

Research report October 2022

Childhood obesity: is where you live important?

Elizabeth Fisher, Eilís Keeble, Charlotte Paddison,
Ronny Cheung and Dougal Hargreaves

nuffieldtrust

Acknowledgements

We would like to thank our external advisers:

- Haroon Chowdry – Director of Evidence, Children’s Commissioner for England (at the time of our research)
- Matthew Dodd – Head of Policy and Public Affairs, National Children’s Bureau
- Ann Hagell – Research Lead, Association for Young People’s Health
- Vanessa Lucas – Policy Adviser, Children’s Health, Local Government Association
- Tom McBride – Director of Evidence, Early Intervention Foundation (at the time of our research)
- Harriet Waldegrave – Senior Policy Analyst, Children’s Commissioner for England.

This work uses data provided by patients and collected by the NHS as part of their care and support. Read more at www.nuffieldtrust.org.uk/about/corporate-policies#information-security-and-data.

Hospital Episode Statistics data (year range 2015/16–2018/19).

Copyright © 2022, NHS Digital. Re-used with the permission of NHS Digital.

All rights reserved.

Find out more online at: www.nuffieldtrust.org.uk/research

Contents

	Key points	2
1	Introduction	4
2	What we did	11
3	What we found	14
4	What does this mean?	22
5	The impacts of the Covid-19 pandemic	32
6	Concluding remarks	38
	References	40

Key points

- Levels of overweight and obesity among children in England remain at harmfully elevated levels, yet despite countless policy initiatives, there has not been any improvement in recent years. Unfortunately, much of the research used to inform policy has been based on changing individual behaviour, despite the known impact of wider social and economic factors.
- This report examines how local authority characteristics are associated with childhood overweight and obesity, for both the Reception and Year 6 age groups (four- and five-year-olds, and 10- and 11-year-olds, respectively).
- Using adjusted regression models, we observe that overweight and obesity levels among children at the upper-tier local authority level in England are likely to be higher in areas where:
 - **There is more childhood poverty**
 - Local authorities with the highest percentage of children living in low-income families had, on average, 6.9% more overweight or obese Year 6 children than those with the lowest percentage.
 - Local authorities with the highest percentage of under-fives living in households in receipt of out-of-work benefits had, on average, 3.5% more overweight or obese Reception children than those with the lowest percentage.
 - **There is poorer access to places for children to engage in physical activities and where fewer adults undertake physical exercise**
 - Local authorities with the lowest percentage of adults who are active had, on average, 2.9% more overweight or obese Year 6 children than those with the highest percentage.
 - Local authorities with the highest percentage of under-fives living in areas with poor access to passive green space had, on average, 1.8% more overweight or obese Reception children than those with the lowest percentage.

- Local authorities with the lowest percentage of adults walking for leisure had, on average, 1.6% more Reception children and 1.8% more Year 6 children who were overweight or obese than those with the highest percentage.
- **There are lower breastfeeding rates**
 - Local authorities with the lowest breastfeeding rates had, on average, 1.9% more overweight or obese Reception children than those with the highest rates.
- For Year 6 children, overweight and obesity levels were more likely to be higher in areas where there was a greater percentage of the population who were from a minority ethnic background.
- Our research highlights the complexity of the pathways that lead to overweight and obesity in childhood and the importance of external societal and environmental factors, which lie outside of an individual's control, for weight outcomes. Environmental factors are particularly important for children and young people, who cannot choose the environment they grow up in.
- The results also suggest that certain populations based on their socioeconomic and demographic status are more at risk of being overweight and obese, which is compounded by the challenges they face in accessing weight management services. Targeted, culturally appropriate, responses are required to support these high-risk populations and individuals.
- The results also highlight the importance of some current and proposed policies in tackling childhood excess weight and obesity – such as food promotion strategies, the use of health impact assessments in local planning and breastfeeding promotion, that should be continued, evaluated and strengthened based on the evidence.
- The Covid-19 pandemic has impacted on the local area characteristics we have found are associated with higher levels of overweight and obesity in childhood and may do further in the future. This may have increased the risk of obesity for some children, as well as provided protection for others. The pandemic has also impacted on wider socioeconomic inequalities, which may increase inequalities in the levels of overweight and obesity in childhood.

1 Introduction

Despite numerous initiatives, there have been no improvements in the levels of childhood excess weight and obesity in England over recent years.

Much of the research used to inform policy on childhood obesity has been based on ways of changing the behaviour of individuals (National Institute for Health Research, 2021), rather than shaping external influences that lie outside of an individual's control, including local environmental characteristics. Understanding these external influences is particularly important for children, who cannot choose the environment they grow up in.

This is a hypothesis-generating piece of research looking at the associations between childhood excess weight and obesity rates and a comprehensive set of local area characteristics at the upper-tier local authority level in England, by combining and analysing publicly available data in a novel way.

Looking at influences at an area level means that policies and interventions can be developed at this level, which may lead to additional benefits for individual-level interventions, including the reduction of health inequalities (Adams and others, 2016; Ritchie and others, 2010).

Looking at this level is also timely as integrated care systems develop and have become statutory bodies (Department of Health and Social Care, 2021a). Within integrated care systems, local organisations (the NHS, local government, community health services and other partners such as the voluntary and community sector) work in partnership at the 'place' level to the benefit of the population. Understanding what local area characteristics impact on childhood obesity can help local areas to understand the different contributions that each organisation can make to improving outcomes and to work together with common goals.

It also provides a focus for local areas to monitor their own data and a new methodology that can be applied locally, for better interrogation of locally held data that might not be available nationally. This will help to build area-specific evidence to support better local decision-making.

Finally, while the analysis in Chapters 2 to 4 uses data from before the Covid-19 pandemic, in Chapter 5 we explore what impact the pandemic has had and what challenges may lie ahead.

Overweight and obesity

Determining whether a child is overweight or obese is based on their Body Mass Index (BMI). Their BMI is calculated by dividing their weight (in kilograms) by the square of their height (in metres). This is then compared to a reference sample of measurements gathered in 1990, which takes age and sex into account, to determine whether the child is underweight, a normal weight, overweight, obese or severely obese (NHS Digital, 2021a).

Terminology used in this report

In this report, where we use the term ‘excess weight’ we mean when someone is clinically defined as overweight and obese based on their BMI. When we talk about obese individuals, this includes those who are obese or severely obese.

How does being overweight and obese impact on children’s health and wellbeing?

Obesity has negative psychological, social and health consequences for children, including depression, asthma and obstructive sleep apnoea¹ (Narang and Mathew, 2012; Patalay and Hardman, 2019; Shan and others, 2020; van Geel and others, 2014). These psychological and health conditions may affect educational attainment (Cohen and others, 2013).

Also, obese children today are developing health problems that once only afflicted adults. This includes type 2 diabetes (Ehtisham and others, 2000; Hauner, 2010), the prevalence of which is increasing year on year (Royal

1 Sleep apnoea is when your breathing stops and starts while you sleep (www.nhs.uk/conditions/sleep-apnoea)

College of Paediatrics and Child Health, 2021b), and the development of cardiovascular risk factors during childhood (Craig and others, 2008).

Obese children are more likely to be obese adults (Simmonds and others, 2016). This increases their risk of several non-communicable diseases, with indications that obesity is related to at least 18 co-morbidities (Djalalinia and others, 2015).

With these health problems having an earlier onset and a more prolonged course, some of which may remain undiagnosed until adulthood, the resulting complications may be more severe and lead to shorter life expectancy and a lower quality of life than for previous generations (Reilly and Kelly, 2011).

The Royal College of Paediatrics and Child Health (Royal College of Paediatrics and Child Health, 2021c) found that 31% of its surveyed members thought that, by 2040, obesity would be the biggest health issue affecting children and young people, the second biggest issue after mental health problems.

Obese parents are more likely to have obese children (NHS Digital, 2020a) and since obese children are more likely to become obese adults, this perpetuates the cycle, with the potential to cause intergenerational obesity over many generations and widening inequalities.

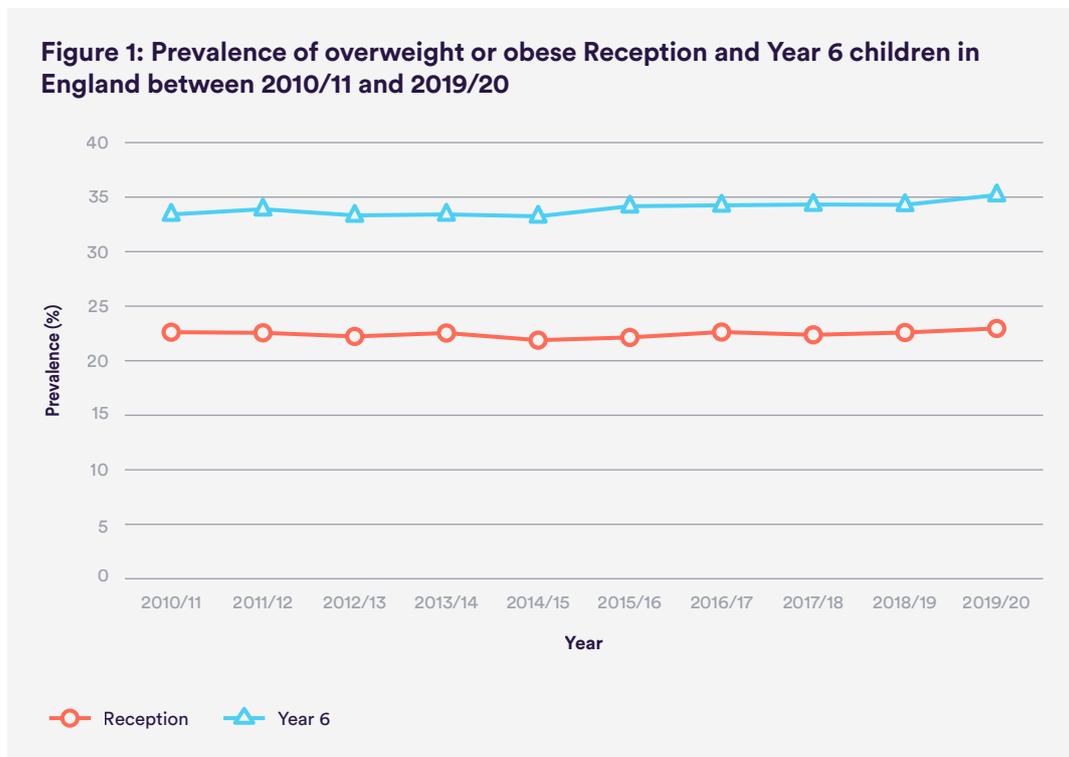
As well as these individual-level impacts, there are also economic costs related to obesity. One estimate puts the cost of obesity in the current population of children at £74 billion for the NHS and £405 billion for wider society over the course of their lifetime (Hochlaf and Thomas, 2020). Local authorities spend an additional £61.7 million each year² on childhood obesity (National Audit Office, 2020).

Given all the above, maintaining a healthy weight through childhood is critical for the short, medium- and long-term health of today's children.

2 Based on 2018/19 figures.

How well did England do before the Covid-19 pandemic?

Using data from the National Child Measurement Programme (NCMP) (NHS Digital, 2021a), we can see that in the 2019/20 school year³ there were 52,319 (13%) Reception children who were overweight and 39,404 (10%) who were obese. For Year 6 children, there were 69,469 (14%) children who were overweight and 103,362 (21%) who were obese. These levels have remained relatively stable over time (see Figure 1).



Source: NHS Digital, 2021a.

There is a strong association between deprivation and obesity in children (QualityWatch, 2021). Trends in England show that this inequality was widening over time before the pandemic, with levels of obesity in children

³ Data collection for the 2019/20 school year ended in March 2020 when schools closed as part of lockdown measures during the Covid-19 pandemic. However, analysis has found that national results are directly comparable to earlier years (NHS Digital, 2020b).

living in the most deprived areas growing faster than levels among those living in the least deprived areas (where obesity prevalence has remained fairly constant).

Looking at comparisons internationally, the UK as a whole does not do well and it has a considerably higher proportion of overweight or obese children and young people than the average among developed countries (Cheung, 2018; Public Health England, 2016).

The policy landscape in England

There are four weight management service tiers in England, which cover:

- universal interventions, which focus on prevention (Tier 1)
- individual weight management services (Tier 2)
- specialist weight management services (Tier 3)
- pharmacological or surgical treatments (Tier 4).

Local authorities are responsible for commissioning Tiers 1 and 2, while clinical commissioning groups were responsible for commissioning Tiers 3 and 4 (Various, 2014).⁴ While these services have an important role to play in helping children maintaining a healthy weight, they are only part of the solution.

Figure 2 details the operational and policy landscape in relation to how childhood obesity has developed over recent years. Although it is positive that there has been this focus, it is not without criticism.

The NHS Long Term Plan promises a targeted offer of individual support in primary care (NHS, 2019b). Who this is offered to is based on a set of criteria,⁵ but it is less likely that children will meet the criteria than adults and so they are less likely to receive this support. Additionally, the plan's offer specifically

4 On 1 July 2022, integrated care systems (ICSs) became legally established through the Health and Care Act 2022, and CCGs were closed down.

5 Access to weight management services in primary care is for people with a diagnosis of type 2 diabetes or hypertension and with a BMI of 30+.

for children is to treat the complications arising from obesity rather than deal with the root cause of it.

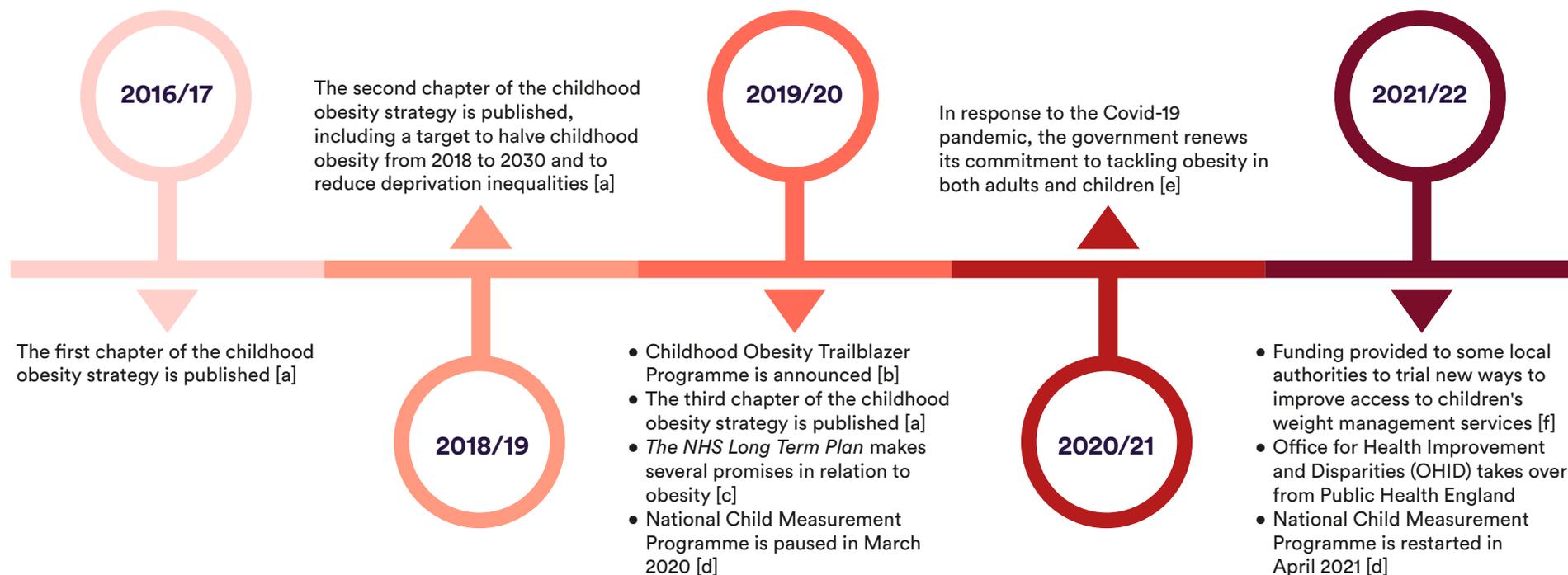
In relation to the national obesity strategy, which launched with the first chapter in 2016/17 and two subsequent chapters in 2018/19 and 2019/20, the National Audit Office concludes that while the strategy's interventions seem to be in the right area, there is limited evidence that they reduce obesity (National Audit Office, 2020). Many have also highlighted that the strategy does not do enough to deal with the complexity of obesity, that it does not understand that a 'one size fits all' approach does not work, it does not go far enough to address inequalities in obesity and that it might actually fuel these further (Corfe and Shepherd, 2020; Nature, 2020; Nield and Paxman, 2020).

The success of the strategy so far has been mixed. For example, the introduction of the Soft Drinks Industry Levy (SDIL) resulted in a decrease in the sugar content of soft drinks but non-mandatory requirements to decrease the amount of sugar in other food products have not had the same level of success (Public Health England, 2019b).

Despite this criticism and mixed success, the aims of the strategy are well intended. However, parts of the strategy that were due to be implemented have been delayed and more recently, it has been widely reported that the new government may review the obesity strategy.

There have also been non-obesity-related policies that have impacted on the ability to tackle obesity. For example, big funding cuts to local authority budgets (Harris and others, 2019) coincided with a 11% decrease in local authorities' spend on childhood obesity services between 2016/17 and 2018/19 (National Audit Office, 2020).

Figure 2: Timeline of recent policy and operational developments in relation to childhood obesity (only showing years where significant activity took place)



Sources: [a] (National Audit Office, 2020); [b] (Department for Health and Social Care, 2019); [c] (NHS, 2019b); [d] NHS Digital (2021b); [e] (Department for Health and Social Care, 2020); [f] (Department of Health and Social Care, 2021b).

2 What we did

Rapid literature review

We took a ‘review of reviews’ approach to identify peer-reviewed publications relating to childhood obesity and to environmental factors such as the nature of children’s neighbourhoods and communities. We also identified literature that discussed conceptual models for early childhood development. From these, we identified local area characteristics that either hypothetically influence, or have previously been shown to be associated with, childhood obesity. Further details are available in the technical annex to this report.

Statistical analysis

We sourced data at upper-tier local authority level in England⁶ to represent the characteristics found in the literature. Details of all the local authority characteristics used are shown in Tables 4 and 5 of the technical annex.

We used data on the prevalence of overweight and obese children in Reception and Year 6 in 2018/19 from the National Child Measurement Programme as outcome measures. These were normally distributed, and so we used linear regression modelling to assess the level of association between the local authority characteristics identified and the prevalence of childhood obesity in Reception and Year 6 children.

6 Where not already done so in the raw data, we combined data for the Isles of Scilly with Cornwall, and data for the City of London with Hackney, to deal with low numbers in these smaller local authorities, resulting in 150 upper-tier local authorities in England.

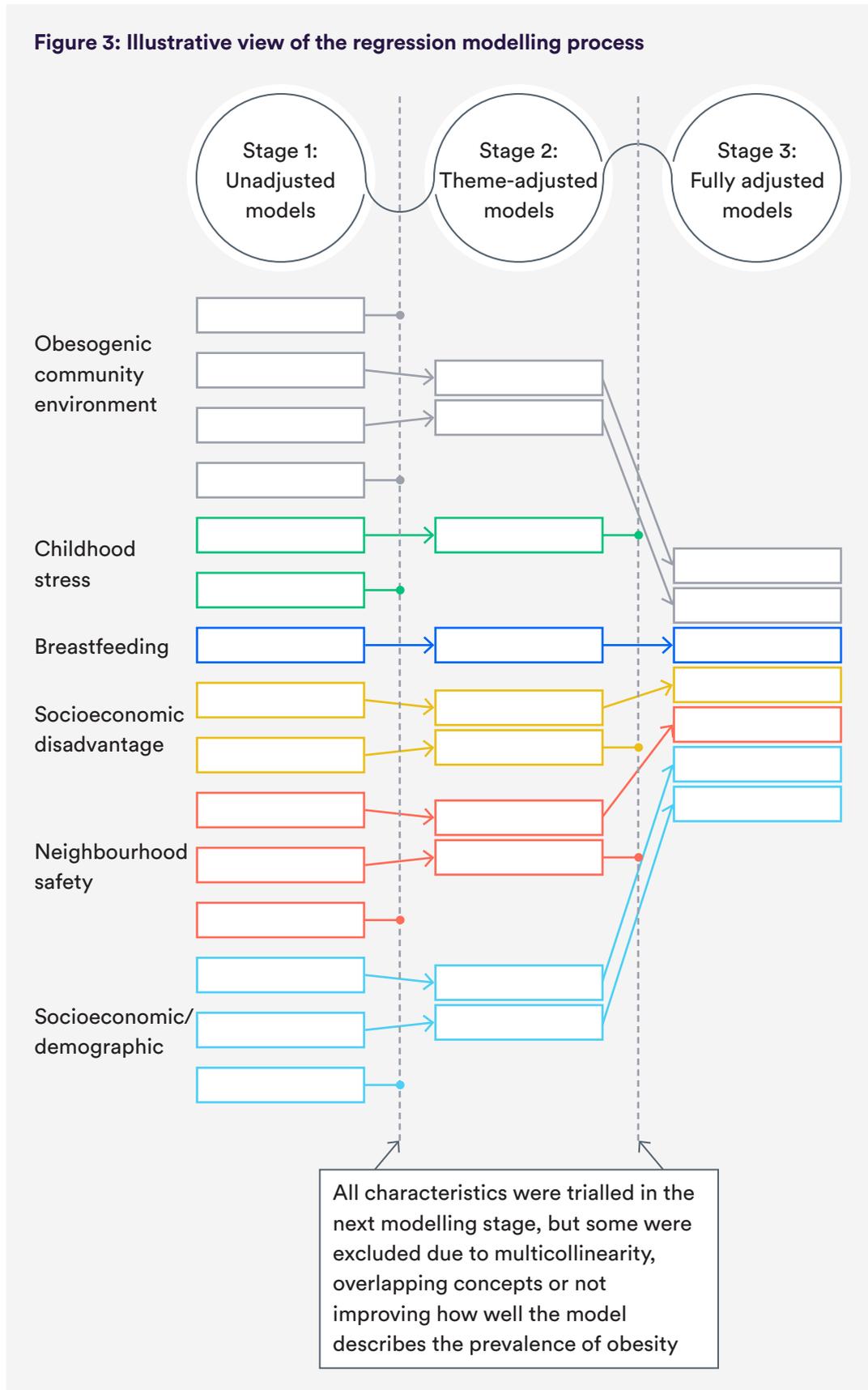
The statistical analysis involved three stages:

- 1 We ran simple models exploring the associations between each individual characteristic and the variation in childhood obesity.
- 2 We grouped the characteristics from the simple associations according to their broad themes (obesogenic community environment, childhood stress, neighbourhood safety and so on) and ran them as multiple regressions to identify the characteristics within each theme that best explained the variation in childhood obesity.
- 3 We ran an overall model using the factors from the second stage that best explained – in statistical terms at least – the variation in childhood obesity observed across local authorities.

Figure 3 is an illustrative view of the regression modelling process, further details of which can be found in the technical annex.

The next chapter details the results of the rapid literature review and the analyses we conducted. We discussed these with experts in childhood policy and practice to help understand the findings.

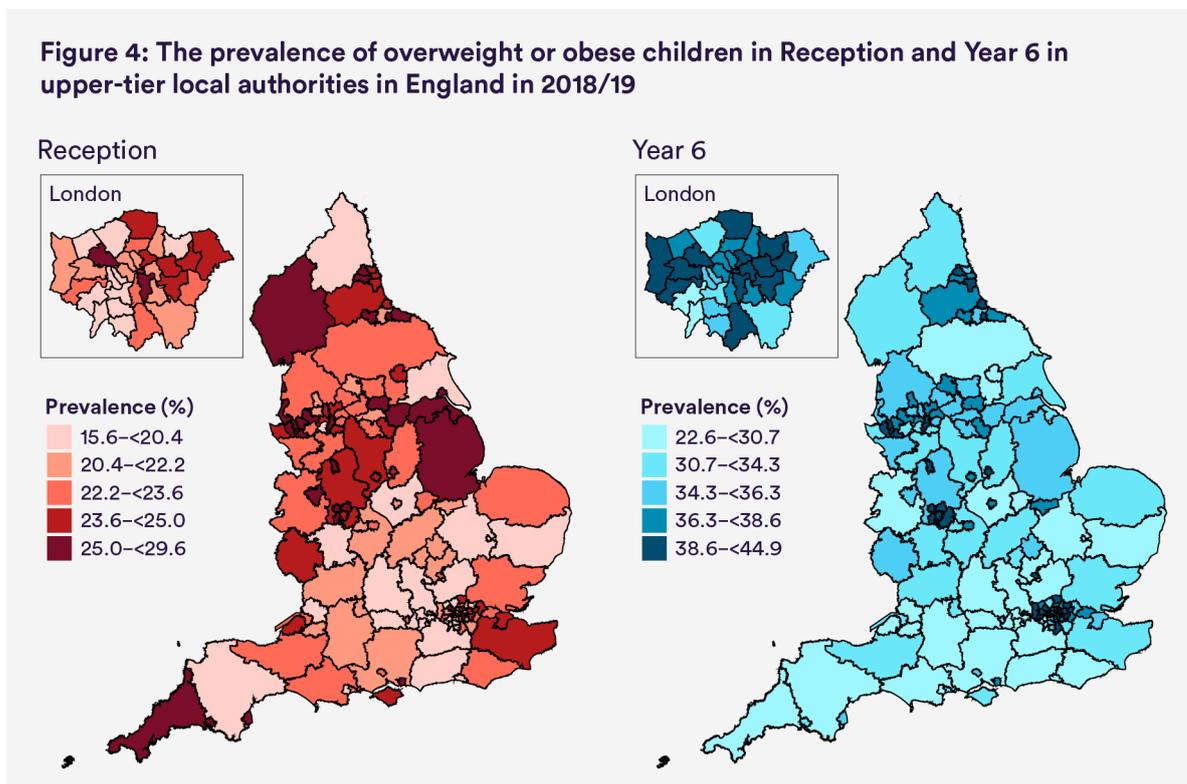
Figure 3: Illustrative view of the regression modelling process



3 What we found

Childhood overweight and obesity prevalence

In 2018/19, 22.6% of Reception children and 34.3% of Year 6 children were overweight or obese in England. This varied between local authorities, particularly for Year 6 children (see Figure 4). The prevalence of overweight or obese Reception children ranged from 15.6% in Kingston-upon-Thames to 29.7% in Knowsley, while for Year 6 children, prevalence ranged from 22.6% in Richmond-upon-Thames to 44.9% in Barking and Dagenham.



Source: National Child Measurement Programme, NHS Digital.

Findings from the rapid literature review

In total, 16 articles were included in a full-text review, covering a wide variety of issues related to childhood obesity. Some common themes along with measures for each theme emerged, which we used to guide the sourcing of quantitative data (see Table 1). Further information on the review process can be found in the technical annex. Full details on the measures, data sources and years for which the data were available are shown in Tables 4 and 5 in the technical annex.

Table 1: Themes and suggested measures identified from the literature review

Theme	Suggested measures
Obesogenic community environment	<ul style="list-style-type: none"> • Convenience foods • Retail environment • Neighbourhood walkability • Public recreation opportunities
Home environment	<ul style="list-style-type: none"> • Shared family meals • Sedentary relaxation and entertainment
Childhood stress	<ul style="list-style-type: none"> • Adverse childhood experiences
Breastfeeding	<ul style="list-style-type: none"> • Breastfeeding at various infant ages
Socioeconomic disadvantage	<ul style="list-style-type: none"> • Maternal depression • Poorer individual diet • Family food routines
Obesogenic characteristics of the early years childcare environment	<ul style="list-style-type: none"> • Environment for early years car
Neighbourhood safety	<ul style="list-style-type: none"> • Crime • Road safety

Findings from the statistical data analyses

The statistical analysis aimed to explain the variation in the prevalence of overweight or obese children across local authorities in England, using local area characteristics associated with childhood obesity as suggested in the literature. We included an additional theme in the statistical analysis, looking at socioeconomic and demographic measures, since there are known inequalities in childhood obesity relating to deprivation and ethnicity. We carried out two separate analyses – one for Reception children and one for Year 6 children.

The first stage of the analysis examined the association between the prevalence of overweight and obese children for each age group and each characteristic individually (for further details, see Tables 6 and 7 in the technical annex). This revealed that, for Reception children, various measures of child poverty explain a large part of the variation in the prevalence of overweight and obese children, with the percentage of children aged under five living in households in receipt of out-of-work benefits explaining more than half of the variation.

Similarly, for Year 6 children, child poverty was a key factor – the percentage of children in low-income families explained around 70% of the variation in the prevalence of overweight and obese children. Local authority characteristics related to the obesogenic community environment – such as the percentage of adults walking for leisure – also explained a high proportion of the variation (> 50%).

While associations between single characteristics and childhood obesity are interesting, we also wanted to know how each of the themes explained the variation in childhood obesity across local authorities. We found that the characteristics from the socioeconomic/demographic and obesogenic community environment themes were the most important for explaining variation across local authorities for both age groups, with the socioeconomic/demographic theme explaining 57% of the variation in Reception children's excess weight and obesity and 78% of the variation in Year 6 children (see Table 2).

Table 2: Theme-adjusted proportion of the variation in childhood excess weight and obesity explained by each theme

Theme	Reception	Year 6
Socioeconomic/demographic	57%	78%
Obesogenic community environment	50%	73%
Breastfeeding	28%	–
Neighbourhood safety	19%	48%
Childhood stress	11%	12%
Socioeconomic disadvantage	3%	24%

Note: The combination of local authority characteristics that represented each theme differed by age group (see Tables 6 and 7 in the technical annex).

Finally, we wanted to know which local authority characteristics were most important when looking at characteristics from across all the themes. Therefore, the final stage of the analysis brought together the remaining explanatory factors from each theme to find the best model to explain variations in childhood obesity for both age groups.

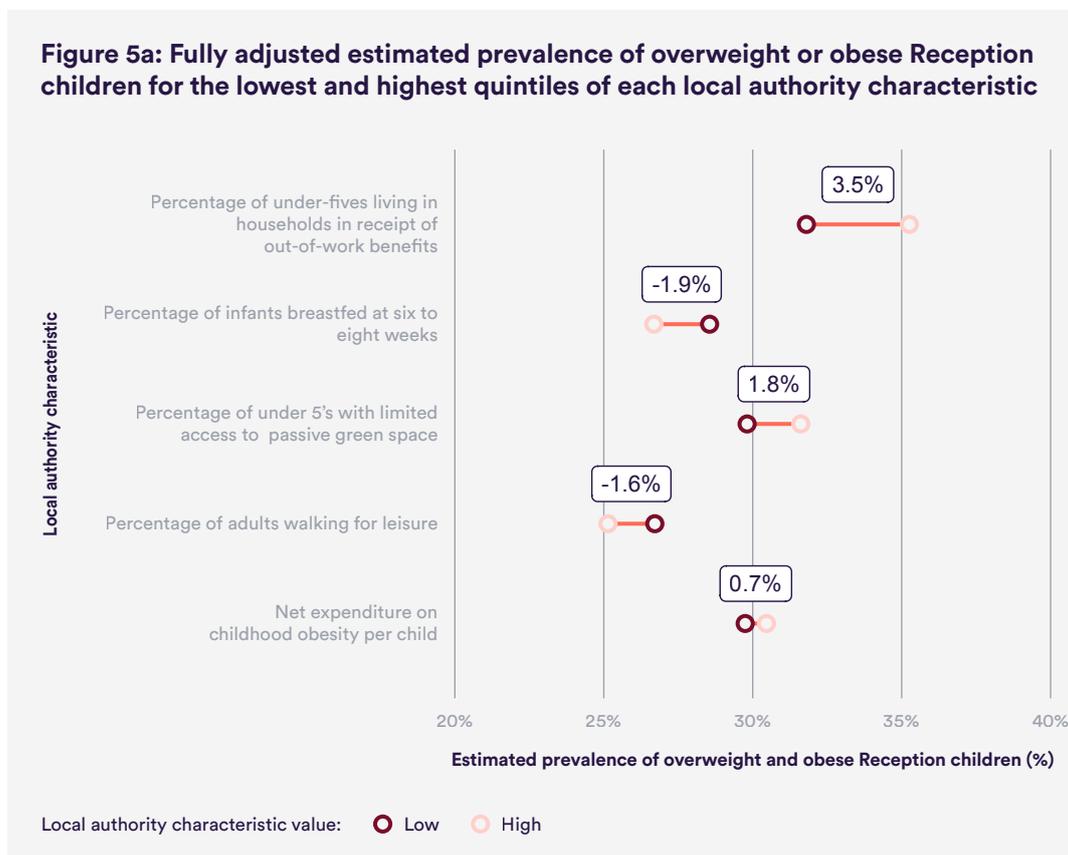
For Reception children, 11 local authority characteristics explained 63% of the variation in the prevalence of overweight and obesity, of which five were statistically significant (see Table 8 in the technical annex). The model indicated that local authorities with a higher prevalence of overweight and obese Reception children had on average:

- a higher percentage of under-fives living in households in receipt of out-of-work benefits
- a lower percentage of infants breastfed at six to eight weeks after birth
- a higher percentage of under-fives living in areas with poor access to passive green space⁷

⁷ Passive green space includes public parks, gardens, playing fields, golf courses, allotments or community growing spaces and cemeteries. It excludes play spaces, bowling greens, tennis courts and religious grounds because these areas are not considered to enhance the ‘green’ environment, often being behind fences etc.

- a lower percentage of adults walking for leisure
- a higher local authority net expenditure on obesity among children.

All other things being equal, the model predicted that local authorities with the highest percentage of under-fives living in households in receipt of out-of-work benefits had, on average, an estimated 3.5% more Reception children who were overweight or obese compared with local authorities with the lowest percentage (see Figure 5a).⁸ This characteristic also explained the majority (54%) of the variation across local authorities (see Table 9 in the technical annex).



8 We calculated this by using the regression model to estimate the prevalence of overweight and obese children when the average value from the fifth of local authorities with highest percentage of under fives living in households in receipt of out-of-work benefits is used (25.4%), which leads to an estimated prevalence of 35.3%. This is compared to the estimated prevalence when the average value from the fifth of local authorities with the lowest percentage is used (9.5%) which gives an estimated prevalence of 31.8%.

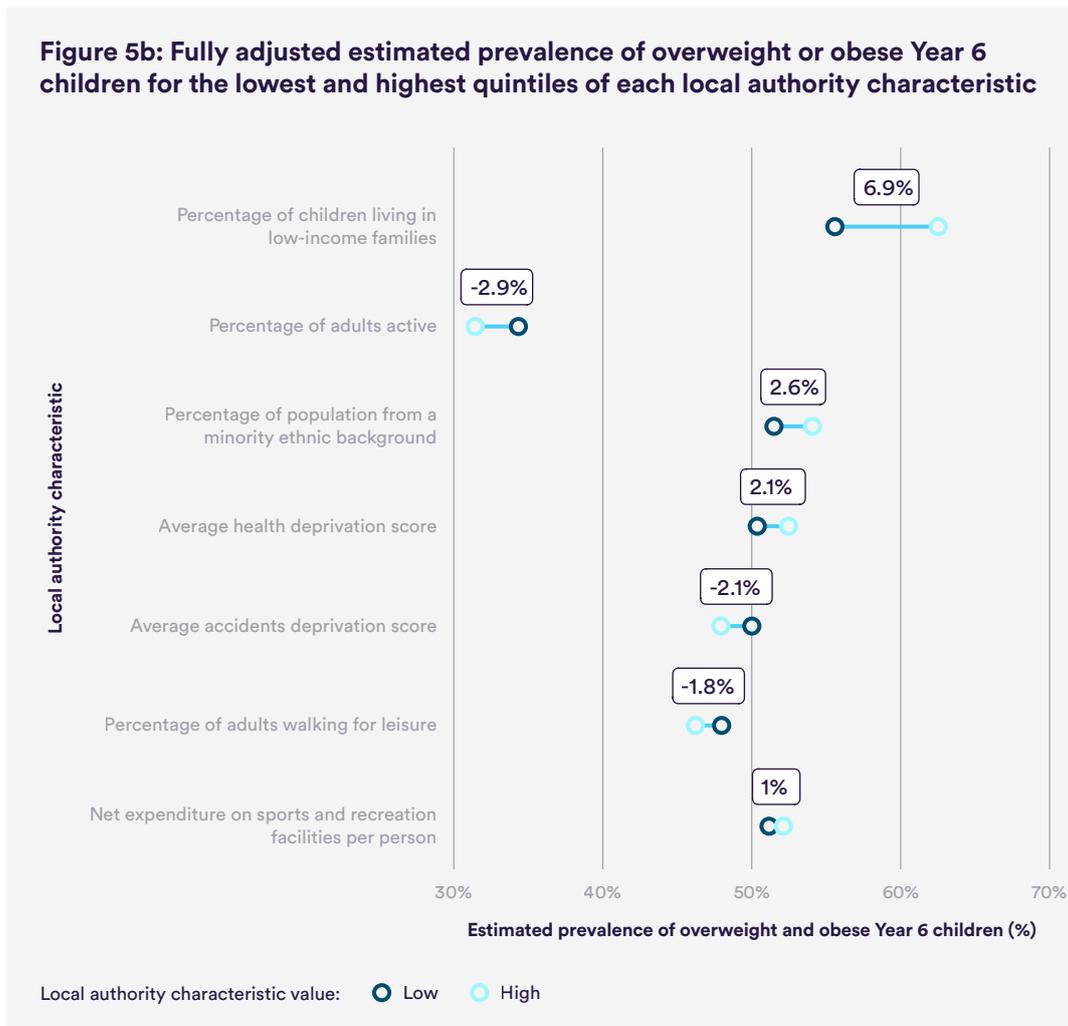
For Year 6 children, nine local authority characteristics explained 84% of the variation in excess weight and obesity, of which seven⁹ were statistically significant (see Table 10 in the technical annex). The model indicated that local authorities with a higher prevalence of overweight and obese Year 6 children had on average:

- a higher percentage of children and young people living in low-income families
- a lower percentage of active adults
- a lower percentage of adults walking for leisure
- a smaller deprivation score for road traffic accidents involving pedestrians and cyclists, that is, they had fewer road traffic accidents involving pedestrians and cyclists
- a higher percentage of the population from a minority ethnic background
- a higher health deprivation score
- a higher local authority net expenditure on sports and recreation facilities.

All other things being equal, the model estimated that local authorities with the highest percentage of children living in low-income families had, on average, an estimated 6.9% more Year 6 children who were overweight or obese compared with local authorities with the lowest percentage

9 The proportion of the population living in areas with the worst adult skills deprivation score from the Index of Multiple Deprivation was additionally significant when 10 influential local authorities were excluded from the model.

(see Figure 5b).¹⁰ This characteristic also explained the majority (69%) of the variation, with small contributions from some of the characteristics relating to the obesogenic community environment (11%) (see Table 11 in the technical annex).



10 We calculated this by using the regression model to estimate the prevalence of overweight and obese children when the average value from the fifth of local authorities with the highest percentage of children living in low-income families is used (32%), which leads to an estimated prevalence of 62.5%. This is compared to the estimated prevalence when the average value from the fifth of local authorities with the lowest percentage is used (12%) which gives an estimated prevalence of 55.6%.

Our analysis also shows that for many of the local area characteristics that explained most of the variation in the prevalence of childhood overweight and obesity in the fully adjusted models, there were stark differences between the worst- and best-performing local authorities.

For example, the average value from the fifth of local authorities with the highest percentage of under-fives living in households in receipt of out-of-work benefits was 25.4%, compared with only 9.5% for the fifth of local authorities with the lowest percentage.

Similarly, on average, 32% of children in the fifth worst-performing local authorities were living in low-income families, whereas in the fifth best-performing local authorities, only 12% were.

Tables 12 and 13 in the technical annex give an indication of the distributions for the local area characteristics that explained most of the variation in the prevalence of overweight and obesity in the fully adjusted Reception and Year 6 models respectively.

The results of these regression models need to be interpreted carefully, particularly from a policy point of view. While some local area characteristics that are positively associated with lower levels of excess weight and obesity – such as access to green spaces – make intuitive sense, others do not, such as the positive association between public health spending and levels of obesity. The next chapter unpicks these results further.

4 What does this mean?

The sheer number of unadjusted associations we found between overweight and obesity levels and local area characteristics indicates the complexity of excess weight and obesity in children. This means that there is unlikely to be a silver bullet when looking to improve outcomes and many things will need to be considered and acted upon. Because of this, those who can bring about change may see it as something that is too difficult to tackle, not knowing where best to focus activity or who is best placed to act. However, the results of our adjusted models, which considered the effects of various local authority measures, show that there are a few local area characteristics that best explain the variation in outcomes across England. This provides a focus, highlighting those that might be the most useful to further explore, research and target.

In this chapter we discuss the specific local area characteristics found to be significant in our analysis, looking at why the associations may exist.

Breastfeeding (prevalence at six to eight weeks after birth)

At an individual level, evidence suggests that breastfeeding is associated with a decrease in the risk of obesity (Rito and others, 2019). This may be through a better ability to regulate food intake (Li and others, 2010) and/or because of a delay in the introduction of formula milk and/or solids (Mannan, 2018). Our results indicate that this association holds at a population level for Reception children, with levels of excess weight and obesity being associated with levels of breastfeeding at six to eight weeks after birth.

The current UK policy is to promote exclusive breastfeeding for the first six months of an infant's life, and mothers and families can get support from the NHS to initiate and continue breastfeeding from midwives, health visitors and trained local volunteers, as well as support from charities (NHS, 2019a).

However, the UK has one of the lowest breastfeeding rates in international comparisons (Royal College of Paediatrics and Child Health, 2021a). In 2018/19 in England, only 48% of infants were totally or partially breastfed at six to eight weeks, and there was huge variation across the country, with rates of prevalence at the local authority level ranging between 23% and 79% (Public Health England, 2021a).

The NHS (2019b), in *The NHS Long Term Plan*, recognised this and said that all maternity services that did not already deliver an accredited, evidence-based infant feeding programme, such as the UNICEF Baby Friendly Initiative, would begin the accreditation process in 2019/20. However, data on progress with accreditation are not publicly available, and it is not clear how services are being supported to achieve accreditation.

Beyond health care provision, there are many determinants of breastfeeding and barriers operate in different ways and at different times, affecting breastfeeding decisions (Rollins and others, 2016). Yet there are many evidenced-based interventions at various levels to improve breastfeeding practices (McFadden and others, 2017; Rollins and others, 2016). And government in all policy and legislation areas, such as those relating to work, can also support breastfeeding.

There is an opportunity also for integrated care systems to collectively review the evidence around barriers to breastfeeding and determine what their local challenges are. From this they can develop a joint strategy and work using the appropriate evidence-based interventions to improve breastfeeding prevalence and duration locally.

Breastfeeding also follows socioeconomic and demographic gradients (see the last section in this chapter), including those of age, ethnicity and deprivation (Oakley and others, 2013). The last of these may explain some of the deprivation inequalities we see in obesity at Reception age. These findings need to be considered when determining what the local barriers to breastfeeding are and developing interventions. This requires the involvement of community stakeholders and should be part of a whole-systems approach to tackling obesity (Public Health England, 2019a).

Finally in this section, in our research we were only able to find data on breastfeeding prevalence at six to eight weeks. To better inform policy, a greater understanding of the associations between breastfeeding and childhood excess weight and obesity is needed. This will require more data on breastfeeding, including at longer durations, and how babies are fed.

Expenditure on helping people maintain a healthy weight

Our adjusted modelling identified two measures relating to expenditure on services that could potentially support people to maintain a healthy weight that were associated with childhood excess weight and obesity.

For Reception children this was local authority net expenditure on obesity per head (aged under 18) and for Year 6 children this was local authority net expenditure on sports and recreation facilities per head.

Our hypothesis was that higher levels of spending would have a positive impact and so would be associated with lower levels of overweight and obese children. However, the results were counterintuitive in that where there was greater spend, this was associated with higher levels of overweight and obesity.

This may be because in local authorities where there is a greater need to support people to maintain a healthy weight, more is spent in these areas to help tackle the problem.

Access to recreation opportunities and levels of physical activity

A common thread across a few of the local area characteristics we identified in our adjusted models was access to recreation opportunities and levels of physical activity.

Interestingly, our modelling showed positive associations between measures representing adult physical activity and childhood weight. Although it does not determine causality, this suggests that family influence plays a part in childhood weight, through providing role models and/or encouraging a healthy lifestyle for children. We did not find any associations between childhood excess weight and obesity and our measures on childhood physical activity, as the data were limited.

Another way this might have an effect is through the fact that obese mothers are more likely to have obese children (Heslehurst and others, 2019; Yu and others, 2013). Therefore, if women of childbearing age are active, they are at less risk of obesity and therefore less likely to have an obese child.

Specifically, for the adults walking for leisure characteristic, it might be that the association is not just a function of adults walking since our modelling did not find associations with the other adult walking characteristics (walking for travel or for utility) we analysed. It might be because when adults are taking walks for leisure then their children will be out walking with them too, particularly those who are of walking age and before they have enough independence not to join in, and they would be less likely to be on the other types of adult walks.

For the association between access to passive green space for children under five years old and lower levels of excess weight and obesity in Reception children, this might be because it provides more opportunities for these children to engage in physical activities such as walking, cycling and playing (Grigsby-Toussaint and others, 2011).

This is observed in adults too – perceived access to green space is associated with the probability of reporting being active and its use is associated with a lower risk of obesity (Hillsdon, 2011). However, we acknowledge that a reverse relationship could be in play – those who are more physically active choose to live nearer to green space and use it more. So, our finding for Reception children in terms of passive green space might also be a function of the adult's physical activity, as discussed above.

A systematic review into green space and obesity highlighted that studies have found evidence that relationships between weight status and green space

vary by socioeconomic status (Lachowycz and Jones, 2011), which might be a driver of the deprivation inequality for obesity in Reception children.

The same relationship between passive green space and levels of excess weight and obesity was not observed in the fully adjusted model for Year 6 children, despite studies at the individual level for children of similar ages or older showing associations between both physical activity (Lachowycz and others, 2012) and obesity (Dadvand and others, 2014).

An absence of an association in our modelling does not mean that it is not important. It might be that the effect sizes at the individual level were not great enough to translate to the population level when factoring in the other local area characteristics. Additionally, Natural England found for adults that only reported green space use, not reported ease of access, was related to excess weight and obesity (Hillsdon, 2011). So, it might be that access is a proxy measure for green space use in Reception children, but it is not a good-enough proxy for Year 6 children.

From our literature review we identified that neighbourhood safety can play a role in childhood obesity. The hypothesis is that where places are, or are perceived to be, unsafe in any way, children are less likely to be outside of the home, reducing their opportunities to undertake physical activity and increasing their risk of overweight and obesity.

However, our finding that higher levels of road traffic accidents involving pedestrians and cyclists in an area (that is, an unsafe environment) are associated with less excess weight and obesity in Year 6 children is counterintuitive to this. In this case, the association we found may be because when children are outside playing, walking and cycling, this helps them maintain a healthy weight, but they are at an increased risk of being involved in a road traffic accident.

The fact that we did not find this association with Reception children may be down to the fact that children of that age are more likely to be with an adult near traffic than Year 6 children, and therefore have a responsible individual to help them with road safety, lowering their risk of being involved in road traffic accidents while out undertaking physical activity.

These results suggest that providing the child and adult population the opportunity for recreational activity in safe and accessible spaces would be an important public health initiative to promote physical activity and tackle the elevated levels of childhood excess weight and obesity.

Where there is a lack of opportunities to undertake recreational and physical activity, it might be difficult to create new spaces or improve existing areas due to competing demands for land use in local areas and budgetary constraints. However, a focus on health in all planning, using a health impact assessment (Public Health England, 2020b), can lead to the development of safe and accessible spaces that promote physical activity, as well as maintaining a focus on health inequalities.

The NHS can also facilitate both adults and children to undertake recreational and physical activities using social prescribing.¹¹

Socioeconomic and demographic characteristics

Child poverty

In our adjusted models, higher levels of excess weight and obesity in Reception children were associated with higher levels of children under five living in households in receipt of out-of-work benefits. For Year 6 children, a similar association was seen among children in low-income families. This suggests that population-level child poverty plays a role in population levels of childhood excess weight and obesity.

Child poverty and physical activity are related. Access to green space and opportunities to undertake recreational activities follow a socioeconomic gradient (Lachowycz and Jones, 2011) and levels of sedentary behaviour are greater in children of lower socioeconomic status (Brodersen and

11 Social prescribing is a way for local agencies to refer people to a link worker. Link workers give people time, focusing on ‘what matters to me’ and taking a holistic approach to people’s health and wellbeing. They connect people to community groups and statutory services for practical and emotional support.

others, 2007). Socioeconomic inequalities have been observed in children’s participation in organised sport (Wijtzes and others, 2014), with frequently reported barriers to access including economic and time costs (Somerset and Hoare, 2018).

Diet may also be a factor in how child poverty influences weight, as the price of food and drink is undoubtedly a key component in the decisions that low-income families make about what to buy. The National Diet and Nutrition Survey shows that with rising income, individuals of all ages tend to eat more fruit and vegetables and drink fewer sugar-sweetened beverages (Public Health England, 2021c).

Healthy goods are more expensive than less healthy ones, with a growing gap between them, due to the costs of healthier items rising faster (Jones and others, 2014). A report by The Food Foundation (2021b) found that the poorest fifth of UK households have to spend 40% of their disposable income to meet the NHS’s Eatwell Guide costs¹² compared with 7% of the richest fifth.

Also, food and drink price promotions, which make products cheaper, are more likely to be used for unhealthy food and drinks and they have been shown to make people buy unhealthy food and drink items, and more of them (Public Health England, 2015).

In addition to costs influencing access to healthy food, limited physical access to healthy food or good access to unhealthy food may also be contributing to these associations. ‘Food deserts’ are places where poor public transport and lack of shopping options make it more difficult to access healthy affordable food and drink. These areas may be linked to higher levels of population-level child poverty (Corfe, 2018). Although we did not find an association between fast-food density and child excess weight and obesity in the fully adjusted models, it was significant in the unadjusted and theme-adjusted models (see Tables 6 and 7 in the technical annex). This has also been observed in Wales (Beynon and others, 2020) and more deprived areas are more likely to have a higher density (Public Health England, 2018).

12 The Eatwell Guide shows how much of what we eat overall should come from each food group to achieve a healthy, balanced diet.

Population health deprivation

The Health Deprivation and Disability Domain of the English Indices of Deprivation measures the risk of premature death and the impairment of quality of life through poor physical or mental health (Noble and others, 2019). The domain measures morbidity, disability and premature mortality but not aspects of behaviour or the environment that may be predictive of future health deprivation.

We observed that Year 6 children were less likely to be overweight and obese in areas where there was lower health deprivation. This association may be reflective of the other associations we found, such as between levels of overweight and obesity and the ability to make healthy choices or the proportion of the population who are active.

Ethnicity

Areas where there was a greater percentage of the population from minority ethnic backgrounds were more likely to have higher levels of Year 6 children who were overweight or obese.

Barriers for some children of black, Asian and minority ethnic backgrounds to undertake physical exercise include: cultural differences, where education is prioritised over physical activity; and different beliefs, when there is a lack of culturally appropriate opportunities for girls (Trigwell and others, 2015). Additionally, individuals of black, Asian and minority ethnic origin are more than twice as likely as a white person to live in areas in England that are most deprived of green space (Friends of the Earth, 2020). Consequently, several studies have shown that at an individual level, some black, Asian and minority ethnic populations are more likely to be less active and more sedentary than their white counterparts (Brodersen and others, 2007; Love and others, 2019).

There is also a crossover between ethnicity and child poverty, as the rate of poverty is higher in black, Asian and minority ethnic families than in other families and they are more likely to be in persistent poverty (Social Metrics Commission, 2020). So, some of the ways in which ethnicity influences weight status in children may be through their economic status.

Also, despite the NHS providing universal services, black, Asian and minority ethnic populations face challenges in accessing health care, including communication, patient knowledge, and cultural, organisational and structural barriers (Szczepura, 2005). This may also be the case for weight management services for children and therefore they may be less able to access help for their excess weight and obesity.

Discussion

All these results suggest that, for children, maintaining a healthy weight is dependent on wider societal factors that influence their ability to undertake physical activity and have a healthy diet. To tackle childhood excess weight and obesity, solely focusing on changing individual behaviours rather than children's circumstances and the environment in which they live will not be sufficient.

While the proposal in the government's obesity strategy to restrict unhealthy food promotions is welcome, its implementation had been delayed. More recently, it has been widely reported that the new government may order a review of the strategy. If it is introduced, it will only affect 'medium and large' businesses employing more than 50 people and stores on land that are more than 2,000 square feet (Department of Health and Social Care, 2021c). So, the required changes will not impact smaller shops. This will be particularly important in 'food deserts' as in those areas there are more likely to be smaller shops serving the community. This means that the populations they serve are more likely to have restricted access to affordable healthy food and drink and be subject to unhealthy food promotions, which could widen inequalities further. Having data on whether the strategy differentially impacts different populations would be useful.

The results also suggest that certain populations, based on their socioeconomic and demographic status, are more at risk of being overweight and obese, which is compounded by the fact that they have more difficulty in accessing weight management services. Targeted, culturally appropriate, responses are required to support these high-risk populations and individuals.

For both health deprivation and ethnicity, we did not see the same associations for Reception children as we did for Year 6 children in the fully

adjusted model. However, we did see similar associations in the unadjusted model for the younger age group (see table 6 in the technical annex). This suggests that the foundations that influence Year 6 obesity are laid down at an early age and so targeting at the younger ages should not be ignored.

5 The impacts of the Covid-19 pandemic

The data and analysis in the previous chapters of this report relate to the period before the Covid-19 pandemic. In this chapter we look at the impacts the pandemic has had on various factors that are associated with levels of childhood excess weight and obesity.

Due to the pandemic and resulting school closures, the National Child Measurement Programme was stopped in March 2020 and started again in April 2021. When the 2020/21 academic year ended in July 2021, a full national programme of measurement was not possible. Instead, the 2020/21 measurement was carried out as a sample study and statistical weighting was applied to the data to produce an estimate of obesity prevalence at the national level that was broadly comparable to previous years (NHS Digital, 2021c). This sample indicated that the national obesity prevalence in England for both Reception and Year 6 children increased by 4.5 percentage points on the previous year, to 9.9% and 25.5% respectively. These increases did not follow historical static trends. They occurred for children (both Reception and Year 6 children) living in both the most and the least deprived areas, but they increased more in the most deprived areas than in the least deprived areas, further widening inequalities.

Given the limited data, this chapter cautiously discusses the impact of the pandemic on childhood weight. Also, it is unlikely that all the impacts of the pandemic will be apparent yet and so we discuss what might happen in the future.

Impacts on breastfeeding

While the Covid-19 pandemic has had an immediate impact on the weight outcomes for the 2020/21 academic year, it may also have further impacts in the future.

Midwives, health visitors and trained local volunteers support mothers to initiate and continue breastfeeding, particularly if they experience difficulties. However, the pandemic has disrupted such services, through the redeployment of the workforce, sickness absence, service modifications (such as remote care) and increasing caseloads (Appleby, 2021; Conti and Dow, 2020; Jardine and others, 2021; Saunders and Hogg, 2021; Best Beginnings and Home-Start and The Parent-Infant Foundation, 2021). Therefore, access to formal high-quality breastfeeding support may have decreased, resulting in reduced initiation or earlier termination of breastfeeding.

During the pandemic, as well as formal support, mothers lost in-person informal peer and family support, which, as well as providing reassurance and advice around breastfeeding, may also help in other ways, which frees up a mother's time to breastfeed.

Conversely, being in lockdown and not being out and about might have made it easier for some women to breastfeed. Plus, online rather than face-to-face support may mean they got more and quicker responses from peers to questions they may have had about breastfeeding.

The data indicate that in England in 2020/21, nearly half of infants (47.6%) were totally or partially breastfed at six to eight weeks during that part of the pandemic (Public Health England, 2021b). In 2019/20, 48.0% of infants were. Due to changes in data collection and reporting, Public Health England say that caution should be exercised when interpreting the latest figures. However, breastfeeding data from Wales, which are comparable, seem to indicate that breastfeeding rates were higher there during 2020/21 (StatsWales, 2021).

The potential mixed impact of the pandemic on breastfeeding in the UK was highlighted in a survey of mothers of infants during the pandemic, where some had a positive experience while others did not (Brown and Shenker, 2021). It found that mothers with a lower education, with more challenging living circumstances and from black, Asian and minority ethnic backgrounds, were more likely to find the impact of lockdown challenging and stop breastfeeding.

Better understanding of what has happened during the pandemic should inform future policies for mothers and breastfeeding.

Impacts on weight management services

As noted earlier, due to the pandemic and resulting school closures, the National Child Measurement Programme was stopped in March 2020 and did not restart until April 2021 as a sample measurement (Public Health England, 2021c). This means that some parents of children who would have been identified as overweight or obese during the 2020/21 academic year would not have been made aware that their child was at risk and therefore may not have acted on their child's weight.

Where a child was already identified as overweight or obese, then the pandemic has reduced the access to weight management services (Moussa and others, 2021; Public Health England, 2020c). This is likely to have created a backlog of patients and potentially means that those waiting might now need a higher level of intervention if their weight has increased.

Support to adults is also pertinent to future childhood obesity levels since, as discussed in the previous chapter, obese parents are more likely to have obese children.

Impacts on families' ability to maintain a healthy weight in their children

The pandemic may have prompted some individuals to take steps to manage their and their family's weight, due to it being highlighted as a risk factor for poorer outcomes from a Covid-19 infection.

Also, Public Health England (2020b, p. 5) states that the 'evidence indicates that many want to embrace the positive changes seen in our environments during the social lockdown such as increased opportunities for walking and cycling, more spaces for social interaction, and a greater value placed on our green and blue spaces'.

However, many people have also reported that they have got less exercise and/or have eaten more or had a poorer diet during the pandemic (Public Health England, 2020c; Social Market Foundation, 2020). Specifically for

children, research indicates that ‘children’s physical activity levels in the UK were significantly lower by the time the Covid-19 pandemic public lockdown restrictions were lifted’ (Salway and others, 2022).

School closures are likely to have had a negative impact on maintaining a healthy weight. Evidence suggests that when children are in school it may help to protect them by regulating obesogenic behaviours, most likely through compulsory physical activity opportunities, restricting caloric intake, reducing screen time and regulating sleep schedules (Brazendale and others, 2017). Also, one study looking at the policy of free school meals, which was initially not extended to children staying at home when schools closed, suggests that its introduction reduced Reception children’s obesity rates (Holford and Rabe, 2020).

Impacts on financial and food insecurity

The pandemic has highlighted and further exacerbated financial and food insecurity.¹³

In Chapter 4 we discussed the association between child poverty and obesity and results from surveys show that households with children were more likely to report that they were managing less well financially or that their financial situation had worsened since the start of the pandemic (Child Poverty Action Group, 2020; Public Health England, 2021d).

Modelling by the Institute for Public Policy Research (Parkes and McNeil, 2020) estimated that 200,000 more children would be below the pre-pandemic poverty line by the end of 2020. According to The Food Foundation (The Food Foundation, 2021b), 2.3 million children directly experienced food insecurity in August 2021 (representing more than one in 10 households with children), which is 81% higher than the same month in 2020.

¹³ Food insecurity (sometimes referred to as food poverty) is the state of being without reliable access to a sufficient quantity of affordable, nutritious food (The Food Foundation, 2021b).

Public Health England (Public Health England, 2021d) indicates that households managing less well financially during the pandemic were more likely to buy items on special offer – which is more likely to be used for unhealthy products – and more likely to use food delivery services to purchase meals, which are more likely to be high in calories, fat, salt and sugar.

As food and drink prices rise (Office for National Statistics, 2022) this will make it even more difficult for families on a low income to afford a healthy diet. And as the cost-of-living crisis reduces the income of households, childhood poverty rates will worsen.

Impacts on local authority funding

The pandemic has created the potential for wider negative economic impacts, which could result in further competing priorities for public funding. History has shown that where these pressures exist, non-statutory spending in local authorities is squeezed.

For children this has previously included decreased spending on the National Child Measurement Programme and real-terms cuts in spending on obesity and services for children aged nought to five (National Audit Office, 2020; The Health Foundation, 2020; The Kings Fund, 2018, 2021).

Also, spending on Sure Start centres decreased, as the ring-fencing on their budgets was removed in 2009/10, resulting in the reduced availability of services (Bate and Foster, 2017; Cattan and others, 2019). Sure Start centres give support to parents, including breastfeeding promotion and parenting sessions to promote healthy eating and physical activity in childhood. There is some evidence that Sure Start centres have had a positive impact on childhood excess weight and obesity (Mason and others, 2021; Sammons, 2015).

Budgetary constraints that might have impacted on childhood obesity historically have not been limited to children-specific services; local authorities may also face pressures on spending relating to access to recreation opportunities. For example, a survey of local authority park departments found that 92% experienced budget reductions in the three years up to 2016, and that 95% of park managers expected further reductions in

the following three years (Heritage Lottery Fund, 2016). The result was that local authorities were increasingly more likely to sell parks and green spaces (Heritage Lottery Fund, 2016), close park facilities such as green gyms and play equipment, reduce opening hours, prioritise one park over another and allow a deterioration in the standards of maintenance (House of Commons: Communities and Local Government Committee, 2017).

These services and facilities could be further reduced in the future due to competing demands for local authority budgets and an acceleration of the current trend of spending on crises rather than on prevention.

Impacts on inequalities

The Covid-19 pandemic has brought the issue of inequalities into people's consciousness to a greater degree than before. At a population level, Public Health England (Public Health England, 2020a) has carried out a review of data on disparities in the risks and outcomes from Covid-19, which align with the health inequalities discussed in this report, in relation to ethnicity and occupation (and potentially income and poverty), for example. If people in these groups face an additional socioeconomic burden because of the pandemic and are excluded from accessing health services due an increasing digital divide and a 'digital first' policy in health care, this may further impact childhood obesity and result in a widening of pre-existing inequalities.

6 Concluding remarks

Much of the research used to inform policy on childhood obesity has been based on ways of changing behaviour at an individual level, yet, over the past decade, there have been no improvements in levels of overweight and obesity in childhood. Interventions at an area level can add to those at an individual level and may be more effective.

However, many previous studies have looked at associations between local area characteristics and excess weight and obesity at an individual level and are based on samples of the population. In this research we have been able to use readily available public data, covering the entire population. Furthermore, using a novel methodology, we have been able to look comprehensively at the associations in relation to each other rather than as simple associations.

In doing so, we have provided a focus, by highlighting areas that should be a priority for further research or where interventions may be best targeted. Our methodology can also be applied locally for better interrogation of locally held data to build area-specific evidence to support better local decision-making.

Where we did not find an association, this does not mean it does not exist, just that our models were not able to pick it up; further research is needed to assess what is in the current literature evidence base. There were also factors that we could not include in the models, such as the home and early years environments, as we could not source real-world data for them. To further interrogate factors involved in childhood weight, we need better data collections.

The number of associations with childhood excess weight and obesity we found, and the variety of things we found associated with them, further highlight its complexity. This emphasises the need to address multiple factors to reduce rates. Approaches that are driven both nationally and locally are needed and require joined-up thinking and integrated implementation. Universal policies and offers are also required, accompanied by targeted interventions where there is greater need/risk.

Additionally, this report has drawn out where the factors we found that are associated with childhood excess weight and obesity overlap with each other, such as poverty and ethnicity, and poverty and green space. However, we do not know enough about how these factors interact with each other and whether, combined, they lead to a greater accumulation of risk and to inequalities in childhood excess weight and obesity. Tackling multiple determinants at once might mean the impacts are additive and greater than the sum of their parts.

With excess weight and obesity being a risk factor for mortality from Covid-19 in adults, tackling obesity at an early stage has been given even greater urgency. However, the evidence suggests that the Covid-19 pandemic and the responses to it have had an immediate negative impact on childhood overweight and obesity prevalence. As we learn to live with Covid-19, families face the cost-of-living crisis, and the government make decisions on their obesity strategy, many questions remain over the future levels of childhood excess weight and obesity, and the impacts on future levels of inequalities.

References

- Adams J, Mytton O, White M and Monsivais P (2016) 'Why are some population interventions for diet and obesity more equitable and effective than others? The role of individual agency', *PLoS Medicine* 13(4), e1001990, doi: 10.1371/journal.pmed.1001990.
- Appleby J (2021) 'NHS sickness absence during the Covid-19 pandemic', *BMJ* 372, 471, doi: 10.1136/bmj.n471.
- Bate A and Foster D (2017) *Sure Start (England)*. House of Commons Library. <https://researchbriefings.files.parliament.uk/documents/CBP-7257/CBP-7257.pdf>.
- Beynon C, Pashayan N, Fisher E, Hargreaves DS, Bailey L and Raine R (2020) 'A cross-sectional study using the Childhood Measurement Programme for Wales to examine population-level risk factors associated with childhood obesity', *Public Health Nutrition*, 1–9, doi: 10.1017/S1368980020001913.
- Brazendale K, Beets MW, Weaver RG, Pate RR, Turner-McGrievy GM, Kaczynski AT, Chandler AL, Bohnert A and von Hippel PT (2017) 'Understanding differences between summer vs. school obesogenic behaviors of children: the structured days hypothesis', *International Journal of Behavioral Nutrition and Physical Activity* 14(1), 100, doi: 10.1186/s12966-017-0555-2.
- Brodersen NH, Steptoe A, Boniface DR and Wardle J (2007) 'Trends in physical activity and sedentary behaviour in adolescence: ethnic and socioeconomic differences', *British Journal of Sports Medicine* 41(3), 140–4, doi: 10.1136/bjism.2006.031138.
- Brown A and Shenker N (2021) 'Experiences of breastfeeding during COVID-19: lessons for future practical and emotional support', *Maternal & Child Nutrition* 17(1), e13088. <https://doi.org/10.1111/mcn.13088>. Accessed 5 May 2022.
- Cattan S, Conti G, Farquharson C and Ginja R (2019) *The Health Effects of Sure Start*. Institute for Fiscal Studies. <https://ifs.org.uk/publications/14139>. Accessed 3 May 2022.

Cheung R (2018) *International Comparisons of Health and Wellbeing in Early Childhood*. Nuffield Trust. www.nuffieldtrust.org.uk/research/international-comparisons-of-health-and-wellbeing-in-early-childhood. Accessed 3 May 2022.

Child Poverty Action Group (2020) *Poverty in the Pandemic: An update on the impact of coronavirus on low-income families and children*. Child Poverty Action Group. https://cpag.org.uk/sites/default/files/files/policypost/Poverty-in-the-pandemic_update.pdf.

Cohen AK, Rai M, Rehkopf DH and Abrams B (2013) 'Educational attainment and obesity: a systematic review', *Obesity Reviews: An Official Journal of the International Association for the Study of Obesity* 14(12), 989–1005, doi: 10.1111/obr.12062.

Conti G and Dow A (2020) 'The impacts of COVID-19 on health visiting services in England: FOI evidence for the first wave'. <https://ihv.org.uk/wp-content/uploads/2021/01/The-impacts-of-COVID-19-on-Health-Visiting-in-England-Redeployment-Brief-211220-POSTED.pdf>.

Corfe S (2018) *What are the Barriers to Eating Healthily in the UK?* Social Market Foundation. www.smf.co.uk/wp-content/uploads/2018/10/What-are-the-barriers-to-eating-healthy-in-the-UK.pdf.

Corfe S and Shepherd J (2020) *Obesity and Coronavirus – Where Next for Policy?* Social Market Foundation. www.smf.co.uk/publications/obesity-and-coronavirus. Accessed 4 May 2022.

Craig L, Love J, Ratcliffe B and McNeill G (2008) 'Overweight and cardiovascular risk factors in 4-to 18-year-olds', *Obesity Facts* 1, 237–42, doi: 10.1159/000156720.

Dadvand P, Villanueva CM, Font-Ribera L, Martinez D, Basagaña X, Belmonte J, Vrijheid M, Gražulevičienė R, Kogevinas M and Nieuwenhuijsen MJ (2014) 'Risks and benefits of green spaces for children: a cross-sectional study of associations with sedentary behavior, obesity, asthma, and allergy', *Environmental Health Perspectives* 122(12), 1329–35, doi: 10.1289/ehp.1308038.

Department of Health and Social Care (2019) 'Tackling childhood obesity: £1.5 million funding for local projects', press release, 25 June. www.gov.uk/government/news/tackling-childhood-obesity-15-million-funding-for-local-projects. Accessed 3 May 2022.

Department of Health and Social Care (2020) 'Tackling obesity: empowering adults and children to live healthier lives'. www.gov.uk/government/publications/tackling-obesity-government-strategy/tackling-obesity-empowering-adults-and-children-to-live-healthier-lives. Accessed 3 May 2022.

Department of Health and Social Care (2021a) 'Integration and innovation: working together to improve health and social care for all'. www.gov.uk/government/publications/working-together-to-improve-health-and-social-care-for-all/integration-and-innovation-working-together-to-improve-health-and-social-care-for-all-html-version#executive-summary. Accessed 3 May 2022.

Department of Health and Social Care (2021b) 'New services launched to help people achieve a healthier weight and improve wellbeing', press release, 1 July. www.gov.uk/government/news/new-services-launched-to-help-people-achieve-a-healthier-weight-and-improve-wellbeing. Accessed 3 May 2022.

Department of Health and Social Care (2021c) 'Restricting promotions of products high in fat, sugar and salt by location and by price: government response to public consultation'. www.gov.uk/government/consultations/restricting-promotions-of-food-and-drink-that-is-high-in-fat-sugar-and-salt/outcome/restricting-promotions-of-products-high-in-fat-sugar-and-salt-by-location-and-by-price-government-response-to-public-consultation. Accessed 3 May 2022.

Djalalinia S, Qorbani M, Peykari N and Kelishadi R (2015) 'Health impacts of obesity', *Pakistan Journal of Medical Sciences* 31(1), 239–42, doi: 10.12669/pjms.311.7033.

Ehtisham S, Barrett TG and Shaw NJ (2000) 'Type 2 diabetes mellitus in UK children – an emerging problem', *Diabetic Medicine* 17(12), 867–71, doi: 10.1046/j.1464-5491.2000.00409.x.

Friends of the Earth (2020) *England's Green Space Gap*. Friends of the Earth. <https://policy.friendsoftheearth.uk/print/pdf/node/190>. Accessed 3 May 2022.

- Grigsby-Toussaint DS, Chi SH and Fiese BH (2011) 'Where they live, how they play: neighborhood greenness and outdoor physical activity among preschoolers', *International Journal of Health Geographics* 10, 66, doi: 10.1186/1476-072x-10-66.
- Harris T, Hodge L and Phillips D (2019) *English Local Government Funding: Trends and challenges in 2019 and beyond*. Institute for Fiscal Studies. <https://ifs.org.uk/uploads/English-local-government-funding-trends-and-challenges-in-2019-and-beyond-IFS-Report-166.pdf>
- Hauner H (2010) 'Obesity and diabetes', *Textbook of Diabetes* 227–41. <https://doi.org/10.1002/9781444324808.ch14>. Accessed 3 May 2022.
- Heritage Lottery Fund (2016) *State of UK Public Parks*. Heritage Lottery Fund. www.heritagefund.org.uk/sites/default/files/media/attachments/state_of_uk_public_parks_2016_final_for_web%281%29.pdf.
- Heslehurst N, Vieira R, Akhter Z, Bailey H, Slack E, Ngongalah L, Pemu A and Rankin J (2019) 'The association between maternal body mass index and child obesity: a systematic review and meta-analysis', *PLoS Medicine* 16(6), e1002817, doi: 10.1371/journal.pmed.1002817.
- Hillsdon M, Jones A and Coombes E (2011) *Green Space Access, Green Space Use, Physical Activity and Overweight*. Natural England. <http://publications.naturalengland.org.uk/publication/40017>. Accessed 3 May 2022.
- Hochlaf D and Thomas C (2020) *The Whole Society Approach: Making a giant leap on childhood health*. Institute for Public Policy Research. www.ippr.org/files/2020-08/a-whole-society-approach-aug-2020.pdf.
- Holford A and Rabe B (2020) *Impact of the Universal Infant Free School Meal Policy*. Institute for Social and Economic Research. www.iser.essex.ac.uk/files/uifsm-impact.pdf.
- House of Commons Communities and Local Government Committee (2017) *Public Parks: Seventh report of session 2016–17*. House of Commons. <https://publications.parliament.uk/pa/cm201617/cmselect/cmcomloc/45/45.pdf>.
- Jardine J, Relph S, Magee LA, von Dadelszen P, Morris E, Ross-Davie M, Draycott T and Khalil A (2021) 'Maternity services in the UK during the

coronavirus disease 2019 pandemic: a national survey of modifications to standard care', *BJOG* 128(5), 880–9, doi: 10.1111/1471-0528.16547.

Jones NR, Conklin AI, Suhrcke M and Monsivais P (2014) 'The growing price gap between more and less healthy foods: analysis of a novel longitudinal UK dataset', *PLoS ONE* 9(10), e109343, doi: 10.1371/journal.pone.0109343.

Lachowycz K and Jones AP (2011) 'Greenspace and obesity: a systematic review of the evidence', *Obesity Reviews: An Official Journal of the International Association for the Study of Obesity* 12(5), e183–e189, doi: 10.1111/j.1467-789X.2010.00827.x.

Lachowycz K, Jones AP, Page AS, Wheeler BW and Cooper AR (2012) 'What can global positioning systems tell us about the contribution of different types of urban greenspace to children's physical activity?', *Health and Place* 18(3), 586–94, doi: 10.1016/j.healthplace.2012.01.006.

Li R, Fein SB and Grummer-Strawn LM (2010) 'Do infants fed from bottles lack self-regulation of milk intake compared with directly breastfed infants?', *Pediatrics* 125(6), e1386–e1393, doi: 10.1542/peds.2009-2549.

Love R, Adams J, Atkin A and van Sluijs E (2019) 'Socioeconomic and ethnic differences in children's vigorous intensity physical activity: a cross-sectional analysis of the UK Millennium Cohort Study', *BMJ Open* 9(5), e027627, doi: 10.1136/bmjopen-2018-027627.

Mannan H (2018) 'Early infant feeding of formula or solid foods and risk of childhood overweight or obesity in a socioeconomically disadvantaged region of Australia: a longitudinal cohort analysis', *International Journal of Environmental Research and Public Health* 15(8), 1685, doi: 10.3390/ijerph15081685.

Mason KE, Alexiou A, Bennett DL, Summerbell C, Barr B and Taylor-Robinson D (2021) 'Impact of cuts to local government spending on Sure Start children's centres on childhood obesity in England: a longitudinal ecological study', *Journal of Epidemiology and Community Health* 75(9), 860. doi: 10.1136/jech-2020-216064.

McFadden A, Gavine A, Renfrew MJ, Wade A, Buchanan P, Taylor JL, Veitch E, Rennie AM, Crowther SA, Neiman S and MacGillivray S (2017) 'Support for healthy breastfeeding mothers with healthy term babies', *Cochrane Database of Systematic Reviews* 2(2), CD001141, doi: 10.1002/14651858.CD001141.pub5.

Moussa O, Zakeri R, Arhi C, O’Kane M, Snowdon-Carr V, Menon V, Mahawar K, Purkayastha S and on behalf of the PanSurg collaborative (COVESITY) (2021) ‘Impact of COVID-19 on obesity management services in the United Kingdom (The COMS-UK study)’, *Obesity Surgery* 31(2), 904–8, doi: 10.1007/s11695-020-05005-1.

Narang I and Mathew JL (2012) ‘Childhood obesity and obstructive sleep apnea’, *Journal of Nutrition and Metabolism* 2012, 134202, doi: 10.1155/2012/134202.

National Audit Office (2020) *Childhood Obesity*. National Audit Office. www.nao.org.uk/wp-content/uploads/2020/09/childhood-obesity.pdf.

National Institute for Health Research (2021) ‘Preventing childhood obesity requires a shift in focus away from individual behaviours towards the wider environment’. <https://evidence.nihr.ac.uk/alert/preventing-childhood-obesity-requires-shift-in-focus-away-from-individual-behaviours-towards-wider-environment>. Accessed 4 May 2022.

Nature (2020) ‘UK policy targeting obesity during a pandemic — the right approach?’, *Nature Reviews Endocrinology* 16(11), 609–9, doi: 10.1038/s41574-020-00420-x.

NHS (2019a) ‘Breastfeeding help and support’. www.nhs.uk/conditions/baby/breastfeeding-and-bottle-feeding/breastfeeding/help-and-support. Accessed 4 May 2022.

NHS (2019b) *The NHS Long Term Plan*. NHS. www.longtermplan.nhs.uk/publication/nhs-long-term-plan. Accessed 4 May 2022.

NHS Digital (2020a) *Health Survey for England 2019*. NHS Digital. <http://healthsurvey.hscic.gov.uk/support-guidance/public-health/health-survey-for-england-2019/overweight-and-obesity-in-adult-and-children.aspx>. Accessed 4 May 2022.

NHS Digital (2020b) ‘National Child Measurement Programme, England 2019/20 school year’. <https://digital.nhs.uk/data-and-information/publications/statistical/national-child-measurement-programme/2019-20-school-year/data-quality>. Accessed 4 May 2022.

NHS Digital (2021a) ‘National Child Measurement Programme’. <https://digital.nhs.uk/services/national-child-measurement-programme>. Accessed 4 May 2022.

NHS Digital (2021b) 'National Child Measurement Programme, England 2020/21 School Year: Methodology and Data Quality'. *Methodology and Data Quality – NHS Digital*. Accessed 13 October 2022.

NHS Digital (2021c) 'National Child Measurement Programme: England 2020/21 school year'. <https://digital.nhs.uk/data-and-information/publications/statistical/national-child-measurement-programme/2020-21-school-year>. Accessed 4 May 2022.

NHS England (2022) Integrated care systems (ICSs) www.england.nhs.uk/commissioning/who-commissions-nhs-services/ccg-ics. Accessed 23 September 2022

Nield L and Paxman J (2020) 'Four reasons the UK government's obesity strategy may not work for everyone', *The Conversation*, 31 July. <https://theconversation.com/four-reasons-the-uk-governments-obesity-strategy-may-not-work-for-everyone-143695>. Accessed 4 May 2022.

Noble S, McLennan D, Noble M, Plunkett E, Gutacker N, Silk M and Wright G (2019) *The English Indices of Deprivation 2019: Research report*. Ministry of Housing, Communities and Local Government. https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/833947/loD2019_Research_Report.pdf.

Oakley LL, Renfrew MJ, Kurinczuk JJ and Quigley MA (2013) 'Factors associated with breastfeeding in England: an analysis by primary care trust', *BMJ Open* 3(6), e002765, doi: 10.1136/bmjopen-2013-002765

Office for National Statistics (2022) 'Consumer price inflation, UK: April 2022'. *Consumer price inflation, UK - Office for National Statistics*. Accessed 25 May 2022.

Parkes H and McNeil C (2020) *Estimating Poverty Impacts of Coronavirus: Microsimulation estimates*. Institute for Public Policy Research. www.ippr.org/files/2020-06/estimating-poverty-impacts-of-coronavirus.pdf.

Patalay P and Hardman CA (2019) 'Comorbidity, codevelopment, and temporal associations between body mass index and internalizing symptoms from early childhood to adolescence', *JAMA Psychiatry* 76(7), 721–9, doi: 10.1001/jamapsychiatry.2019.0169.

Public Health England (2015) *Sugar Reduction: The evidence for action: Annexe 4: An analysis of the role of price promotions on the household purchases of food and drinks high in sugar*. Public Health England. https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/470175/Annexe_4._Analysis_of_price_promotions.pdf.

Public Health England (2016) 'Child obesity international comparisons data factsheet'. <https://khub.net/documents/31798783/32038776/Child+obesity+international+comparisons+data+factsheet/1aa529dc-8411-401c-a4f0-f216b28257b9?version=1.1>. Accessed 4 May 2022.

Public Health England (2018) 'Fast food outlets: density by local authority in England'. www.gov.uk/government/publications/fast-food-outlets-density-by-local-authority-in-england. Accessed 4 May 2022.

Public Health England (2019a) 'Health matters: whole systems approach to obesity'. www.gov.uk/government/publications/health-matters-whole-systems-approach-to-obesity/health-matters-whole-systems-approach-to-obesity. Accessed 4 May 2022.

Public Health England (2019b) *Sugar Reduction: Report on progress between 2015 and 2018*. Public Health England. https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/839756/Sugar_reduction_yr2_progress_report.pdf.

Public Health England (2020a) *Disparities in the Risk and Outcomes of COVID-19*. Public Health England. https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/908434/Disparities_in_the_risk_and_outcomes_of_COVID_August_2020_update.pdf.

Public Health England (2020b) *Health Impact Assessment in Spatial Planning: Guide for local authority public health and planning teams*. Public Health England. www.gov.uk/government/publications/health-impact-assessment-in-spatial-planning. Accessed 4 May 2022.

Public Health England (2020c) *Supporting Weight Management Services during the COVID-19 Pandemic: Phase I insights*. Public Health England. https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/915274/WMS_Report.pdf.

Public Health England (2021a) 'Breastfeeding at 6 to 8 weeks after birth: annual data'. www.gov.uk/government/statistics/breastfeeding-at-6-to-8-weeks-after-birth-annual-data. Accessed 4 May 2022.

Public Health England (2021b) 'Breastfeeding at 6 to 8 weeks after birth: annual data 2020 to 2021'. www.gov.uk/government/statistics/breastfeeding-at-6-to-8-weeks-after-birth-annual-data-2020-to-2021. Accessed 4 May 2022.

Public Health England (2021c) 'National Diet and Nutrition Survey'. www.gov.uk/government/collections/national-diet-and-nutrition-survey. Accessed 4 May 2022.

Public Health England (2021d) *National Diet and Nutrition Survey: Diet, nutrition and physical activity in 2020: A follow up study during COVID-19*. Public Health England. https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/1019663/Follow_up_stud_2020_main_report.pdf.

QualityWatch (2021) 'Obesity', indicator. www.nuffieldtrust.org.uk/resource/obesity. Accessed 4 May 2022.

Reilly JJ and Kelly J (2011) 'Long-term impact of overweight and obesity in childhood and adolescence on morbidity and premature mortality in adulthood: systematic review', *International Journal of Obesity (Lond)* 35(7), 891–8, doi: 10.1038/ijo.2010.222.

Ritchie D, Amos A and Martin C (2010) 'Public places after smoke-free—a qualitative exploration of the changes in smoking behaviour', *Health & Place* 16(3), 461–9. <https://doi.org/10.1016/j.healthplace.2009.12.003>. Accessed 4 May 2022.

Rito AI, Buoncristiano M, Spinelli A, Salanave B, Kunešová M, Hejgaard T and others (2019) 'Association between characteristics at birth, breastfeeding and obesity in 22 countries: the WHO European Childhood Obesity Surveillance Initiative – COSI 2015/2017', *Obesity Facts* 12(2), 226–43, doi: 10.1159/000500425.

Rollins NC, Bhandari N, Hajeebhoy N, Horton S, Lutter CK, Martines JC, Piwoz E, Richter LM and Victora CG (2016) 'Why invest, and what it will take to improve breastfeeding practices?', *The Lancet* 387(10017), 491–504. [www.thelancet.com/journals/lancet/article/PIIS0140-6736\(15\)01044-2/fulltext](http://www.thelancet.com/journals/lancet/article/PIIS0140-6736(15)01044-2/fulltext). Accessed 5 May 2022.

- Royal College of Paediatrics and Child Health (2021a) 'Breastfeeding in the UK – position statement'. www.rcpch.ac.uk/resources/breastfeeding-uk-position-statement. Accessed 4 May 2022.
- Royal College of Paediatrics and Child Health (2021b) *National Paediatric Diabetes Audit (NPDA) National Report 2019/20*. Royal College of Paediatrics and Child Health. www.rcpch.ac.uk/resources/npda-annual-reports. Accessed 4 May 2022.
- Royal College of Paediatrics and Child Health (2021c) 'Paediatrics 2040: forecasting the future'. <https://paediatrics2040.rcpch.ac.uk>. Accessed 4 May 2022.
- Salway, R., Foster, C., de Vocht, F., Tibbitts, B., Emm-Collison, L., House, D., . . . Jago, R. (2022). Accelerometer-measured physical activity and sedentary time among children and their parents in the UK before and after COVID-19 lockdowns: a natural experiment. *The international journal of behavioral nutrition and physical activity*, 19(1), 51-51. doi:10.1186/s12966-022-01290-4
- Sammons P, Hall J, Smees R and Goff J with Sylva K, Smith T, Evangelou M, Eisenstadt N and Smith G (2015) *The Impact of Children's Centres: Studying the effects of children's centres in promoting better outcomes for young children and their families*. Department for Education. https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/485347/DFE-RB495_Evaluation_of_children_s_centres_in_England__the_impact_of_children_s_centres_brief.pdf.
- Saunders B and Hogg S (2021) *Babies in Lockdown: Listening to parents to build back better*. Best Beginnings, Home-Start UK and the Parent-Infant Foundation. <https://babiesinlockdown.files.wordpress.com/2020/08/babies-in-lockdown-main-report-final-version.pdf>.
- Shan L-S, Zhou Q-L and Shang Y-X (2020) 'Bidirectional association between asthma and obesity during childhood and adolescence: a systematic review and meta-analysis', *Frontiers in Pediatrics* 8, 576858, doi: 10.3389/fped.2020.576858.
- Simmonds M, Llewellyn A, Owen CG and Woolacott N (2016) 'Predicting adult obesity from childhood obesity: a systematic review and meta-analysis', *Obesity Reviews: An Official Journal of the International Association for the Study of Obesity* 17(2), 95-107, doi: 10.1111/obr.12334.

- Social Metrics Commission (2020) *Measuring Poverty 2020*. Social Metrics Commission. <https://socialmetricscommission.org.uk/wp-content/uploads/2020/06/Measuring-Poverty-2020-Web.pdf>.
- Somerset S and Hoare DJ (2018) 'Barriers to voluntary participation in sport for children: a systematic review', *BMC Pediatrics* 18(1), 47, doi: 10.1186/s12887-018-1014-1.
- StatsWales (2021) 'Breastfeeding, quarterly rates by age and LHB'. <https://statswales.gov.wales/Catalogue/Health-and-Social-Care/NHS-Primary-and-Community-Activity/Breastfeeding/breastfeedingquarterlyrates-by-age-lhb#>. Accessed 5 May 2022.
- Szczepura A (2005) 'Access to health care for ethnic minority populations', *Postgraduate Medical Journal* 81(953), 141-7, doi: 10.1136/pgmj.2004.026237.
- The Food Foundation (2021a) 'Food insecurity tracking'. <https://foodfoundation.org.uk/initiatives/food-insecurity-tracking>. Accessed 5 May 2022.
- The Food Foundation (2021b) *The Broken Plate 2021*. The Food Foundation. <https://foodfoundation.org.uk/publication/broken-plate-2021>. Accessed 5 May 2022.
- The Health Foundation (2020) 'The public health grant has been increased but is still too low'. www.health.org.uk/news-and-comment/charts-and-infographics/the-public-health-grant-has-been-increased-but-is-still-too. Accessed 5 May 2022.
- The King's Fund (2018) 'Local government spending on public health: death by a thousand cuts'. The King's Fund blog, 3 January. www.kingsfund.org.uk/blog/2018/01/local-government-spending-public-health-cuts. Accessed 5 May 2022.
- The King's Fund (2021) 'Spending on public health'. www.kingsfund.org.uk/projects/nhs-in-a-nutshell/spending-public-health. Accessed 5 May 2022.
- Trigwell J, Murphy RC, Cable NT, Stratton G and Watson PM (2015) 'Parental views of children's physical activity: a qualitative study with parents from multi-ethnic backgrounds living in England', *BMC Public Health* 15(1), 1005, doi: 10.1186/s12889-015-2351-8.

- Van Geel M, Vedder P and Tanilon J (2014) 'Are overweight and obese youths more often bullied by their peers? A meta-analysis on the relation between weight status and bullying', *International Journal of Obesity* 38(10), 1263–7, doi: 10.1038/ijo.2014.117.
- Wijtzes AI, Jansen W, Bouthoorn SH, Pot N, Hofman A, Jaddoe VWV and Raat H (2014) 'Social inequalities in young children's sports participation and outdoor play', *International Journal of Behavioral Nutrition and Physical Activity* 11(1), 155, doi: 10.1186/s12966-014-0155-3.
- Working Group (2014) *Report of the Working Group Into: Joined up clinical pathways for obesity*. NHS England. www.england.nhs.uk/wp-content/uploads/2014/03/owg-join-clinc-path.pdf.
- Yu Z, Han S, Zhu J, Sun X, Ji C and Guo X (2013) 'Pre-pregnancy body mass index in relation to infant birth weight and offspring overweight/obesity: a systematic review and meta-analysis', *PLoS ONE* 8(4), e61627, doi: 10.1371/journal.pone.0061627.

Nuffield Trust is an independent health charity. We aim to improve the quality of health care in the UK by providing evidence-based research and policy analysis and informing and generating debate.

**59 New Cavendish Street
London W1G 7LP
Telephone: 020 7631 8450
www.nuffieldtrust.org.uk
Email: info@nuffieldtrust.org.uk**

Published by the Nuffield Trust.
© Nuffield Trust 2022. Not to be reproduced without permission.

Design by Soapbox: soapbox.co.uk

nuffieldtrust