Management of obesity in children and adolescents: Lifestyle and exercise options

NOBLES, James, BEECROFT, Stephanie, DHIR, Pooja, GATELY, Paul, ELLS, Louisa and HOMER, Catherine <http://orcid.org/0000-0003-2571-6008>

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Author and Co-author Contact Information

Corresponding Author Name: Dr James Nobles

Postal Address: Calverley Building, Leeds Beckett University, City Campus, Leeds, LS1 3HE

Email: j.d.nobles@leedsbeckett.ac.uk

Telephone: 0113 812 9114

Co-author Name: Stephanie Beecroft

Postal Address: Collegiate Crescent, Broomhall, Sheffield, S10 2BP

Email: s.beecroft@shu.ac.uk

Telephone: 0114 225 5815

Co-author Name: Pooja Dhir

Postal Address: Calverley Building, Leeds Beckett University, City Campus, Leeds, LS1 3HE

Email: p.dhir2675@student.leedsbeckett.ac.uk

Telephone: 0113 812 9114

Co-author Name Professor Paul Gately

Postal Address: Churchwood Hall, Leeds Beckett University, Headingley Campus, Leeds, LS6 3QJ

Email: p.gately@leedsbeckett.ac.uk

Telephone: 0113 812 5233

Co-author Name: Professor Louisa Ells

Postal Address: Calverley Building, Leeds Beckett University, City Campus, Leeds, LS1 3HE

Email: l.ells@leedsbeckett.ac.uk

Telephone: 0113 812 6394

Co-author Name: Dr Catherine Homer

Postal Address: Sheffield Hallam University, Olympic Legacy Park, 2 Old Hall Road, Sheffield, S9 3TU.

Email: c.homer@shu.ac.uk

Telephone: 0114 225 5815

Abstract

Childhood obesity remains a major public health and social issue. Its' prevalence has grown significantly over the last 30 years and it is expected to rise further in future years. The physical, psychological, social, emotional, and economic consequences of obesity are significant on both the individual and society as a whole. There is a moderate evidence base for the treatment of childhood obesity, with many reviews suggesting that weight management (WM) programmes can be both effective and cost effective. That said, data on longer term efficacy is currently limited, as is that for specialist weight management services and pharmacotherapy. This chapter sets out to discuss a range of WM programmes and their component parts, how to ensure appropriate services are referred to, and distil the evidence base around effectiveness. We also place WM in the context of the wider political systems in the UK – those which fundamentally shape the offer available to families in need. In this Edition 3 update, we highlight recent advancements and contemporary issues in childhood WM provision.

Key words

Behaviour Change Techniques; Childhood Overweight and Obesity; Commissioning; Complexity; Lifestyle Interventions; Obesity Policy; Obesity Treatment; Service Provision; Weight Maintenance; Weight Management Programmes; Whole Systems Approaches

Key points

1. Weight management support is required for young people living with overweight or obesity as part of a comprehensive systems approach.
2. There are several key gaps in the evidence base regarding children's weight management, including long-term intervention effectiveness, equitability of intervention access and outcomes, and based on different models of care. Data on surgical outcomes is particularly scarce.
3. Advancements are being taken within the field, particularly in policy and practice, and high-quality research is required to build the evidence base concurrently.

BODY TEXT

Introduction

Childhood overweight and obesity has risen dramatically across the world since 1990 (World Health Organization, 2024). In 1990, an estimated 8% of children, aged 5-19 years, were living with overweight or obesity. This contrasts with 20% in 2022, the equivalent to 390 million children and young people. Within the UK, the context in which this chapter is positioned, obesity affects almost one in four children, aged 10-11 years (NHS Digital, 2023). This estimate rises to one in three when figures include overweight (NHS Digital, 2023). The prevalence of overweight and obesity increases proportional to deprivation (NHS Digital, 2023), tracks strongly into adulthood (Simmonds *et al.*, 2016), leads to premature mortality (Danesh *et al.*, 2016), and has numerous health-, economic-, and social- ramifications. These inequalities were exacerbated by the COVID 19 pandemic, whereby we witnessed the prevalence of overweight and obesity rise significantly, and the gap widen between those in the most and least deprived socioeconomic positions (NHS Digital, 2023). Recent data suggest that the global economic burden of obesity (2.8% gross domestic product [GDP]), comes third to smoking (2.9% GDP) and armed violence, war, and terrorism (2.8% GDP) (McKinsey Global Institute, 2015), costing the UK economy £27 billion per year (Foresight, 2007). In light of the aforementioned evidence and given that 80% of children with obesity are predicted to have obesity as an adult (Simmonds *et al.*, 2016), the need for both prevention and treatment of childhood obesity is paramount. This chapter aims to present an overview of the evidence for childhood weight management, and places this in the context of the UK system.

The Context of Weight Management in the UK

Although this chapter is placed in the context of England and the UK, it is anticipated that the topics discussed will be pertinent internationally.

We begin this chapter from the viewpoint of the national health systems in the UK. Overseeing the health system and the budget of the health sector is the Department of Health and Social Care; a ministerial department within the British government. However, due to the varied demographics in the UK, a centralised system is not considered to be the best approach to account for differences across local geographic areas. As part of a significant health care reform in 2012, the national government devolved the responsibility for Public Health to Local Government Authorities (LAs: *n*=152 across England) and Clinical Commissioning Groups (now Integrated Care Boards: *n*=42 across England) (HM Government, 2012). These two bodies – alongside NHS England (who oversee the commissioning of specialist national health care services) – are responsible for the prevention and treatment of obesity in England.

Within England, the Obesity Care Pathway (Figure 1) – a four Tiered approach to preventing and managing obesity – has been developed (Blackshaw *et al.*, 2014, DH, 2013); each Tier being commissioned by one of the three bodies. The first Tier of the pathway focuses on the prevention of overweight and obesity, primarily through marketing campaigns, awareness raising, and knowledge building (e.g. 'NHS Healthier Families' & 'This Girl Can'). Tiers 2-4 are dedicated to obesity treatment. The pathway stipulates that more specialist treatment is provided in line with the greater degree and complexity of obesity, insofar that Tier 2 provides generic weight management (WM) advice for children with overweight, Tier 3 provides specialist intervention from a multidisciplinary team for children with obesity, and Tier 4 offers intensive treatment, residential camps, pharmacotherapy, and bariatric surgery for children with severe obesity (Nobles *et al.*, 2016b, Blackshaw *et al.*, 2014).

[INSERT FIGURE 1 HERE: OBESITY CARE PATHWAY]

The aim of non-bariatric/non-pharmacological WM programmes is to stabilise and reduce the weight of the child through education aiming to improve lifestyle behaviours which include dietary intake, physical activity, and sedentary behaviour (NICE, 2013). These services often provide weekly, group-based intervention for families over a period of 10-12 weeks. Programmes tend to be delivered by paraprofessionals (i.e. trained non-experts) and conducted in a non-clinical format (NICE, 2013). Tier 3 services should utilise a multidisciplinary team (i.e. possibly a paediatrician, dietitian, psychologist and an exercise professional) and likely to be clinically-based (Wright and Wales, 2016). Tier 4 non-bariatric services can be residential in nature, providing an immersive experience for young people; with programmes including camp-based models (i.e. more holistic approach) and hospital-based models (i.e. more clinical approach). Effectiveness of these WM programmes is ubiquitously measured through mean change in standardised body mass index (BMI SDS), pre- to post- programme.

The UK therefore adheres largely to a medicalised model of care when aiming to treat obesity in children and young people. The more severe an individual's obesity becomes, the greater the promotion of medicalised intervention. Epitomising this are Tier 4 bariatric services; those which aim to alter the physiology of the human body to bring about an energy deficit. The extent to which the Obesity Care Pathway accurately reflects the realities and needs of the children living with obesity shall be discussed at a later point in this chapter; where we speak to both the current UK service provision and also that which we believe is required in the future.

Given the burgeoning prevalence of obesity in England, the national government has made multiple public commitments to rally action against obesity (HM Government, 2008; HM Government, 2016; HM Government, 2018, HM Government, 2020; National Audit Office, 2006; NHS, 2019; Theis & White, 2021). Yet despite such governmental prioritisation of obesity, local level action is scant. In 2015, Public Health England (PHE: an executive agency of the Department of Health and Social Care) reported that 56% and 61% of LAs had a Tier 2 service for children and adults respectively (Public Health England, 2015). At Tier 3, PHE declared that insufficient information was available to generate conclusions – very few areas indicated having these services. As will later be noted, there has been a significant investment in Tier 3 services across England via the Complications from Excess Weight (CEW) Clinics.

This is despite estimates that there are 140,000 children with severe obesity and 2.5 million children with obesity (Ells *et al*., 2015). The picture of service provision is further clarified when examining LA expenditure on WM programmes (Figures 2-4). In the most recent annual LA revenue expenditure reports (HM Government, 2024) – when compared against the 2015/16 Public Health grant as reported in the last edition (£2.80b) (HM Government, 2016b) – the total spend on prevention and treatment of obesity was £101.7m (3.%), with £40.4m of that spent on children. In the 2022/23 Public Health grant (HM Government, 2024), although greater overall (£3.83b), the percentage of funding to the prevention and treatment of obesity reduced to £109.7m (2.86%), £46m of which was spent on children's WM. When considering inflation, this is 10% less than 10 years ago, and the public health spending on obesity has seen a cut of 14.3% since 2016 (The King's Fund, 2023). This expenditure is in stark contrast to that on substance misuse (£754.6m, 19.7%), sexual health (£547.3m, 14.2%), and smoking cessation and wider tobacco control (£83.2m, 2%) (HM Government, 2024). NHS England have however invested significantly to deliver the Complications from Excess Weight clinics programme, which aims to provide 3000 young people with access to Tier 3 support over a three-year period (NHS England, 2023). We will speak more about the CEW clinics later in the chapter.

[INSERT FIGURE 2 - 4 HERE: SPEND ON PH SERVICES, PH SPENDING ON OBESITY, AND ANNUAL ESTIMATED COST OF PH ISSUES]

Identifying Appropriate Treatment Options

When thinking about the management of obesity, it is imperative that the initial assessment considers the holistic health of the individual, as opposed to solely the consideration of their weight status. In adult cohorts, tools such as the Edmonton Obesity Staging System (Sharma and Kushner, 2009) can be used to understand the support- and need- requirements for those with obesity. This tool – which has been widely utilised – assesses physical symptomology (i.e. associated co-morbidities), psychological symptomology (e.g. depression, anxiety, maladaptive eating practices, suicidal ideation), and functional limitations (e.g. ability to work, complete daily tasks, quality of life) of the individual. These tools can then help signpost adults to the most appropriate services, acknowledging that a 'one-size-fits-all' approach is inadequate. Comprehensive tools such as the Edmonton Obesity Staging System are not yet available for young people in England, hence reporting of research and practice-based outcomes vary considerably. In Belgium however, the Edmonton Obesity Staging System for Pediatrics (EOSS-P) was developed in 2016 (Hadjiyannakis *et al.,* 2016), and a new pathway using this system was introduced in December 2023 (Belgian Association for the Study of Obesity, 2023; de Wolf *et al*., 2024).

In the UK, the National Institute for Health and Care Excellence (NICE) provides evidence-based guidance to help shape the delivery of the health and social care services, with updated guidance due imminently. NICE have created several guidance documents to assist health professionals in designing effective WM programmes (NICE, 2013, NICE, 2014, NICE, 2016). These documents state – for both young people and adults with obesity – that the complex needs of individuals should be assessed. However, how one defines "complex needs" is unclear. NICE suggest that assessments should consider presenting symptoms, eating behaviours, co-morbidities, lifestyle factors, psychosocial factors, medical problems, the social environment, and readiness to change as a starting point for understanding complex needs (NICE, 2014). In children, these assessments are recommended for those living with obesity as opposed to those with overweight – albeit that there is no empirical evidence to suggest why this is so. Dependent on the needs of the individual, the health professional can then look to refer the individual to a Tier 2, 3, or 4 WM programme. Further work is needed to help health professionals ascertain a comprehensive picture of the individual – child or adult – in an efficient manner.

Treatment should – dependent on the outcome of these assessments – then be tailored to the needs of the individual. This could be achieved through a Stepped Care Approach (Sharman and Nobles, 2016), where the intensity and specificity of treatment options is increased relative to the need of the individual. For example, at SHINE Health Academy – a not-for-profit WM provider – an initial assessment of 1.5 hours is undertaken with young people and their parents. The assessment considers some of the factors listed above, including anthropometric and physiological functioning (e.g. height, weight, blood pressure, peak flow, and medical history), and psychosocial symptomology (e.g. self-esteem, anxiety, depression, maladaptive eating practices, weight-related bullying, and self-harming). After determining the preferences of the individual, SHINE then offer individuals access to one of seven treatment options (Sharman and Nobles, 2016). Alternatively, as will be described later in the chapter, the intention of the CEW clinics is to provide holistic and person-centred care for individuals, whereby treatment plans are drawn together by health care professionals in collaboration with the young person and their family. In contrast to SHINE, the CEW clinics seldom provide a group-based component, and care is often provided on an individual or family basis.

Types of Weight Management

Whilst the Obesity Care Pathway lays out a four-tiered approach to WM, it is also important to note that there are various types of children's WM programme. The review of Altman and Wilfley (2014) categorises a range of different WM programmes. As aforementioned, the majority of programmes

aim to modify dietary intake, physical activity and sedentary behaviours through the use of behaviour change strategies/techniques (Altman and Wilfley, 2014), however some have started to acknowledge the wider biopsychosocial factors associated with obesity. There are myriad ways in which these aims can be accomplished, and the effectiveness of the different types of programme varies too.

The first element to note when differentiating between programmes is the type of *family involvement*. Altman and Wilfley (2014) identify two types of programme here, Family-based Behavioural Treatment (FBT) and Behavioural Weight Loss (BWL). The distinguishing factor is the extent to which goals are set for both parents and children. In FBT, specific goals are set for both parents and children, whereas in BWL goals are only set for one of these parties – often the child. FBT emphasises that parents act as an agent for change, role modelling and advocating the behaviours they wish their children to make (Epstein *et al*., 2014). There is however a third type of programme to note associated with family involvement, parent-only programmes (POP). The review of Altman and Wilfley (2014) included 14 POPs, some of which focused on the involvement of fathers only (Morgan *et al.,* 2014). The rationale for the POP being that parents can, independently, act as the change agent and modify the home environment – additionally making the treatment easier to implement (Boutelle *et al.,* 2011; Ball *et al.,* 2017). Thus, the age of the child is a pertinent factor to consider regarding family involvement.

Treatment modality can also help to differentiate between programmes. Modality, the method of administering treatment, can differ substantially. In the previous section, community-based (i.e. delivered by paraprofessionals in a local community venue) and clinically-based (i.e. delivered by multidisciplinary teams in a primary care setting/specialist facilities) WM programmes were mentioned, as were group-based (i.e. delivered to more than one family at the same time) and individual-based (i.e. delivered to one family at a time) programmes. In recent years though, additional modalities have started to form. Firstly, commercial WM programmes have emerged as an option for children and young people – especially adolescents (Bonham *et al.,* 2017; Dordevic *et al*., 2015; Stubbs *et al*., 2012). Commercial programmes are delivered by private sector organisations, providing their own WM guidance, and are popular amongst adult cohorts (Gudzune *et al.* 2015). They provide a scalable alternative to clinical programmes, whereby participants can pay to access said group-based services. Resources – such as meal replacements and pre-packaged food – are often advocated by these providers. They rely fundamentally on the alteration of energy intake, thus not considered to be a holistic, multicomponent service (Gudzune *et al.* 2015).

Residential WM camps (i.e. Tier 4 WM) are also another type of treatment modality. Camp models have been found in the UK (Gately *et al*., 2005) and in the US (Gately *et al*., 2001), with hospital models also having been utilised (Braet *et al*., 2004; Endo *et al*., 1992; Rolland-Cachera *et al*., 2004; Wabitsch *et al*., 1996; Widhalm *et al*., 1983). Camp models tend to be holistic in nature, creating energy imbalance through dietary restriction and physical activity, however doing so within a social, fun-, and experiential environment. These programmes are led by education professions with support from clinicians (Psychologists, Dietitians and exercise experts). Hospital-based models typically use a variety of dietary methods (including very low-calorie diets and liquid diets), and tend to be led by clinical teams (Physicians, Psychologists, Nurses, and Dietitians). The presence of camp-based models has decreased in recent years, likely due to their cost and short-term nature.

The penultimate noteworthy WM modality is through interactive *m*-health or *e*-health programmes (e.g. mobile applications, internet-based programmes, tele-interventions). This modality also offers a wider dissemination in conjunction with flexibility around the timings in consuming information (Altman and Wilfley, 2014), alongside the easy setting, and real-time tracking, of goals/performance (Norliza *et al.,* 2014). Lastly, the self-help modality – whereby health care professionals refer their

patients to helpful WM resources (e.g. handouts, online materials, information) – sometimes referred to as bibliotherapy (Sharman and Nobles, 2016).

Focus is the final programme characteristic to differentiate between types (Oude Luttikhuis *et al*., 2009). Oude Luttikhuis *et al*. (2009) characterised WM programmes into three broad groups, those with a focus on 1) diet only, 2) physical activity and sedentary behaviour only, and lastly, 3) behavioural programmes. Whilst there is a general consensus that multicomponent programmes (i.e. focused on all three of the above) are preferred, a plethora of research and evidence exists for each of these programme types. As spoken to earlier in this chapter, WM programmes should seriously consider the wider biopsychosocial factor associated with obesity. Although very few children's WM programmes like this exist, some services such as SHINE and MoreLife place a concerted effort on addressing these wider factors in their session content (Nobles *et al*., 2016a, Nobles *et al*., 2016b). Whilst limited information is publicly available regarding the NHS England funded CEW clinics, a key intention is that they should identify and support the psychosocial needs of young people (NHS England, 2023), and thus, we might begin to see more of a focus being placed on these needs in the future. SHINE and MoreLife both provide a psychosocial intervention with dedicated programme content focusing on the importance of social relationships, personal hygiene, stress management, dealing with bullying, and improving self-esteem (Hester *et al*., 2010; Nobles *et al*., 2016b). This programme content is provided in equal measures to advice on diet and physical activity.

The involvement of family members, treatment modality and treatment focus are distinctive, observable elements of a WM programme. But given that the aim of a WM programme is to bring about changes in behaviour, the active ingredients of a WM programme lie within the behaviour change techniques (Michie *et al.,* 2015). Behaviour change techniques (BCT) are defined as 'the smallest components compatible with retaining the postulated active ingredients (i.e. the proposed mechanisms of change)' (Michie *et al*., 2015) – of which Michie and colleagues (2013) have identified a list of 93 in their most recent taxonomy, categorised into 16 groupings. These active ingredients – all of which are clearly labelled, distinct, irreducible and precise (Cane *et al*., 2015) – include among others, goal setting and planning, social support, feedback and monitoring, covert learning, rewards, and natural consequences (Michie *et al*., 2013). The ability to identify these active components is dependent upon the clarity and depth of programme reporting, for example in programme protocols or via standardised reporting templates (e.g. TIDieR: Hoffman *et al*., 2014).

As can be deduced, WM programmes – particularly when studying their macro (e.g. modality) and micro (e.g. BCT) details – are heterogenous. This is without appraisal of the specific programme content (i.e. information on diet), the treatment dose (i.e. intensity, duration and follow up), the wider context, the level of support, the characteristics of programme delivery staff, and the use of adjunctive inputs (e.g. pharmacological intervention) – amongst others. There has been a substantial volume of research into the use of WM programmes (and to a lesser degree, the study of BCTs) for the treatment of childhood overweight and obesity, but the effectiveness of these programmes is yet to be discussed.

Effective Weight Management

The effectiveness of a WM programme is often assessed against one primary outcome in both academic and Public Health arenas, a change in weight status (NICE, 2013, NICE, 2015, NICE, 2014, Altman and Wilfley, 2014, DH, 2013, Roberts *et al*., 2009, Oude Luttikhuis *et al*., 2009, Upton *et al*., 2014, Janicke *et al*., 2014). Whilst the range of outcomes related to a change in weight status is vast (e.g. absolute weight, change in BMI percentage, percent overweight etc…), the mean change in BMI SDS, from baseline to post-intervention, is frequently utilised to measure the effectiveness (i.e. under real-world conditions) or efficacy (i.e. under optimum controlled conditions) of children's WM programmes (Upton *et al*., 2013, NICE, 2013, Roberts *et al*., 2009). The measure, BMI SDS, accounts

for the child's age and sex, and subsequently enables the score to be compared against a reference population (usually national or international growth charts– see (Cole *et al*., 1995)). Once the mean change in BMI SDS has been calculated for the WM programme, the programme effectiveness can be established by comparing the outcome against a benchmark.

Cochrane Reviews create this benchmark; these reviews collate high quality research studies and pool their effects into an overall estimate. The most recent Cochrane Reviews examine the efficacy of preventing obesity (Brown *et al.,* 2019), various paediatric WM programme types (Al-Khudairy *et al.,* 2017; Colquitt *et al*., 2016; Mead *et al.,* 2017), pharmacological interventions (Torbahn *et al.,* 2024) and surgery for the treatment of obesity (Torbahn *et al*., 2022). Prevention – for now – is considered outside the scope of this chapter.

Behavioural interventions (i.e. those most closely aligned with multicomponent interventions) were included in the reviews of Al-Khudairy, 2017, Colquitt *et al*., 2016, and Mead *et al.,* 2017, with the results separated into three reviews for different childhood age groups (a] preschool up to the age of 6 years, b] 6 to 11 years, and c] ≥12 years). Following a multicomponent intervention between six to twelve months, the pooled average reduction in BMI SDS for those attending a behavioural intervention targeting children in preschool up to 6 years was -0.3 units (95% CI: -0.4 to -0.2). Further follow ups found at 12- to 18- months' a mean difference of -0.4 units (95% CI: -0.6 to -0.2) and at two years' a mean difference of -0.3 units (95% CI: -0.4 to -0.1) (Colquitt *et al*., 2016). For children living with excess weight or obesity aged 6 to 11 years (Mead *et al.,* 2017), behavioural interventions compared to no treatment/usual care control at longest follow-up reduced BMI, BMI SDS and weight. The mean difference in BMI was -0.53 kg/m^2 (95% CI: -0.82 to -0.24) and mean difference in BMI SDS was -0.06 units (95% CI: -0.10 to -0.02). For those interventions targeting older children aged 12 to 17.5 years (Al-Khudairy *et al.,* 2017), the mean difference of the change in BMI at the longest follow-up period was -1.18 kg/m^2 (95% CI:-1.67 to -0.69) and change in BMI SDS was by -0.13 units (95% CI: -0.21 to -0.05).

The latest review of *pharmacological interventions* (Torbahn *et al.*, 2024) for the treatment of obesity in children and adolescents included studies investigating exenatide, liraglutide, metformin, orlistat, lorcaserin, topiramate, phentermine/topiramate, semaglutide and sibutramine, and included 35 trials. The length of interventions ranged between 12 weeks and two years. The review found a mean 1.71kg/m^2 (95% CI: -2.27 to -1.4) reduction across 25 five trials included in this particular BMI analysis (10 studies excluded), whereby pharmacological intervention was tested against a control group. When broken down by drug type, the differences ranged from -0.79 to -5.88kg/m^2 BMI unit reductions, with semaglutide producing the largest reduction. The reduction in BMI according to drug intervention is as follows: *exenatide* (-1.0kg/m^2 (95% CI: -4,22 to 2.22), *liraglutide* −1.58kg/m^2 (95% CI: −2.47 to −0.69), *metformin* −1.27kg/m^2 (95% CI: −1.69 to −0.85), *orlistat* −0.79kg/m^2 (95% CI: −1.08 to −0.51), *phentermine/topiramate* −4.57kg/m^2 (95% CI: −6.16 to −2.98), *semaglutide* −5.88kg/m^2 (95% CI: −6.99 to −4.77) and *sibutramine* −1.70 kg/m^2 (95% CI: −2.92 to −0.48). There was no evidence to suggest the length of intervention moderated effectiveness.

A review of *surgical interventions* (Torbahn *et al*., 2022) only found one study with 50 patients aged <18 years, where laparoscopic gastric banding led to a mean BMI reduction of 12.7kg/m^2 (95% CI: 11.3 to 14.2) after two years compared to 1.3kg/m^2 (95% CI: 0.4 to 2.9) in the control arm. It is important to note that this Cochrane Review was an update from its predecessor (Ells *et al*., 2015), and that no additional studies had been identified subsequently since. Further research is needed to assess the impact of surgical procedures, including the impact of different procedures, post-operative care to minimise adverse events, and long-term follow-up.

Collectively, the Cochrane Reviews conclude that multi-component behavioural interventions may be beneficial in producing small reductions in BMI SDS, and that pharmacological interventions have a

moderate certainty that when combined with behavioural interventions, they can reduce BMI. Surgical interventions are currently too limited to yet develop recommendations (Ells *et al.,* 2018).

Given that more data is available on behavioural interventions, in contrast to pharmacological or surgical, additional high-quality reviews are allow us to examine these interventions in greater depth. Altman and Wilfley (2014) suggest that FBT (9/10 studies deemed efficacious) and POP (14/14 studies deemed efficacious), as opposed to control interventions and BWL (4/10 studies deemed efficacious), bring about greater weight-related change. Both FBT and POP have a multicomponent treatment focus and family involvement – with BWL only focused upon goal setting for children or parents independently. Looking further, the additional reviews of Janicke *et al*. (2014), van Hoek *et al*. (2014) and Whitlock *et al.* (2010) suggest that behavioural WM programmes of moderate-to-high intensity (i.e. >26 hours contact), in-person sessions, and one-to-one sessions (opposed to group-based) were more effective in bringing about positive changes in weight status amongst children. Extending from the above, Hayes *et al*. (2015) concluded that mixed sessions (i.e. a combination of individual- and group-based sessions) demonstrated greatest efficacy. The age of the child, the degree of childhood obesity, and parental weight loss success are often moderating factors of programme efficacy (Altman and Wilfley, 2014).

As for the active components of a WM programme (i.e. the BCT), Martin *et al* (2013) drew on the CALO-RE taxonomy (Michie *et al*., 2011a) to investigate the BCTs included within 9 RCTs viewed as effective (≥0.13 unit reduction in BMI SDS; *n*=6 trials) and non-effective (<0.13 unit reduction; *n*=3 trials) in the management of childhood obesity. Although the study adopted an older version of the CALO-RE taxonomy (41 items rather than 93), six BCTS were found useful: 1) provide information on consequences of behaviour to the individual, 2) environmental restructuring, 3) prompt identification as role model/position advocate, 4) stress management/emotional control training, 5) general communication skills training and 6) prompt practice. Additional reviews – whilst less robust – also suggest that goal setting, interactive sessions, social support, rewards/incentives, self-monitoring, and stimulus control are effective (Altman and Wilfley, 2010; Sahota *et al*., 2010; Sutcliffe *et al*., 2017). Sahota *et al*. (2010) stated that many BCTs come as a 'package' rather than acting in isolation, yet notwithstanding this, Dombrowski *et al*. (2012) emphasised that programmes with more BCTs may not necessarily generate better outcomes, and instead should carefully be selected. The interaction of combined BCTs are yet to be examined.

Whilst the examination of high-quality systematic reviews and meta-analyses are fundamental to understand the efficacy of WM programmes, they tend to focus on studies of RCT design. These RCTs do not reflect real-world commissioned WM programmes that are delivered under service-level conditions[1] and constrained budgets, and therefore these estimates may be less achievable. The reviews of Altman and Wilfley (2014), Upton *et al*. (2014), and Whitlock *et al*. (2010) include non-RCT study designs within their remit; with the review of Upton *et al*. (2014) being of particular pertinence. Upton *et al.* reviewed the change in BMI SDS for all community-based, family WM programmes in the UK with published results (*n*=10). The review illustrates that the effectiveness of WM greatly differs between programmes; the change in BMI SDS (pre- to post- measurement) ranged from -0.01 units (Rudolf *et al*., 2006) to -0.18 units (Robertson *et al*., 2008). Albeit that the SHINE programme was not included in the review of Upton *et al*. (2014), a service evaluation of the psychosocial intervention demonstrated mean BMI SDS reductions of 0.19 units at 3 months, and 0.29, 0.35, and 0.41 units at 6, 9, and 12 months respectively (Nobles *et al*., 2016b). Again, although not included in the review of

[1] Service-level conditions: programmes or interventions which are not conducted for the primary purpose of research. RCTs are highly controlled, and the conditions which they are carried out do not reflect real-world practices.

Upton *et al*., (2014), in the context of Tier 4 residential WM camps, there is evidence for short and medium-term effectiveness (Gately *et al*., 2000). These differences in outcomes between WM programmes are largely attributable to the various design, dose, delivery, and contextual characteristics of the WM programmes – as detailed above.

NICE guidance not only provide information on how services can be designed, they also highlight what type of results are to be expected/should be promoted in WM programmes. As aforementioned, there is a desire for WM programmes to generate a mean reduction in BMI SDS. However, NICE recommends that childhood WM programmes should encourage weight maintenance in the short term, rather than weight loss[2]. That said, this goal may not be appropriate for those who have either stopped growing or have severe obesity (BMI SDS ≥99.6th centile); a gradual reduction in body weight of 1kg/month is recommended (Scottish Intercollegiate Guideline Network 2010, Wright and Wales, 2016, NICE, 2006). With this in mind, any programme which reports a mean maintenance in BMI SDS could be viewed as effective (for those with overweight or obesity). This is without considering the wider outcomes that families, children, and parents may value when attending a programme (e.g. self-esteem, friendships, confidence, quality of life) – this will be discussed later in this chapter.

Weight Maintenance

Although the chronic and relapsing nature of obesity in children and adults is well documented, the evidence base has been dominated by programmes seeking short-term outcomes over 3-6 months. Seldom do we see, particularly in the childhood arena, programmes that offer long-term support for weight maintenance. This is despite evidence from families that longer term support is wanted, as – after 12 weeks of intervention – many do not yet feel confident in their future WM endeavours (Nguyen *et al*., 2015; Reece *et al.,* 2015). The presence of a maintenance/follow up intervention is reliant on the design of the WM programme. Some WM programmes include a maintenance intervention (Brennan *et al.*, 2012; Nobles *et al.*, 2016b; Spence *et al.*, 2016), whilst others do not (Jensen *et al.*, 2012; Sacher *et al.*, 2010). Maintenance interventions hope to shift the attribution of outcomes from WM services to families, with self-management of obesity being the promoted strategy (Nobles *et al*., 2018). In England, the CEW clinics have been specifically funded to allow for longer term support of children and young people living with severe obesity.

That said, there is still a paucity of evidence for maintenance programmes, which is exemplified in the recent systematic review and meta-analysis of van der Heijden *et al*. (2018). The review concluded that across the 11 included studies, continued treatment does have a stabilising effect on BMI SDS. Furthermore, the review highlighted that whilst there was no evidence to recommend a certain programme dose over another, face to face interventions were preferable over virtual intervention. Perhaps due to this lack of evidence, there is minimal guidance to support the development of effective maintenance programmes. Many other reviews illustrate that the preponderance of studies / programmes are short term in nature, seldom longer than 1 year (Ells *et al.,* 2018; Kirk *et al*., 2022; O'Connor *et al.,* 2024)

Due to the study design of the SHINE article (Nobles *et al*., 2016b) – a service level evaluation – it was not included in the review of van der Heijden *et al*. (2018). However, SHINE has a carefully designed one-year maintenance programme aiming to equip families with skills for long-term WM (including

[2] Given that BMI SDS is the primary measure of effectiveness, weight (i.e. kg) does not need to change in order to evoke a reduction in BMI SDS, providing that the individual is still growing. A WM goal that promotes a reduction in weight may be counter-productive – programme effectiveness is measured based upon change in BMI SDS, whilst an individual is likely to measure their success based upon a change in weight.

mental health, social relationships, and enjoyment of physical activity). It is important to ensure that families do not become dependent on service provision (Reece *et al*., 2015), and so SHINE seeks to ensure that families internalise outcomes as a product of their own efforts. A phased approach to weight maintenance – where the intensity of support reduces over time – may be useful, particularly as van der Haijden *et al*. (2018) found no difference in outcomes between maintenance programmes of differing dose. As with other issues raised in this chapter, further research is warranted to facilitate our understanding of weight maintenance programmes.

Recent Advances and Contemporary Issues in Weight Management Provision

A Changing Policy Context in the UK

Since the last edition of this book, the UK has experienced a sea change around the prevention and management of overweight and obesity from a policy perspective. 2016 marked the publication of the first Childhood Obesity Plan in the UK whereby the UK Government set out its strategy for trying to stem, and reverse, the prevalence of overweight and obesity (UK Government, 2016a). This first plan included 14 policy items, ranging from the introduction of the UK Soft Drinks Industry Levy to the voluntary sugar reduction programme, to the enhancement of the food / nutrition labelling system. Whilst the plan made clear that it represented the first step, rather than the only step, to addressing overweight and obesity, there was no explicit mention as to how they would support the millions of young people currently living with overweight and obesity.

The Childhood Obesity Plan was subsequently updated in 2018, this time including 18 areas for action (UK Government, 2018). Only four of these spoke to tangible actions: 1) developing a trailblazer programme to showcase how LAs can tackle obesity, 2) develop resources to help LAs use their powers to tackle obesity, 3) invest £1.6 million during 2018/19 to support cycling and walking, and 4) Ofsted (who inspect and regulate services for children and young people) to develop a new inspection framework for how schools can enhance pupil health behaviours. The remaining 14 actions were focused on opening consultations and reviewing the progress made against the 2016 Childhood Obesity Plan. However, as with the 2016 plan, there was no reference to supporting young people who are living with overweight or obesity.

It was not until 2020, whereby the Childhood Obesity Plan was broadened to the Obesity Plan (i.e. now inclusive of adults), that WM services came to the fore (UK Government, 2020). This plan, which included seven items, had an explicit action to expand WM services for adults through the NHS. Simultaneously, calls were being made to Government about the need to ensure that young people, particularly those with severe or complex forms of obesity, were also supported (Select Committee, 2018). The subsequent Long Term Plan published by the NHS had a clear objective to fund specialist WM services (i.e. Tier 3) to support at least 1000 young people each year living with complications associated with obesity (NHS, 2019).

Complications from Excess Weight Clinics

As noted earlier in this chapter, specialist WM services for children living with severe or complex obesity are scarce, especially those which provide intensive and prolonged support. The publication of the NHS Long Term Plan, and the ring-fenced money, led to the establishment of the CEW clinics in England, which denotes an intentional effort to fill this service- and evidence- gap in the Obesity Care Pathway for children and young people.

The CEW clinics are unique in that they focus on the complications or co-morbidities associated with obesity to try and avoid the need for more invasive treatment (NHS England, 2023). For some, this may mean that a reduction in weight or BMI SDS is the main aim to manage their complication (e.g. hypertension, impaired fasting glucose, type 2 diabetes, or polycystic ovary syndrome) whereas for

others, it may mean addressing psychosocial issues underlying their excess weight (e.g. depression, anxiety, binge eating, or self-harm). As such, the CEW clinics – of which there are now 30 – have highly specialised multi-disciplinary teams, with the combined skills to address the mental health, physical health, and social needs of the young people. Notably, each CEW clinic has been able to adapt their approach and composition based on the needs of their patient cohort and the expertise within their team. Clinics may therefore differ in duration and intensity, the team make up, the content, the location from which it is delivered (e.g. hospital / community / home), and in their use of medical technologies to name but a few. Given the scale of the CEW programme, the number of young people anticipated to access them, and the variation in clinic designs, the programme provides a timely opportunity to build the much-needed evidence base. A comprehensive evaluation is also in place to ensure that the evidence base develops regarding the CEW services (National Institute for Health and Care Research, 2024).

Pharmacotherapy

Since the last edition, we have started to see wider utilisation of pharmaceutical products to help young people living with severe obesity. Until 2020, orlistat was the only drug approved to support children living with obesity aged 12 years or above. Now, orlistat, liraglutide, and semaglutide are approved by both the United States Food and Drug Administration (FDA) and European Medicines Agency (EMA). The FDA approved has also approved phentermine/topiramate, however due to the higher chance of adverse effects, this was not approved by the EMA (Torbahn *et al.,* 2024). These medications are generally not recommended for children younger than 12 years unless under exceptional circumstances where severe comorbidities are present (NICE, 2006; NICE, 2014).

The wider evidence base has examined the use of other medications, including metformin, sibutramine, liraglutide, and topiramate (Ells *et al.,* 2018; O'Connor *et al.,* 2024). Collectively, alongside the data included within the Cochrane Reviews (see earlier section), significant reductions in BMI SDS have been demonstrated across all pharmacological products (Ells *et al.,* 2018) with semaglutide consistently exhibiting the greatest effects in the review of O'Connor *et al.* (2024) and Torbahn *et al.* (2024).

Recommendations suggested that the evidence on younger children, those with type 2 diabetes, and on psychosocial health is urgently required (Torbahn *et al*., 2024). There is also a need for longer follow-up studies and on the use of pharmacotherapy for the maintenance of weight loss following meal replacements. It was also acknowledged that pharmacological intervention should only be considered alongside other options (e.g. behavioural intervention), that adverse events are carefully monitored (gastrointestinal discomfort, tachycardia, constipation, and hypertension are commonly noted), and that it is provided as part of a person-centred care approach (Ells *et al.,* 2018; O'Connor *et al.,* 2024; Torbahn *et al.*, 2024).

Co-designing Weight Management Services

One of the final advances that we wanted to highlight is the role of young people and families in co-designing WM services. In the last version of this book, we wrote that high attrition rates can challenge the effectiveness of WM services, and that in part, this may be because services have not been designed to meet the needs of young people. Moreover, this poses a more serious, interrelated issue that traditional WM services may inadvertently widen health inequalities. This is because those who most frequently drop out are those who experience poorer health outcomes (e.g. higher baseline BMI), for example, those who live in more deprived areas, are from diverse ethnic communities, or with additional complex needs (Birch *et al.,* 2022; Dhaliwal *et al.,* 2014; Skelton and Beech, 2010; Torbahn et al., 2024). Thus, one possible solution here is to co-design services with those members from under-served or at-risk groups (Langford *et al.,* 2024).

Co-design is a somewhat nebulous term, yet peer reviewed articles on “co-design” and “health” have increased dramatically year on year since the early 2000’s, and more so in the last decade (Fusco *et al.,* 2020). We are now seeing more and more LAs in the UK aiming to co-design their WM services. For example, whilst in the context of adult WM, we identified seven examples of co-designed services within the West of England, four of which were studied in depth (Langford *et al.,* 2024). The co-design methods very much laid along a continuum, from more light touch approaches to intensive and prolonged involvement of service users. These co-design approaches helped to shape content, focus, and modality of the services. With regards to the more in-depth co-design approach (see the Men’s Project, Langford *et al*., 2024), the service transformed from being orientated around weight to improving general health and wellbeing, and centred upon the notion of building social connectedness. This demonstrates the need for WM services to consider broader outcome measures and alternative designs, aligned to the hypotheses made in the previous edition of this chapter. One pressing challenge in the co-design field is the lack of high-quality and long-term data, and that which relates to different socio-demographic groups, including children and young people (Halvorsrud *et al.,* 2021).

One aspect of co-design that has seen significant interest, albeit that it is often done in a light touch manner, is cultural adaptation. Several studies have highlighted the importance of incorporating cultural elements into interventions for childhood obesity (Barragán *et al.,* 2022; Berge *et al.,* 2017; Falbe *et al.,* 2017). For instance, research by Berge *et al.,* (2017) emphasises the need for culturally-tailored interventions to reduce childhood obesity disparities. Similarly, Falbe *et al.,* (2017) and Barragán *et al.,* (2022) have shown that culturally tailored interventions, such as the Active and Healthy Families programme, can lead to improvements in weight status among Latino children. These interventions are designed to be family-centred and account for the specific cultural backgrounds of the target population. Understanding how cultural beliefs and practices influence lifestyle choices and health outcomes is crucial when developing interventions that resonate with diverse populations.

Creating Healthier Environments for All

It is well accepted that the wider determinants of health add to the complexity of obesity, and lay the foundations for health- and social- inequalities to exist (Dahlgren & Whitehead, 1991; Nobles *et al.*, 2019). For example, where we live, the education, health care, and employment that we have access to, and the social circles which we function within, all contribute to health outcomes – be that directly or indirectly. The National Child Measurement Programme clearly demonstrates this, whereby in the most socioeconomically deprived areas of England, the prevalence of childhood obesity is double that of the least deprived areas (NHS Digital, 2023). As such, it is important for LAs (or equivalent outside the UK) to focus on creating equitable and health promoting environments.

In some of our recent work (Nobles *et al.*, 2019), we invited ten LAs to complete an Action Mapping Tool to understand what actions were being taken locally to address obesity, and to contrast this against the causes of obesity, when viewed through Dahlgren and Whitehead’s (1991) Wider Determinants of Health model. The greatest distribution of perceived causes of obesity were focused on living and working conditions and wider conditions (60%), with only 16.4% being attributed to individual lifestyle factors (ILF). Despite this, the majority of actions taken to address obesity were interventions focusing on ILF (60%) showing a mismatch between perceived causes and the implementation of interventions in LAs. For example, we observed many LAs delivering WM services, physical activity sessions, general health improvement programmes, workplace wellbeing initiatives, and food growing projects (see Figure 5). The same analysis did reveal that LAs were, on average, taking 28 actions which denotes a significant effort to support those living with, or at risk of, overweight and obesity. This is noteworthy given that LAs do not have a *mandated* responsibility to

prevent overweight and obesity (unlike their mandated responsibility to provide smoking cessation and sexual health programmes).

The conclusions of our analysis suggest that whilst the complexity of obesity is recognised by local stakeholders, it is frequently addressed through individual level behavioural based interventions (Nobles *et al.*, 2019). Thus, this is doing little to change the environments which contribute towards overweight and obesity and the inequalities that exist therein. What we have seen though since this publication, is that many LAs are starting to take a systems approach which aims to bring together the various departments and organisations who can change the environments that people live in. These include those responsible for new housing developments, to transport infrastructure, to how town and city centres are planned, and how local businesses are regulated (Foresight, 2007, Bagnall *et al.,* 2019).

[INSERT FIGURE 5 HERE: LA ACTIONS ON OBESITY]

From Prevention *vs.* Treatment to Prevention *and* Treatment

A constant challenge in the Public Health arena is the assumed dichotomy of obesity prevention *versus* obesity treatment. Many stakeholders working in the field of obesity often end up pitching their tent in one of these two camps. From our standpoint and others, such dichotomies are unhelpful when trying to create equitable and healthier populations (Roberto *et al*., 2015). As Roberto *et al*., (2015) alludes to, there are many important insights to be seen at the intersect of these dichotomies. We cannot expect treatment programmes to be efficacious in the long-term if peoples' environments are not health promoting. Nor can we expect a preventative approach to adequately support the needs of individuals already with overweight and obesity, especially in light of the psychosocial complexities which many face. If we can meaningfully and appropriately support individuals living with obesity through holistic and person-centred care *and* simultaneously create health promoting environments, then a healthier population is more likely to occur. This health promoting environment would both support those of a healthy weight and those living with overweight and obesity.

By appreciating that obesity is a chronic and relapsing condition, and one that is influenced by myriad socioecological factors, we must view both prevention and treatment within the context of a complex adaptive system. Singular interventions – be those prevention or treatment orientated – will not influence the prevalence of obesity alone. For example, the Soft Drinks Industry Levy is unlikely to reverse the population levels of obesity, but what it may do is reduce the volume of sugar contained within soft drinks, and as such, slightly reduce population consumption of sugar.

Taking a systems approach to obesity will require the input of many stakeholders from across many sectors. Obesity is not just an issue for Public Health teams to solve; for example, Urban Planning teams can create health promoting environments, Transport teams can ensure that well connected infrastructure is in place to support active journeys, and Housing teams can provide high quality homes which are also well linked to local amenities and resources. Central to a whole systems approach is that these efforts are co-ordinated to achieve maximum effect. Our current systems are set up in a manner that promotes obesity – "Obesity is a normal response to an abnormal environment" (The Lancet, 2011) – and this needs to be altered.

As such, a systems approach can bring multiple policies, interventions and actions together in a co-ordinated manner to work across the breadth of the system that causes overweight and obesity at the population level. Thus, a systems approach would position prevention and treatment alongside each other.

Summary

Childhood obesity is one of the greatest challenges of this century. Due to the complex nature of obesity and the lack of success in reducing its prevalence, there has been little sustained action to date in the UK, albeit that this is now starting to shift. Whilst the short-term evidence of WM programmes for children with obesity is apparent, that multidisciplinary services are effective and cost effective, we are missing robust long-term data. Although many different programmes are available, we must acknowledge that WM will only ever be truly effective if implemented as part of a wider systems approach. For those wishing to implement WM in the future, it is paramount to understand the context in which their programme is implemented. It is also important to consider co-designing WM services to better, and more equitably, meet the needs of those they seek support, through a person-centred approach.

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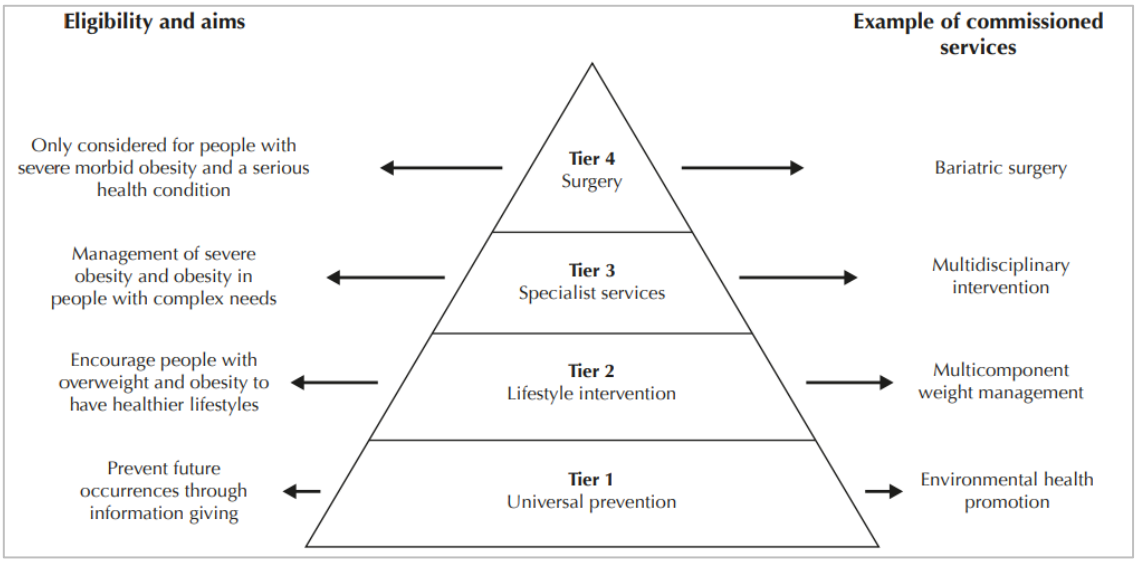
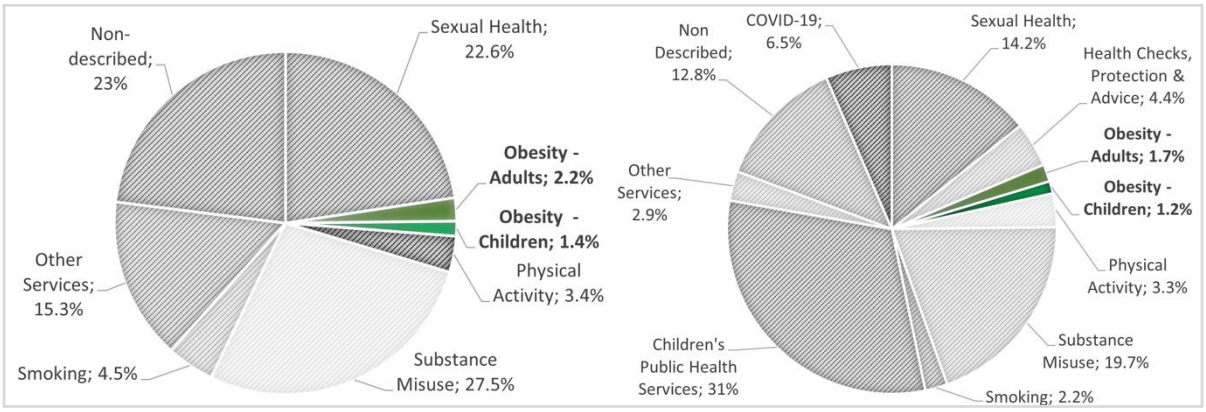
Figures

Figure 1: The Obesity Care Pathway



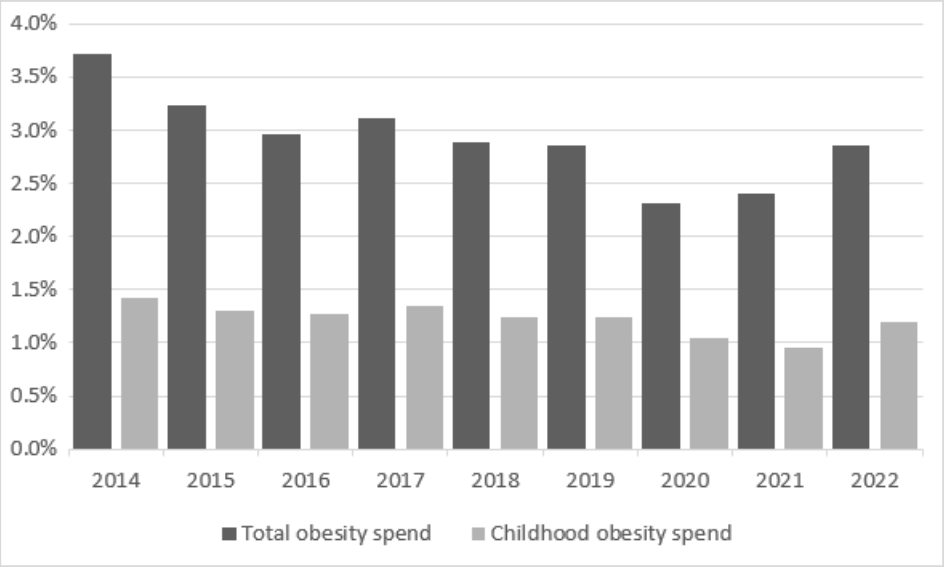
Adapted from the Department of Health and Social Care (2013)

Figure 2: Public Health Spend in England 2015/16 vs 2022/23



Calculated as a proportion of the £2.8b Public Health Grant in 2015/16 (left) and £3.8b in 2022/23 (Right) (HM Government, 2024)

Figure 3: Percentage of Public Health Grant Spent on Obesity from 2014 to 2022



Information collected from HM Government (2024)

Figure 4: Estimated Cost of Several Public Health Issues in England

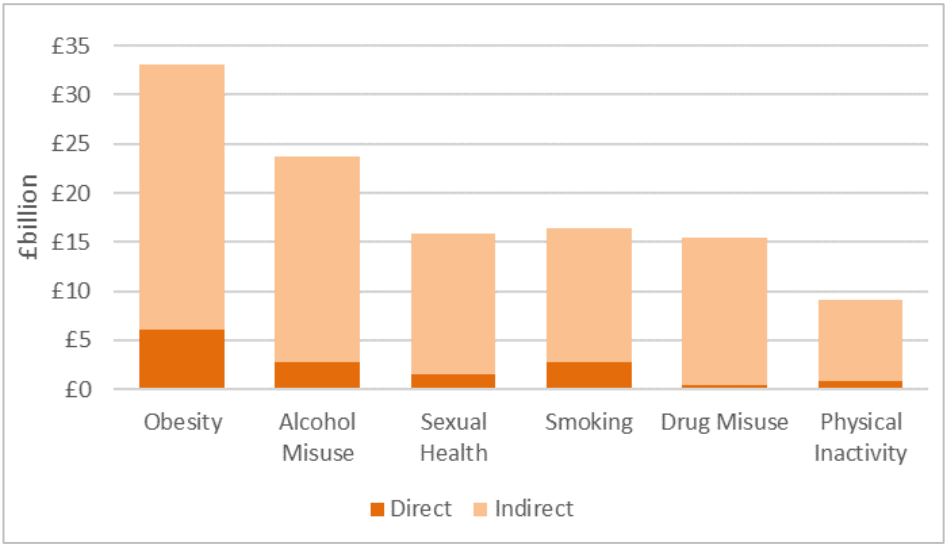


Figure 5: Actions Undertaken by 10 LAs in England to Address Obesity (Nobles *et al.,* 2019)