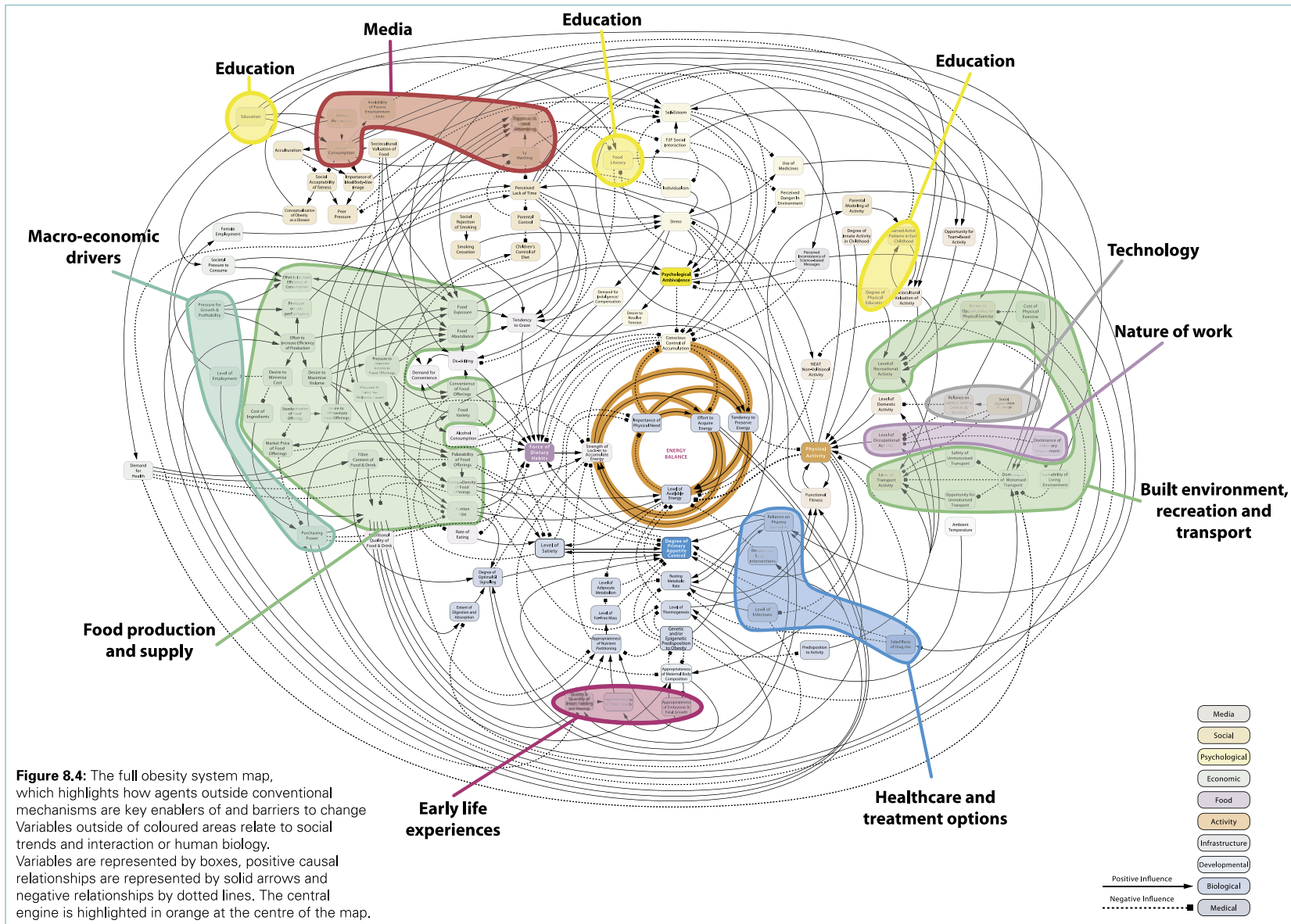


**Figure 8.4: The full obesity system map, which highlights how agents outside conventional mechanisms are key enablers of and barriers to change**





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.

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

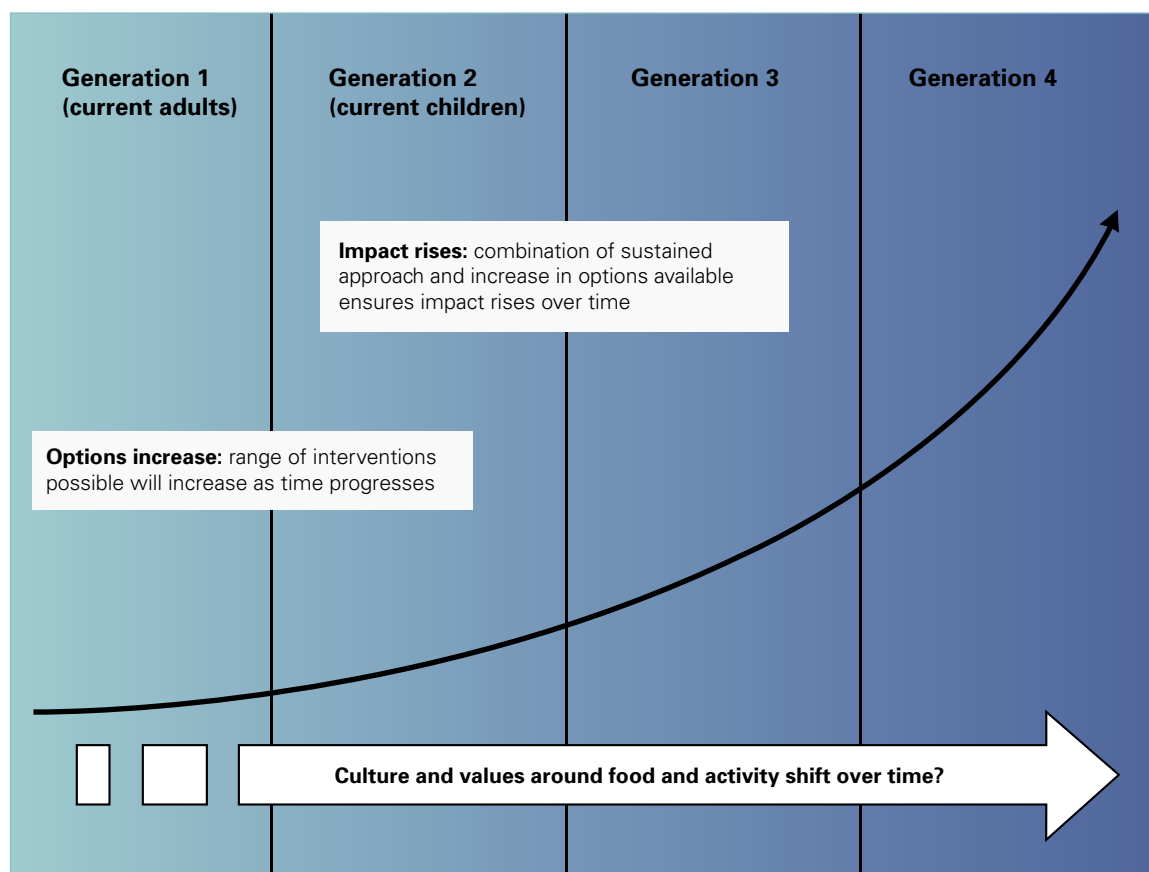
Success in tackling obesity requires that the health of the population is seen as a priority both by government ministers and society and that other social and economic goals that may be acting counter to this aim are identified. For example current European legislation on the composition of some foods, 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>

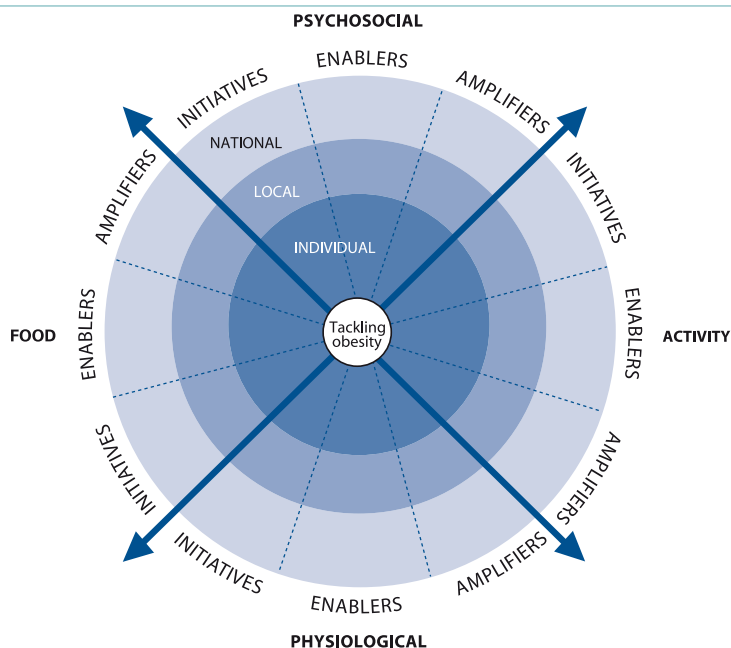
**Table 8.1: Criteria checklist for an effective obesity strategy (Continued)**

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>

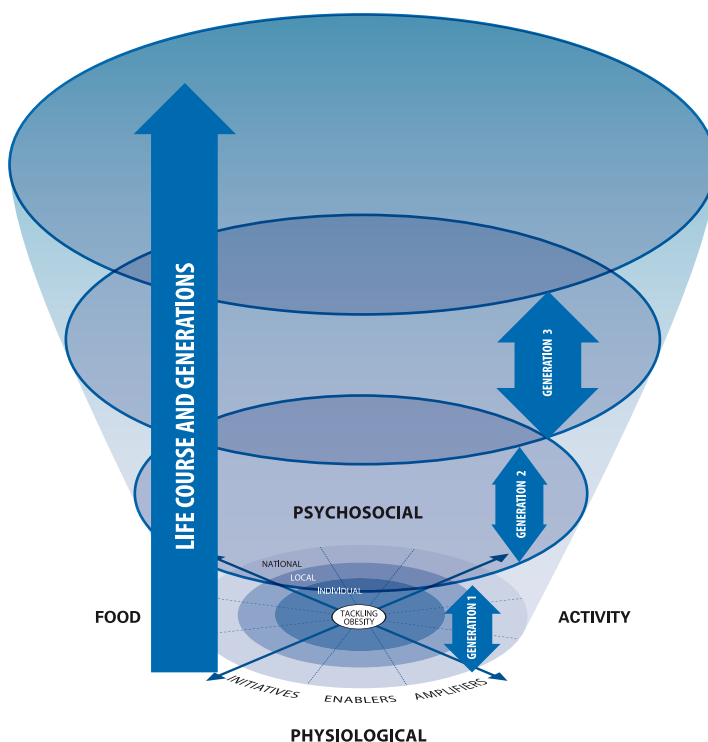


**Figure 8.6: The core elements of the strategy criteria checklist are summarised in Figure 8.6a:** the need to influence a broad set of systems levers (physiological, psychosocial, food-related and physical activity environment); the need to balance population-level measures against local and individually 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:

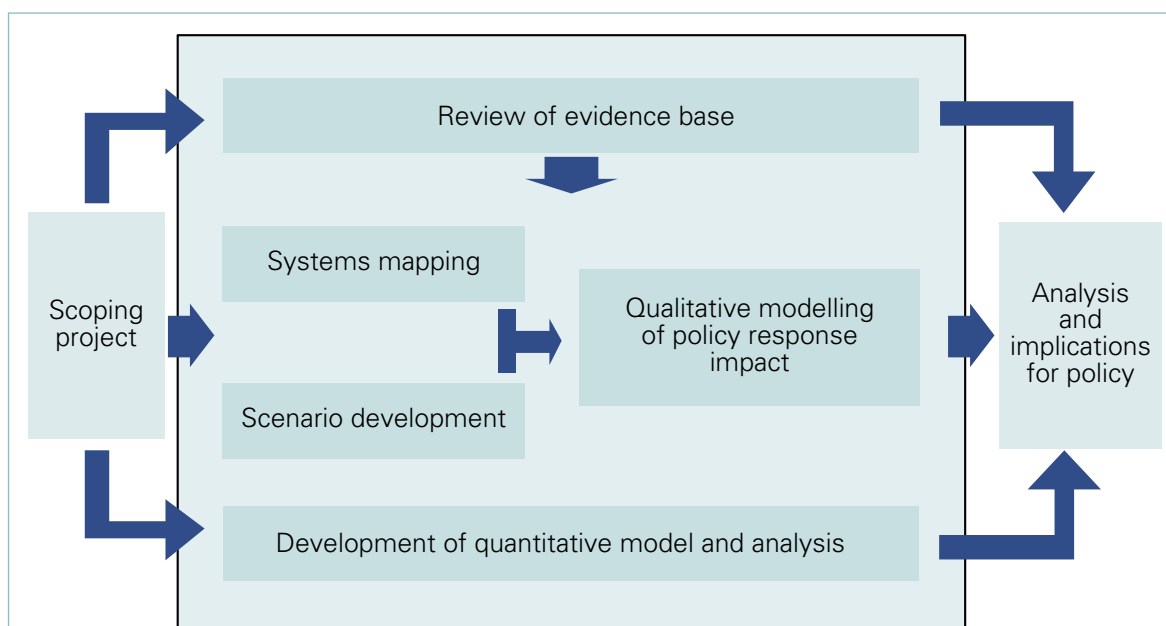
Flood and Coastal Defence developed a cross-disciplinary model for flood and coastal erosion risk during the 21st century. It developed a range of scenarios for the potential impacts of climate change and socioeconomic change.

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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