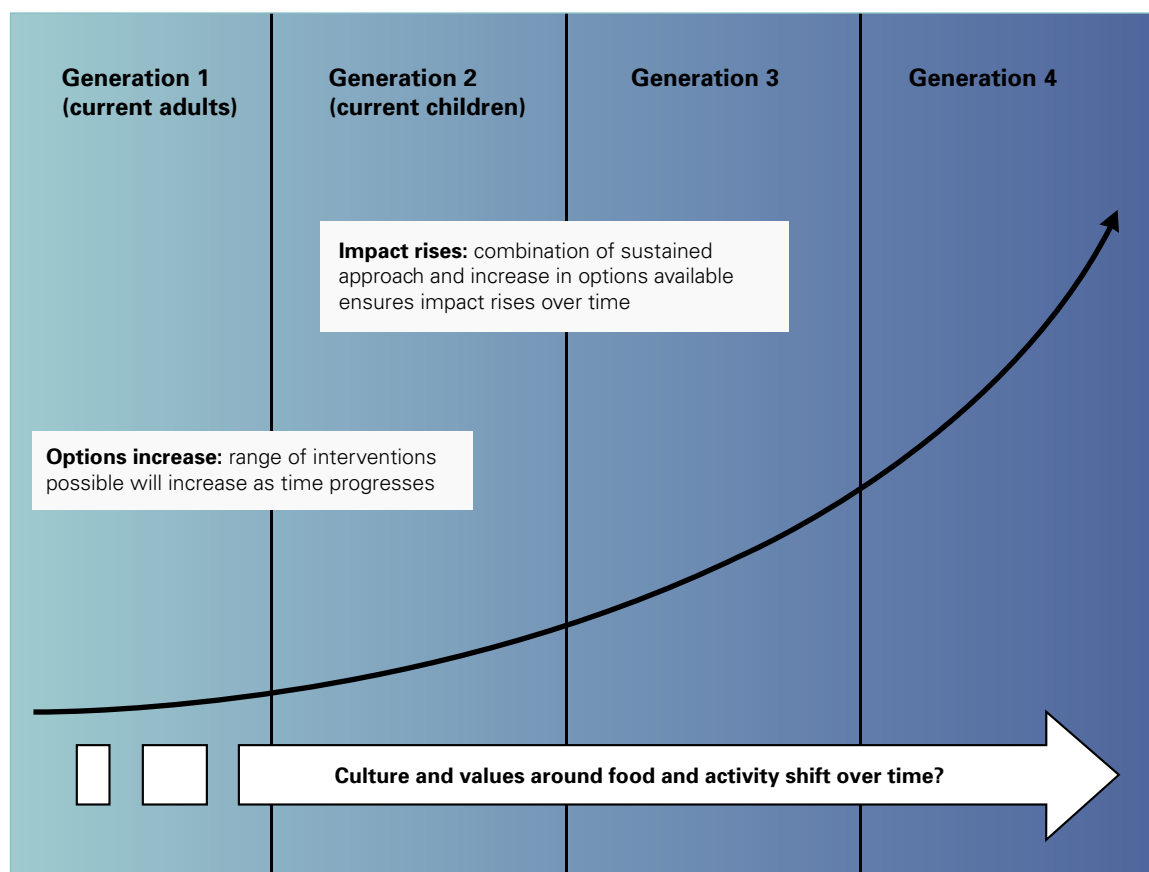
Strong leadership at a senior level across the whole of Government is necessary to champion an effective strategic approach to countering the rise in obesity. Structural changes in Government may provide a mechanism to ensure the development and continued refinement of an overarching strategy for obesity and the co-ordination of activities. Introducing 'health impact' as a criterion for the regulatory impact assessment of policies, along with economic and environmental impact assessments, could help reinforce this approach.

## **3 Engagement of stakeholders within and outside Government**

Progress in reducing the prevalence of obesity will be enhanced by stimulating multi-sector, multi-level action within and beyond the public health profession. Numerous organisations inside and outside Government have already engaged with the obesity issue, including the food industry, health professionals, local government, patient and consumer groups, and others. Action to build on this and further develop co-ordination and genuine partnership would enable greater benefit to be realised. A good example of this is the Food Standard Agency, Department of Health and food industry's action to reduce salt content of food and drink. The Foresight systems mapping exercise has shown that the majority of the levers of change lie outside the traditional health arena and outside the control of Government. Recent NICE guidance for obesity prevention also illustrated this by including recommendations for employers, communities, local authorities, schools and the public.<sup>37</sup>



**Figure 8.5: Intervention options and impact will increase over generations.**



#### 4 Long-term, sustained interventions

Interventions will only be effective if they are designed to have in-built sustainability.<sup>10</sup> The lifelong and generational aspects of obesity have already been emphasised. Just as obesity develops slowly both within individuals and populations, so too will it take time to establish new habits and build new structures to support a healthy diet and to build physical activity into everyday life. This important principle also implies the need for long-term strategies spanning several generations and beyond the traditional planning cycle. The introduction of interim targets and supportive measures will help evaluate progress towards this goal (see Figure 8.5).

#### 5 Ongoing evaluation and a focus on continuous improvement

Regular evaluation of policy, surveillance and monitoring will be essential to test the effectiveness of any new policy approach. There is scope to refine these procedures to consistently enhance their value to researchers and policy makers and improve risk management through rigorous evaluation.<sup>36</sup> Further analysis of this information can also inform future projections to support the provision of



public services, including health and pensions, and to assess economic implications.<sup>2</sup> This principle is particularly critical where much of the evidence needed for the effectiveness of potential interventions, or the scale-up of pilot interventions, is lacking.

Continuous improvement also requires monitoring of the social and cultural context and public and organisational beliefs and attitudes towards obesity. An important trigger for the different scenarios was how people felt about themselves: their fears, attitudes and personal sense of control.<sup>16</sup> Greater interaction between biological, behavioural and social scientists and policy makers can strengthen the development and execution of effective interventions in a virtuous circle of continuous improvement that combines scientific development, policy implementation and joint evaluation.<sup>10</sup>

### 8.1.3 Developing a strategic framework

Unless a portfolio of policies is put in place, the shift required in existing population obesity trends is unlikely to be achieved.<sup>13,17,18,25</sup> A checklist of criteria for use in strategy development is provided in Table 8.1 with some examples of interventions to illustrate these points. The core elements of the list are captured in a tool that could be used as part of a strategy development exercise or as a means of testing the comprehensiveness of existing responses (see Figure 8.6).

**Table 8.1: Criteria checklist for an effective obesity strategy**

Does the strategy:	Explanation	Examples
... influence a broad set of systems levers (physiological/ psychosocial/food-related factors and the physical activity environment)?	<ul style="list-style-type: none"> <li>A set of policies that acts across the system map needs to be devised that would include interventions in physiological, psychosocial, food-related and physical activity issues.</li> <li>A recognition is needed of how action in one domain can support action elsewhere; for example, environmental changes support and reinforce messages around behaviour change.</li> </ul>	<ul style="list-style-type: none"> <li>Environmental changes support and reinforce messages around behaviour change.</li> <li>'Walk to school' policies can be supported by action to improve work-life balance by tackling the time barrier people cite as limiting their ability to walk/cycle with their children to school.<sup>100</sup></li> <li>Consideration needs to be given to the impact of drivers in the food chain for cost and consumption of food and drink.</li> </ul>
... act at multiple levels, from the national through the local to the individual?	<ul style="list-style-type: none"> <li>A single policy area needs to be supported at all levels of governance to provide consistent messages and to reinforce and enable healthy behaviours.</li> </ul>	<p>The intention to increase rates of breast-feeding:</p> <ul style="list-style-type: none"> <li>at an individual level includes support networks to help new mothers to breast-feed</li> <li>at a local level means positive breast-feeding policies at local hospitals and initiatives such as Sure Start to inform and educate mothers</li> <li>at a national level means regulation to give women the right to breast-feed in public places or to protect employment rights and maternity leave entitlements.</li> </ul>
... contain interventions that act at different levels with varying but cumulative degrees of impact (amplifiers, enablers, focused initiatives)?	<ul style="list-style-type: none"> <li>Interventions that act as amplifiers, enablers, as well as focused initiatives need to be used (see Figure 8.3).</li> </ul>	<ul style="list-style-type: none"> <li>Initiative: provision of healthy school meals.</li> <li>Enabler: efforts to improve knowledge and education about food and activity such as front-of-pack signposting.</li> <li>Amplifier: reduction in the perceived or real information inconsistency around health messages.</li> </ul>
... obtain a balance between population-level measures and more targeted interventions?	<ul style="list-style-type: none"> <li>This is best illustrated through the balance between treatment (targeted) and prevention (universal) measures. Preventative measures are focused more on the provision of a 'non-obesogenic' environment. Treatment includes focused initiatives to help those who are already obese, or considered to be at high risk of becoming obese, to lose weight and sustain that weight loss. These two approaches are complementary.</li> </ul>	<p>Population measures:</p> <ul style="list-style-type: none"> <li>design of the built environment to promote walking and active transport</li> <li>building health into infrastructure through careful investment</li> <li>seeking to reduce exposure to an obesogenic diet by focusing on portion size, energy density of foods and sugar-rich drinks.</li> </ul> <p>Targeted interventions:</p> <ul style="list-style-type: none"> <li>focused programmes to help those who are already obese, or considered to be at high risk of becoming obese, similar to those outlined in Section 4.2.</li> </ul>

**Table 8.1: Criteria checklist for an effective obesity strategy (Continued)**

Does the strategy:	Explanation	Examples
... take time into account (e.g. life-course and generational effects)?	<ul style="list-style-type: none"> <li>• Many initiatives may have limited impact beyond the lifetime of the intervention. A lifelong strategy will therefore involve two elements. First, initiatives targeted across the life course, and, second, interventions to initiate a particular change, will need to be delivered repeatedly across the life course but in slightly different formats.</li> <li>• The generational nature of obesity means thinking about a different strategy for different generations as options change. This also means thinking about long-term goals such as how to integrate health more fully into food culture, values and habits – which could take some time.</li> </ul>	<ul style="list-style-type: none"> <li>• Seeking to optimise maternal nutrition (pre-pregnancy and pregnant mothers), improving the quality and quantity of breast-feeding and ensuring optimal infant growth.</li> <li>• Developing strategies for older people where health consequences can be more immediate.</li> <li>• Developing strategies for long-term goals such as how to integrate health more fully into food culture, values and habits.</li> </ul> <p>Repeated delivery of interventions could include:</p> <ul style="list-style-type: none"> <li>• extending school food standards to pre-school care and to food provision for adults e.g. within the public sector such as the NHS or in other occupational settings</li> <li>• positively facilitating activity in young people outside the school environment and after leaving school.</li> </ul>
... have interim targets and measures, as well as a long-term obesity goal?	<ul style="list-style-type: none"> <li>• This enables clear evaluation of progress over the short term, despite the significant time lags involved in seeing changes to population BMI or associated disease levels, and means focusing on different age groups at different times.</li> </ul>	<ul style="list-style-type: none"> <li>• Setting a long-term vision to shift the population BMI profile and monitoring diet and activity levels over the shorter term.</li> <li>• Reducing the short-term health costs means the focus needs to be on adults who are at risk of shortly needing medical care for diabetes or heart disease. Preventative action to reduce the risk of obesity among children will reap rewards over the medium to long term.</li> </ul>
... actively seek alignment with other policy agendas, recognising synergies and conflicts?	<ul style="list-style-type: none"> <li>• As discussed in Section 8.1.1 (and see Figure 26), many goals of obesity policy could best be met through close integration with other policy goals, such as climate change, where there are shared objectives.</li> </ul>	<ul style="list-style-type: none"> <li>• Requiring health impact assessments of all policies with health recognised as an overarching goal.</li> <li>• Working to identify commonalities and conflicts, with action on sustainability, health inequalities etc. as shown in Figure 26.</li> </ul>
... engage a broad range of stakeholders?	<ul style="list-style-type: none"> <li>• Joint working can help deliver consistent messages and, in doing so, contribute to lower levels of ambivalence about behaviour change.</li> </ul>	<ul style="list-style-type: none"> <li>• Elements of the public sector, both central and local</li> <li>• The food industry</li> <li>• Town planning, architecture and the construction industry</li> <li>• The sport and leisure industry</li> <li>• The voluntary sector</li> <li>• The media</li> <li>• Communities</li> <li>• Parents and children.</li> </ul>

**Table 8.1: Criteria checklist for an effective obesity strategy (Continued)**

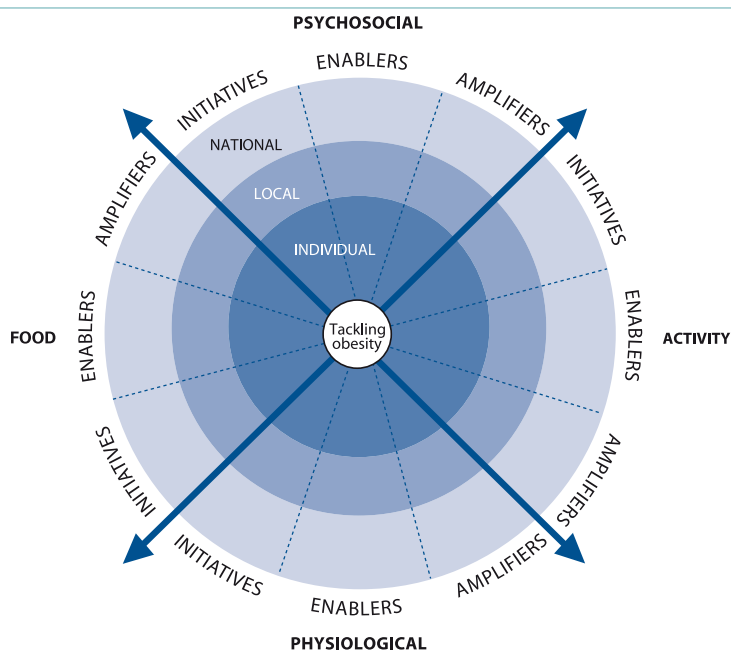
Does the strategy:	Explanation	Examples
... consider the balance between cost-effectiveness and likely efficacy?		<ul style="list-style-type: none"> <li>• Building sustainability into existing programmes to provide value for money.</li> <li>• Adopting a process of assessment of public health impact similar to that used in the ACE modelling work.<sup>91</sup></li> </ul>
... consider the impact on and implications for health inequalities?	<ul style="list-style-type: none"> <li>• This would mean considering the possibility of negative or unexpected consequences, for example, on low-income groups, and ensuring awareness of the increased risk of obesity in lower socioeconomic groups.</li> </ul>	<ul style="list-style-type: none"> <li>• Equity impact assessment of policies such as taxing the fat content of food products, which may not be successful in reducing the demand for highly desired food but may serve to reduce the income available for other healthier foods.</li> </ul>
Is the strategy supported by:	Explanation	Examples
... an ongoing strategy development process underpinned by expert analysis, data-gathering processes and a robust evaluation framework?	<ul style="list-style-type: none"> <li>• A continuous improvement model is required to ensure new data is considered and used to refine strategy.</li> </ul>	<ul style="list-style-type: none"> <li>• Establishing an independent strategic-level expert group to advise Government on obesity.</li> <li>• Enhancing population surveillance activities and data gathering on obesity.</li> <li>• Building robust evaluation into existing activities, building on existing work,</li> </ul>
... suitable government management structures to enable clear leadership, strategy formulation and co-ordination of action across Government (UK, devolved administrations, regions and localities) and with other key stakeholders?	<ul style="list-style-type: none"> <li>• It is critical that any structure raises the profile of improving population health and enables government departments to work effectively together and to engage with other key partners on both strategy development and delivery.</li> </ul>	<ul style="list-style-type: none"> <li>• There are a number of alternative models. These could range from a government department focused on public health, or the establishment of a special agency or commission through to the appointment of a champion or figurehead for obesity.</li> </ul>
... underpinning risk analysis (for management of unexpected consequences)?	<ul style="list-style-type: none"> <li>• Expert input is vital for risk management as well as risk assessment. It needs to be supported by robust surveillance and evaluation activities to track a wide range of outcomes of interventions and to spot unexpected consequences.</li> </ul>	<ul style="list-style-type: none"> <li>• Undertaking detailed monitoring of the impact on activity levels of new transport policies (for example, when a subsidised yellow school bus scheme was piloted in Bristol, a third of the pupils using the service stopped walking or cycling in order to take the bus, and another third merely transferred from other bus services; as a result, the full service was not introduced).<sup>101</sup></li> </ul>
... sufficient resources to enable a scaled-up response?	<ul style="list-style-type: none"> <li>• It is critical that a raised priority for obesity is supported by appropriate levels of resources.</li> </ul>	<ul style="list-style-type: none"> <li>• This could include considering levels of staffing and training needs, as well as financial support.</li> </ul>



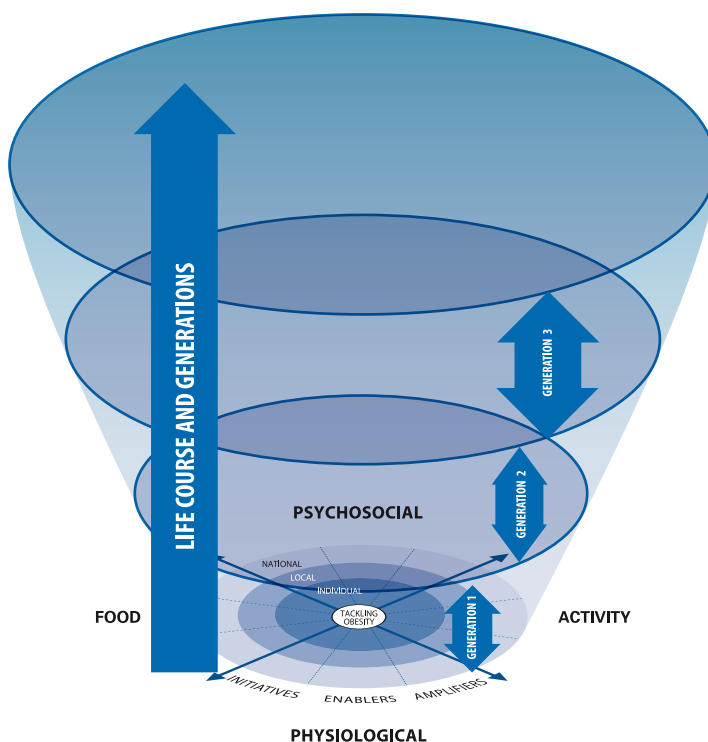


**Figure 8.6: The core elements of the strategy criteria checklist are summarised in Figure 8.6a:** the need to influence a broad set of systems levers (physiological, psychosocial, food-related and physical activity environment); the need to balance population-level measures against local and individually focused measures; and the need to use interventions that act in different ways (e.g. enablers and amplifiers) as well as focused initiatives. There are many other dimensions to this issue which are impossible to capture in a single diagram, but the **lifelong and generational aspects** are symbolised in Figure 8.6b.

**Figure 8.6a**



**Figure 8.6b**



Foresight's analysis indicates that there are currently no realistic short- or medium-term solutions to curtail the projected increase in obesity. It is therefore all the more urgent to build the foundations for long-term sustainable change without delay. A timeline of interventions needs to be constructed as part of the long-term overarching strategy building on existing action. Short-term actions must be focused on developing the basis for future interventions, such as creating awareness of the problem and its complexities and developing a mandate for intervention. Medium- and long-term actions are needed that focus on, for example, the built environment and transport policies.

Providing they do not act counter to the longer-term goal, there is also justification for a range of other short-term actions that have the potential to reinforce other elements of a long-term strategy:

- low-cost, low-risk interventions with limited evidence of efficacy
- opportunistic interventions as circumstances arise that can reinforce key messages
- addressing areas of public concern, even if they are not necessarily of the highest priority, e.g. enhancing cooking skills in young people.

#### **8.1.4 Moving towards practice-based evidence**

Given the current limitations of the evidence base (see Sections 3 and 4), it is crucial that an obesity strategy should continually evolve to reflect the emerging science and evidence. Research may open up new opportunities for intervention, and feedback from the evaluation of ongoing initiatives may necessitate a shift in priorities. Close and ongoing engagement with scientists at a strategic level, and not merely in the context of individual initiatives, is vital if the translation from science to policy is to be managed most effectively. Key areas where new research is needed are shown in Box 8.1.

Obesity challenges traditional research paradigms. The nature of the problem necessitates the collation of diverse data over long periods of time, yet there is an acute need for urgent action. Scientists, trained to strive for the best evidence possible, must, where necessary, make do with the best evidence available. This means placing greater priority on 'practice-based evidence'. This challenges existing funding mechanisms and the nature of scientific training. In turn, policy makers must understand the need for incremental change, recognise the concept of 'better practice' rather than 'best practice', and acknowledge that some well-intentioned interventions may fail.

Critical to this new model is a mechanism to improve the communication and trust between scientists and policy makers. Policy makers need to recognise the expertise of scientists and be willing to draw them into policy discussions at a strategic level, recognising that scientists themselves have a diversity of opinions



and views. Scientists need a better understanding of policy development and the skills to effectively translate their research into a form accessible by policy makers. This needs to become a core component of generic skills training. There is also a need to motivate scientists to engage by removing some of the barriers and/or adding specific incentives. New metrics are required to judge contributions to policy work that could sit alongside traditional publication lists and citation indices.

### Box 8.1: Implications for research

This Foresight project has identified some broad categories where additional evidence is needed to improve our understanding of the scientific basis of obesity. The most significant are:

- large-scale 'pilot' or 'demonstration' projects for the prevention of obesity
- population-based solutions, including studies of the built environment and diet/activity/obesity
- greater focus on prevention
- risk perception
- improvement in our understanding of human behaviour and values and how this drives change
- evaluation of 'natural experiments', including policy initiatives.

The systems mapping work also acts as a useful guide to the more detailed evidence gaps.<sup>17,18</sup>

Obesity illustrates a number of well-known yet still persistent methodological challenges in the accurate measurement of key obesity determinants, especially relating to behaviour; the need for more large-scale studies; a longitudinal approach; the need for a common language and appropriate definitions; the value of multidisciplinary research; the need for better data collection, including the expansion of surveillance schemes, as well as data on the determinants of health-related behaviours, and mechanisms to exploit existing data sets.

### 8.1.5 Management and co-ordination of the government response

Reducing the prevalence of obesity requires concerted long-term action from several stakeholders at multiple levels. The lead must come from Government. We have argued that the infrastructure and wider environment to deliver a comprehensive long-term obesity strategy and a wide array of specific prevention policies have much in common with other policy goals as well as other public health issues. There are therefore wide-ranging implications for the strategic management and co-ordination of a complex issue within central government.

There are many decision-making models that could help us achieve the aims we have set out, with various advantages and disadvantages. For success, any model must be able to:

- offer senior (Cabinet-level) government support
- develop a high-level, long-term comprehensive strategy
- obtain and act on strategic expert advice on an ongoing basis, for example, through the establishment of an expert advisory group
- deliver a sustained long-term view as well as short-term interim measures
- develop synergies with other cross-cutting policy issues
- co-ordinate implementation within and outside Government, including links between local and central government
- further develop relationships and partnerships with multiple stakeholders inside and outside Government
- further develop and resource mechanisms of surveillance and evaluation
- have sufficient resources to meet the rising challenges
- build on existing best practice.

Different models for decision making in public health have been debated extensively in recent years. They range from the establishment of a government department dedicated to public health to a cross-cutting agency, office or commission of public health and the introduction of an 'obesity champion' or other figurehead. Whatever the model, it will benefit from a strong symbolic appreciation of the cross-cutting approach required to tackle obesity and similar public health issues. That symbolism could come from an association of the structure with the Cabinet rather than a single department, at least until cross-cutting working becomes the norm. The treatment of obesity and its associated health consequences, of course, remains a matter for a department of health.

## 8.2 Conclusion

In recent years, Britain has become a nation where being overweight has become usual rather than unusual. The rate of increase in overweight and obesity, in children and adults, is striking. Obesity threatens the health and well-being of individuals and will place an intolerable burden on the Exchequer in terms of health costs, on employers through lost productivity and on families because of the increasing burden of long-term chronic disability.

Obesity is a consequence of abundance, convenience and underlying biology. It might also be viewed as the perverse outcome of constantly expanding 'choice'. What is certain is that this epidemic of 'passive obesity' is unlikely to come to a



natural end, i.e. without intervention. Obesity presents society with a number of tough choices about the relative importance of different goals and aspirations. Obesity, like climate change, is a complex problem, but it is not insoluble. At present, the best scientific advice suggests that solutions will not be found in exhortations for greater individual responsibility nor in short-term fragmented initiatives.

Tackling obesity is fundamentally an issue about healthy and sustainable living for current and future generations. This is only likely to be achieved if there is a paradigm shift in thinking, not just by Government but by individuals, families, business and society as a whole. There is therefore an urgent need for leadership, vision and, above all, sustained commitment. The case for action can be strengthened by identifying potential synergies and complementarities with other policy goals, such as climate change, to provide multiple benefits. Alignment with these other issues is crucial if the prospect of the majority of the UK adult population being obese in less than 50 years, with its attendant costs, is to be prevented from becoming a reality. The UK has the opportunity to build on existing work and pioneer a new long-term and integrated approach that sets a global standard for success.

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## Appendix 1

# Background to Foresight and this project

### About Foresight

This project is one of a number of projects within the Foresight programme based in the Government Office for Science. The aim of Foresight is to produce challenging visions of the future in order to ensure effective strategies now and to inform evidence-based policy development.

Seven Foresight projects have now been completed and details of each may be found at <http://www.foresight.gov.uk>. Examples include:

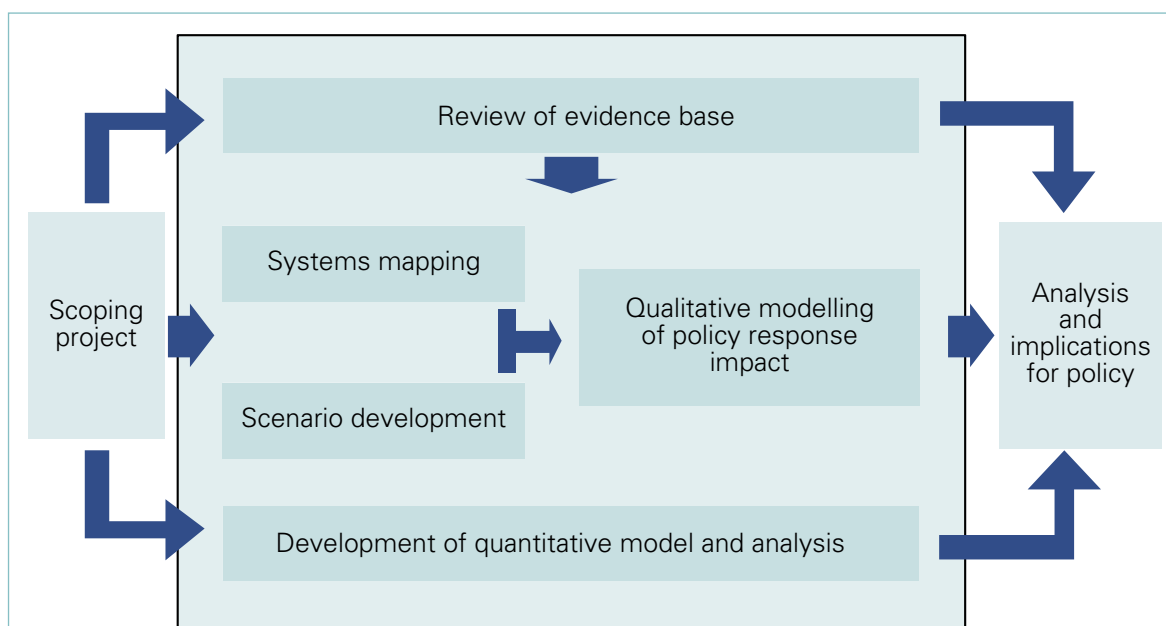
Flood and Coastal Defence developed a cross-disciplinary model for flood and coastal erosion risk during the 21st century. It developed a range of scenarios for the potential impacts of climate change and socioeconomic change.

Brain Science, Addiction and Drugs considered how we might manage the use of psychoactive substances for the benefit of individuals, communities and society in 2025. It explored what those substances might be in the future, what their effects might be, and what methods we might have for managing their use.

The Foresight programme is supported by its **Horizon Scanning Centre**, which undertakes central strategic scanning for future opportunities, risks and developments across Government. It explores the implications of emerging trends and issues identified in its Sigma Scan (full public policy spectrum) and Delta Scan (science and technology).

### Foresight Tackling Obesity: Future Choices

The Foresight Tackling Obesity: Future Choices project commissioned a number of work streams, which fed into the final analysis, summarised in Figure A.

**Figure A: Summary of project process**

### Review of evidence base

Underpinning the analysis of the project was a review of the evidence base for obesity. The project commissioned experts in a wide range of disciplines to set out the current understanding of the evidence on obesity and possible key developments over the next 25–30 years. These short science reviews<sup>38</sup> cover a wide range of subjects relevant to obesity, including biology, food, activity, and social and cultural factors, and address causal factors as well as interventions to prevent and treat obesity. By accessing experts in specialised fields and by asking them very open questions about what they believe to be important, the project aimed to identify some fundamental issues that might not appear in more focused discussions.

It was felt that a number of areas required more in-depth analysis, either because they had not been reviewed in detail before in the context of obesity by other stakeholders or were developing fields that were beginning to reveal some interesting insights. These areas included behaviour and lifestyle change, the impact of the obesogenic environment, and international comparisons, which was commissioned to put the UK into its global context and to identify key implications for the UK.

### Understanding the complexity: systems mapping<sup>17,18</sup>

Using this understanding of the evidence together with extensive expert consultation, a parallel systems mapping exercise sought to explore the complexity of the determinants of obesity, how these determinants interact and the implications for key points of intervention.





## Visualising the future

### Scenario development<sup>16</sup> and qualitative modelling<sup>25</sup>

A set of four scenarios of the future to 2050 was used as a tool to:

- identify key macro-level drivers for change
- explore the future societal context for intervention
- consider the implications for obesity trends.

The scenarios are underpinned by evidence from research and expert input that considered both analysis of the latest science around obesity and exploration of the drivers of change of the social, economic, environmental and political context within which obesity may operate in the future. A series of workshops were run with government and outside experts to bring in and test knowledge and ideas.

The scenarios are not designed to predict the future nor to represent a desired future; rather, they act as a tool to help us explore uncertainty and identify underlying assumptions. They enable us to investigate the potential consequences and recognise the impact of key macro trends, such as climate change, the ageing population, and technological developments in the area of obesity.

The scenarios formed the basis for discussion with those in the food industry to identify key issues, opportunities and barriers for the sector, and with school children to explore their views and goals for the future.

The scenarios were also used in a qualitative modelling exercise, with experts seeking to identify the potential impact of different policy responses on obesity levels in the future. This process began to highlight key issues and challenges for policy.

### Quantitative modelling<sup>1</sup>

This provides a quantitative assessment of possible future levels of obesity and the implications for downstream health consequences and costs. It provides a platform for the development of a microsimulation to support long-term strategy planning in this area, which we hope will continue to be developed as an analysis tool as more quantified data become available.

## Appendix 2

# Foresight Tackling Obesities: Future Choices – project publications and resources

### Evidence reviews

- Tackling Obesities: Future Choices – Short Science Reviews (*Obesity Reviews*, Volume 8, Supplement 1)
- Tackling Obesities: Future Choices – International Comparisons of Obesity Trends, Determinants and Responses. Evidence Review
- Tackling Obesities: Future Choices – Lifestyle Change. Evidence Review
- Tackling Obesities: Future Choices – Obesogenic Environments. Evidence Review
- Tackling Obesities: Future Choices – Obesogenic Environments. Summary of discussion workshops

### Systems mapping

- Tackling Obesities: Future Choices – Building the Obesity System Map
- Tackling Obesities: Future Choices – Obesity System Atlas

### Scenarios

- Tackling Obesities: Future Choices – Visualising the Future: Scenarios to 2050
- Tackling Obesities: Future Choices – Food Chain Industries' Perspectives on the Future
- Tackling Obesities: Future Choices – Future Trends in Technology and their Impact on Obesity
- Tackling Obesities: Future Choices – Perspectives of 13-year-olds
- Tackling Obesities: Future Choices – Perspectives of 10-year-olds

### Qualitative modelling

- Tackling Obesities: Future Choices – Qualitative Modelling of Policy Options

### Quantitative modelling

- Tackling Obesities: Future Choices – Modelling Future Trends in Obesity and the Impact on Health



## Appendix 3

### Definitions of obesity<sup>11</sup>

At present, body mass index (BMI) is routinely used to measure for overweight and obesity. BMI = weight (kg) divided by height (m<sup>2</sup>). The following figures are based on a report by the International Obesity Task Force (IOTF) and refer to a Caucasian population.

Classification	BMI
Underweight	<18.5
Normal range	18.5–24.9
Overweight:	≥25.0
Pre-obese	25.0–29.9
Obese class I	30–34.9
Obese class II	35–39.9
Obese class III	≥40.0

Although BMI is useful on a population scale, it has limitations on an individual level, where more specific means of body composition measurement may be more useful and accurate (see the appendices of the Foresight project international comparisons report<sup>11</sup> for information on alternative measures). However, the use of these alternative, more precise, measurements on a large scale is simply not possible. Height and weight measurements are taken routinely across the globe and therefore this provides a simple but crude measure to estimate prevalence of overweight and obesity on a large scale.

BMI does not account for body fat distribution; more recently, research has suggested that waist circumference has a closer association with morbidity and mortality. At present, however, waist measurements are not routinely taken (though health practitioners are increasingly being encouraged to do so) and the observer error may be substantial due to difficulties in identifying the waist. Extensive data are not yet available for analysis at a population level.

## Appendix 4

# Interpreting the System Map

### What is systems mapping?<sup>17</sup>

A system can be considered to be 'a structured set of objects and/or attributes together with the relationships between them'.<sup>98</sup> The constitutive elements of a system are therefore (1) its elements; (2) the relationships between these elements; and (3) the system boundary that distinguishes between what does and does not belong to the set.

The obesity system, therefore, is pragmatically defined as the collection of all the relevant factors and their interdependencies that determine the energy balance for an individual or a group of people.

The purpose of building a causal loop model is to improve insight into the underlying structure of a complex situation. A system map shows how 'things hang together' and where one could likely intervene in the modelled system to influence its behaviour. It helps to communicate current trends, relationships and constraints that may influence the future behaviour of a system.

### Interpreting the system map

The obesity system has been visualised as a **causal loop model**. In a causal loop model, the system's elements (factors, variables) are represented by boxes, and the causal relationships between two **variables** are represented by arrows. The variable at the tail of the arrow has a causal effect on the variable at the point.

There are also **positive and negative causal relationships**. A positive causal relationship implies that both variables will change in the same direction: if variable *a* (at the tail) increases, then also variable *b* (at the point) will increase (and if *a* decreases, then *b* decreases). A negative relationship, on the other hand, implies that variables change in opposite directions (if *a* increases, *b* will decrease and if *a* decreases *b* will increase).

Systems mapping also helps identify where there are **feedback loops**, which are critical to understanding the behaviour of a system. There are two kinds of feedback loops: reinforcing (or positive) and balancing (or negative) loops. Reinforcing loops encapsulate exponential growth, while balancing loops push the system towards equilibrium. Here are two illustrative examples:



- *An example of a reinforcing loop.* A reinforcing loop from the obesity system map is:

If the 'demand for convenience' by consumers increases, the 'convenience of food offerings' from food manufacturers is likely to increase in response. If then consumers habituate themselves to these convenient offerings, they will lose cooking skills. Therefore an increase in the 'convenience of food offerings' triggers 'de-skilling' of people. And this, in turn, increases the demand for convenience. And so on, until compromises on taste or price flatten the dynamic.

- *An example of a balancing loop.* A balancing loop is at the very core of the obesity system:

When human beings' 'level of available energy' goes down, they experience a 'physical need for energy'. The stronger that need is, the more effort is invested in 'acquiring new sources of energy' or in 'preserving the energy' that is already available. This, in turn, leads to a higher level of available energy, which finally dampens the physical need for energy. And so the system remains in equilibrium.

The purpose of this systems mapping work was to understand how other factors in the wider system impact on the core balancing loop and, in the case of obesity, create an internal bias towards the accumulation of energy.

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