



# GROWING UP IN SCOTLAND: OVERWEIGHT AND OBESITY AT AGE 10

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Authors: Paul Bradshaw and Stephen Hinchliffe, ScotCen Social Research

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Responsibility for the opinions expressed in this report, and for all interpretation of the data, lies solely with the authors.

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# EXECUTIVE SUMMARY

Childhood obesity is one of the world's foremost current public health challenges. This challenge is particularly acute for Scotland, along with the UK as a whole, which has one of the highest levels of obesity amongst OECD countries (OECD, 2014).

The Growing Up in Scotland study (GUS) has collected data which provides a unique opportunity to further understand patterns of childhood overweight and obesity and to inform policy development.

This report explores rates of overweight and obesity amongst 10 year old children in Scotland and examines how these vary between children with different characteristics. It also investigates whether the level of overweight/obesity changes as the children grow older (from 6 to 10 years of age), and whether the changes are associated with the children's demographic and socio-economic characteristics. Uniquely, using the study's longitudinal data, the report illustrates how individual weight status changes - that is, what proportion of children move into or out of overweight/obesity between the age of 6 and 10 – and identifies the demographic, socio-economic and related characteristics associated with those changes.

In this report, children's BMI has been classified using the national BMI percentiles classification (Cole *et al*, 1990; Cole *et al*, 1998). The 85th / 95th percentile cut-off points are commonly accepted thresholds used to analyse children's overweight and obesity, respectively. The terms 'overweight (including obese)', 'overweight or obese' and 'overweight/obese' are used interchangeably throughout the report to describe children whose BMI was at or above the 85<sup>th</sup> percentile.

### **What proportion of children are overweight/obese at age 10, compared with age 6, and what proportion move into and out of healthy weight/overweight/obese categories during that period?**

- Children are more likely to be overweight or obese at age 10 than age 6. At age 6, 24% of children were overweight including 11% who were obese. By age 10, 34% of children were overweight including 19% who were obese. On average, BMI had increased by 2.5 BMI points for all children over the period from age 6 to age 10.
- Most (79%) children who were a healthy weight at age 6 remained a healthy weight at age 10. However, around 12% became overweight and a further 8% became obese.
- Children already overweight or obese at age 6 were more likely to remain so or to see their BMI increase over the following four years than to see their BMI decrease. Amongst children who were overweight at age 6, 34% remained

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overweight and 33% became obese at age 10. Around 34% returned to a healthy weight.

- The vast majority (79%) of children who were obese at age 6 remained so at age 10. Thirteen percent became overweight and just 8% became a healthy weight.
- Even amongst those children who remained in the same BMI category at both ages, BMI increases are evident. For children who remained a healthy weight, BMI increased by an average of 1.4 points. For those who were overweight and those who were obese at both time points BMI increased by 2.3 and 4.8 points respectively.

### **How does overweight/obesity vary amongst 10 year old children according to demographic and socio-economic characteristics and is there any change in the social gradient of overweight/obesity between age 6 and age 10?**

- Between age 6 and age 10, rates of overweight and obesity increased similarly both for boys and girls, and for children of white and other ethnicities. For example, overweight/obesity amongst boys increased from 25% to 34% and amongst girls from 23% to 34%. There were no significant differences in the proportion of children overweight/obese by sex or ethnicity at any age point.
- Levels of overweight and obesity also increased amongst children with all types of social background.
- However, levels of overweight including obesity increased more amongst children in more disadvantaged groups than amongst children in more advantaged groups. As children in more disadvantaged groups were more likely to be overweight or obese at age 6, this means that inequality in levels of overweight and obesity according to social background widens between age 6 and age 10.
- For example, rates of overweight including obesity amongst children living in the 20% least deprived areas rose by just 3 percentage points from 22% at age 6 to 25% at age 10. In contrast, the proportion of children living in the 20% most deprived areas that were overweight including obese increased by 15 percentage points from 24% to 39%.
- Similarly, amongst children in the lowest income group overweight including obesity increased from 23% at age 6 to 36% at age 10 and for children in the highest income group from 20% to 29%.

### What other factors are associated with overweight/obesity at age 10?

- Children whose mothers are overweight or obese are significantly more likely to be overweight or obese themselves at age 10 than children whose parents have a healthy BMI. For example, 29-32% of children whose mother was obese were also obese compared with 11% of children whose mother was a healthy weight.
- Higher typical screen time and irregular breakfast habits were associated with overweight/obesity. For example, 34% of children with between 14 and 21 hours per week of screen time were overweight or obese compared with 25% of children with less than 14 hours, and 31% of children who always ate breakfast were overweight or obese compared with 44% of those who only occasionally ate breakfast. Both factors also varied considerably by social background. For example, children in lower income households were more likely than those in higher income households to have higher screen time and irregular breakfast habits.
- Children with a television in their bedroom were more likely to be overweight or obese than those without – 38% compared with 26%. Having less than the recommended amount of sleep was also associated with overweight/obesity. Thirty-seven percent of children who had less than the recommended amount of sleep were overweight or obese at age 10 compared with 32% of those who had the recommended amount of sleep.
- Child longstanding illness, frequency of unhealthy snacking for children or parents, level of physical activity at age 6, participation in sport were not statistically significantly associated with child overweight/obesity at age 10.
- Thirty-five percent of parents whose children were obese and 88% of those whose children were overweight perceived them to be of normal weight. Children also misperceived their weight status: 63% of children who were obese and 78% of those who were overweight perceived themselves to be 'about the right size'.
- Children who were obese were less likely to be very happy about the way they looked than healthy weight children (53% compared with 62%). Differences in body satisfaction between children who were overweight and healthy weight were not statistically significant.
- Analysis was undertaken to explore which factors were most closely associated with being overweight or obese at age 10 when all factors of interest were taken into account. The results show that being overweight or obese at age 6, having a mother who was obese, an average weekly screen time of 14 hours or more, only occasionally eating breakfast and having a TV

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in the child's bedroom were all associated with being overweight/obese at age 10. Of these, BMI status at age 6 was by far the strongest predictor of overweight/obesity at age 10.

### **Which factors are associated with a move out of or a move into overweight and obesity between ages 6 and 10?**

- Using a child's BMI status at age 6 and at age 10, a new variable was derived which captured transitions in BMI status between the two age points. This variable had the following categories:
  - Remain healthy weight: children whose BMI was classified as healthy weight at both ages
  - Move out of overweight: children who were overweight or obese at age 6 and healthy weight or underweight at age 10
  - Move into overweight: children who were healthy weight or underweight at age 6 and overweight or obese at age 10
  - Remain overweight: children who were overweight or obese at age 6 and age 10
  - Other: children who were underweight at age 6 and age 10 or who moved between being underweight and healthy weight
- Fifty-eight percent of all children were a healthy weight at age 6 and age 10. Fifteen percent moved into overweight whilst 5% moved out of overweight. A significant minority (19%) remained overweight whilst 3% fell into the 'other' category.
- A higher proportion of children living in more deprived areas moved into overweight than did children living in less deprived areas. Seventeen percent of children living in areas in the most deprived quintile became overweight or obese compared with 11% of those living in areas in the least deprived quintile.
- Higher rates of moving into overweight were also seen amongst children whose mothers were obese, children who reported eating breakfast 'occasionally' or 'quite often' (rather than 'always'), those with higher weekly screen time and those with a TV in their bedroom. For example, 16% of children with a TV in their bedroom moved into overweight compared with 11% of those who did not have a TV in their bedroom.
- A greater proportion of children with heavier birth weights than those with lighter birth weights moved out of overweight. Higher rates of moving out of overweight were also seen amongst those who snacked on unhealthy items less frequently and children who did not have a TV in their bedroom. For

example, 10% of children who ate unhealthy snacks up to once a day moved out of overweight compared with 4% of those who consumed unhealthy snacks more often.

- As previously, analysis was undertaken to explore which factors were most closely associated with moving into overweight when all factors of interest were taken into account. The results found that having a higher weekly screen time and a mother who was overweight or obese were statistically significantly associated with moving into overweight. The results also tentatively suggest that having a TV in the child's bedroom and not always eating breakfast may also be associated with moving into overweight, though the relationship was not statistically significant.
- Similar analysis was also undertaken to identify which factors were most closely associated with moving out of overweight. The results indicate that moving out of overweight was associated with lower household income, less frequent consumption of unhealthy snacks and not having a TV in the child's bedroom. The relationship with lower household income is opposite to that found in the other analysis where it has been associated with BMI increase. This may have occurred because a higher proportion of lower income children were overweight/obese at age 6 thus providing greater scope for a reduction in BMI amongst children in that group by age 10.

### Conclusion

This report demonstrates a notable increase in rates of overweight and obesity in children between age 6 and age 10. Indeed, BMI increased by an average of 2.5 BMI points for all children over the four years. The findings also show that inequalities in levels of overweight/obesity between children from different social backgrounds – which already exist at age 6 – have widened by age 10. This makes subsequently reducing that inequality more difficult as children move into adolescence and through onto adulthood.

A key factor predicting overweight and obesity at age 10 was being overweight or obese at age 6. Similarly, the majority of children who were a healthy weight at age 6 were also a healthy weight at age 10. This suggests that addressing factors associated with being overweight in the early years and thus increasing the proportion of younger children of healthy weight would have a knock on effect, reducing levels of overweight in later childhood.

The findings further confirm existing evidence on some of the key influencing factors amongst children's day-to-day environments and experiences which may be modifiable in order to prevent and tackle increasing levels of overweight and obesity between early and middle childhood. These include mother's overweight/obesity, poor diet and inactivity including, particularly, a home environment which facilitates

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higher levels of inactivity. Parental recognition of child overweight/obesity is also problematic suggesting many parents are ill-informed or find it hard to recognise. Thus interventions to reduce child overweight and obesity would benefit from the involvement of parents and the wider family along with steps to address issues in the home environment.

# 1 INTRODUCTION

## 1.1. Background and report overview

Childhood obesity currently presents one of the world's foremost public health challenges. This challenge is particularly acute for Scotland which, along with the UK as a whole, has one of the highest levels of obesity amongst OECD countries (OECD, 2014). During childhood, those who are overweight or obese have an increased risk of conditions such as hypertension, type 2 diabetes and asthma (Oude Luttikhuis *et al*, 2009; Waters *et al*, 2011). If their weight continues to be unhealthy into adulthood, they are at an increased risk of numerous conditions associated with adult obesity, not only type 2 diabetes but also cardiovascular disease, osteoarthritis and some cancers (Nathan and Moran, 2008; SIGN, 2010; Grant, Fischbacher and Whyte, 2007). Understanding, tackling and preventing childhood overweight and obesity therefore forms an important public health priority amongst Scottish policymakers and practitioners.

The Growing Up in Scotland study (GUS) has collected data which provides a unique opportunity to further understand patterns of childhood overweight and obesity and to inform policy development. Children in the first birth cohort (BC1) have had their height and weight measured at ages 4, 6, 8 and 10. A further measurement is being undertaken as part of the age 12 fieldwork over 2017/18. A previous report, published in 2012 (Parkes *et al*, 2012), used some of these data to identify factors associated with overweight and obesity at age 6 – around the time the cohort children had started primary school. With the children now of secondary school age, and following two further sweeps of data collection at age 8 and age 10, the study can provide new information on childhood overweight and obesity in Scotland, specifically in later childhood.

This report explores the prevalence of overweight and obesity amongst 10 year old children in Scotland and examines how this varies between children with different characteristics. It also investigates whether the level of overweight/obesity amongst 10 years olds is different than amongst 6 year olds and whether social and demographic variations in levels of overweight/obesity change during that period. Uniquely, using the longitudinal nature of the data, the report illustrates how individual weight status changes - that is, what proportion of children move into or out of overweight/obesity – and identifies the demographic, socio-economic and related characteristics associated with those changes. Specifically, the analysis explores the factors associated with becoming overweight/obese and with moving into healthy weight from overweight/obese between the ages of 6 and 10. It therefore builds on the extensive analysis undertaken in the 2012 report (Parkes *et al*, 2012).

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The Scottish Government Health and Social Care Delivery Plan (2016) emphasises the requirement for a concerted, sustained and comprehensive approach to improving population health through targeting particular health behaviours, acting to reduce avoidable harm and illnesses and taking a population and whole life approach to prevention and early intervention. In relation to the latter aim, analysis of GUS data presents a unique opportunity to understand how prevention and early intervention may reduce the prevalence of poorer health outcomes – in this case levels of overweight and obesity – in later childhood, adolescence and beyond.

### 1.2. Childhood obesity in Scotland: what do we know?

Aside from GUS, there are two principal national data sources used to monitor children's weight in Scotland: the Scottish Health Survey (SHeS) and the Child Health Surveillance Programme (CHSP).

SHeS collects data on a sample of children aged between 2 and 15 years old, and includes an objective measurement of their height and weight. The most recent findings (McLean *et al*, 2018), which come from the 2017 survey, show 26% of children aged 2 to 15 years at risk of overweight including 13% at risk of obesity. Historic data from the survey shows that the prevalence of overweight including obesity remained relatively stable between 1998 and 2016, fluctuating between 28% and 33%. However, in recent years levels of obesity have shown a steady decline dropping from 17% in 2014. This is largely due to a decline in obesity amongst boys which have dropped from 20% in 2012 to 12% in 2017. There are clear inequalities according to children's background: children living in more disadvantaged circumstances are more likely to be overweight or obese than those in more advantaged circumstances. For example, the 2017 results show that 30% of children living in the 20% most deprived areas in Scotland were at risk of overweight/obesity compared with 22% of those living in 20% least deprived areas.

Unlike SHeS, height and weight measurements from CHSP are taken from a census rather than a sample. However, only children in Primary 1 – the first year of formal schooling when children are aged between 4.5 and 6 years – are measured. Findings from the 2016/17 school year (ISD, 2017) indicate that 23% of children were at risk of overweight and obesity. This figure is comparable to that found amongst six year olds measured as part of GUS in 2010/11; 22%<sup>1</sup> were overweight including obese (Parkes *et al*, 2012). Indeed, similar to the SHeS data, measurements from CHSP over time show that levels of overweight and obesity amongst children in Primary 1 have remained broadly stable over the last 10 years at around 21-23%. Data from CHSP

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<sup>1</sup> Slight differences in the figures between this and the 2012 report occur because the sample being analysed and the weights used for analysis vary between the two reports. For this report the age 6 sample is restricted to those who also provided data at age 10.

also evidence the inequality in childhood overweight observed in other data. The 2016/17 statistics indicate that 18% of children living in the least deprived 20% of areas were at risk of overweight including obesity compared with 27% of children living in the most deprived 20% of areas.

Neither SHeS nor CHSP data provides any insight into individual BMI trajectories for children. For example, to demonstrate the proportion of children who remain overweight or obese between Primary 1 and Primary 7 or how many children move into or out of overweight during that time – or any other time period. Such insight is possible using data from the National Child Measurement Programme in England which takes height and weight measurements from children in Reception year and Year 6 – their first and final years of primary school. Although national level routine linking of children’s Reception and Year 6 results is not yet possible, it is possible to link individual results using locally held data. Analysis by Public Health England (Copley et al, 2017) used these data from four local authorities to examine trajectories of BMI amongst children in primary school between 2006/07 and 2014/15.

They found that most (75%) children who were healthy weight in Reception remained a healthy weight in Year 6. However, around 15% became overweight and a further 8% became obese. Amongst children who were overweight in Reception, the majority either remained overweight (30%) or became obese (43%). Around 27% returned to a healthy weight. For children who were obese but not severely obese, around two-thirds remained so, including a third who developed severe obesity. Twenty percent became overweight and just 10% became a healthy weight. Thus children already overweight or obese at entry to primary school were at significant risk of remaining so or seeing their BMI increase over the primary school period.

Similar analysis at a UK level has also been undertaken using data from the Millennium Cohort Study (Mead et al, 2016). In tracking BMI between ages 5 and 11, researchers found comparable results: 19% of children of healthy weight at age 5 had become overweight or obese at age 11; 63% of children who were overweight at age 5 remained so at age 11, including 32% who became obese; and 68% of children obese at age 5 were also obese at age 11.

### **1.3. Tackling childhood obesity: the policy context**

As noted above, Scotland, along with the UK as a whole, has a particularly poor obesity record relative to other OECD countries (OECD, 2014). The implications of the issue are such that recent estimates of the total (direct and indirect) costs of overweight and obesity to Scottish society, including labour market related costs such as lost productivity, have been put at £0.9-4.6 billion (SPICe, 2015). The pervasiveness of the obesity problem, and the health and economic consequences of

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obesity, mean that tackling it remains a key priority and a major challenge for the government and its delivery partners.

Given its severity, addressing the issue of childhood obesity is a priority for the Scottish Government. At an overarching level, the National Performance Framework contains an ongoing commitment to increase the proportion of healthy weight children<sup>2</sup>. Progress towards this target is monitored via a set of National Indicators which utilise data from SHeS and is supported by a range of proposals to address overweight and obesity set out in the Scottish Government's Fairer Scotland Action Plan (Scottish Government, 2016). Alongside a range of actions designed to tackle health inequalities, including new national strategies for mental health, alcohol and maternal and infant nutrition, the Action Plan proposed a new strategy on poor diet and obesity. This proposal was also committed to in the 2017-18 Programme for Government (Scottish Government, 2017).

In July 2018, the Scottish Government published A Healthier Future – Scotland's Diet and Healthy Weight Delivery Plan (Scottish Government, 2018a). The plan sets out a vision for everyone in Scotland to eat well and have a healthy weight. More specifically, it also sets an ambition to halve childhood obesity by 2030 and to significantly reduce diet-related health inequalities. Actions to tackle childhood obesity will start pre-pregnancy and continue throughout the early and school years and into adolescence. This sits alongside broader population measures to tackle conditions in the overall environment which make healthier food choices more difficult. The Scottish Government published a consultation in early October 2018<sup>3</sup> to consider the promotion of discretionary foods high in fat, sugar or salt with little or no nutritional benefit and how such incentives encourage people to buy and eat more.

Recognising that the drivers of overweight and obesity are complex, multi-faceted and shaped by a broad range of factors, the delivery plan for improving diet and weight sits alongside a wide range of government policy and action. Promoting a joined up approach to public health, the Scottish Government along with the Convention of Scottish Local Authorities' (COSLA), published Public Health Priorities (Scottish Government and COSLA, 2018) which aims to focus efforts to improve the health of the population. Included amongst these is a priority to create 'a Scotland where we eat well, have a healthy weight and are physically active'. The Diet and Healthy Weight Delivery Plan is therefore designed to be considered alongside A More Active Scotland: Scotland's Physical Activity Delivery Plan (Scottish Government, 2018b). The recently published tobacco control strategy (Scottish

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<sup>2</sup> Available from: <http://nationalperformance.gov.scot>

<sup>3</sup> <https://www.gov.scot/Publications/2018/10/6984/0>

Government, 2018c) and other forthcoming renewed public health strategies on alcohol prevention and substance use are also relevant.

The Scottish Dietary Goals (Scottish Government, 2016), revised in 2016, provide the characteristics of the diet that will “improve and support the health of the Scottish population”, in part through reducing levels of obesity. Applicable to both adults and children, the goals include reducing intake of salt, free sugars and calories and increasing intake of fruit and vegetables, fibre and oil-rich fish. Amongst a range of actions aimed at achieving these goals are the Eat Better Feel Better campaign<sup>4</sup> and various programmes designed to encourage people to make healthier choices in the way they shop, cook and eat. Food available in and around schools has also been a focus of policy aimed at improving children’s diets. Legislation<sup>5</sup> requiring local authorities to ensure schools provide food and drink of an appropriate nutritional standard has been in place since 2007 with accompanying guidance (Scottish Government, 2008). These regulations are due to be updated following a recent consultation on proposed amendments<sup>6</sup>. *Better Eating Better Learning* (Scottish Government 2014a) provides guidance for a range of stakeholders (schools, local authorities, caterers, procurement departments, parents, children and young people) aimed at making further improvements in school food and food education through partnership working. Meanwhile, *Beyond the School Gate* (Scottish Government, 2014b) seeks to help the same stakeholders and other partners, influence the food environment around schools and support children and young people to make healthier choices.

Alongside a range of benefits for physical and mental health, regular physical activity helps adults and children maintain a healthy weight. A More Active Scotland: Scotland’s Physical Activity Delivery Plan (Scottish Government, 2018b) sets out the Scottish Government’s ambitions for a Scotland where “more people are more active, more often”. Building on the Active Scotland Outcomes Framework<sup>7</sup>, the delivery plan sets out actions the Scottish Government and a wide range of delivery partners are taking to achieve a series of outcomes ranging from encouraging and enabling the inactive to be more active to improving opportunities to participate, progress and achieve in sport. Progress towards achieving the goal of a more active population has been made through a range of activities in recent years including the implementation of the National Walking Strategy (Scottish Government, 2014c), the

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<sup>4</sup> See <https://www.eatbetterfeelbetter.co.uk/>

<sup>5</sup> Schools (Health Promotion and Nutrition) (Scotland) Act 2007

<sup>6</sup> <https://consult.gov.scot/support-and-wellbeing/food-and-drink-in-schools/>

<sup>7</sup> [http://www.gov.scot/About/Performance/scotPerforms/partnerstories/Outcomes-Framework?\\_ga=2.87871900.565990737.1526569500-747484107.1526034304](http://www.gov.scot/About/Performance/scotPerforms/partnerstories/Outcomes-Framework?_ga=2.87871900.565990737.1526569500-747484107.1526034304)

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Cycling Action Plan (Scottish Government, 2017b), the Active Schools programme<sup>8</sup>, Community Sports Hubs<sup>9</sup> and the Legacy 2014 Physical Activity Fund<sup>10</sup>. Of particular relevance for children and young people is the Scottish Government's commitment to expanding the Daily Mile<sup>11</sup> to ensure that Scotland becomes the first 'Daily Mile nation' with roll out to nurseries, schools, colleges, universities and workplaces. Recent research results suggest the Daily Mile is effective at increasing levels of moderate to vigorous physical activity (MVPA), reducing sedentary time, increasing physical fitness and improving body composition (Chesham et al, 2018).

### 1.4. About the Growing Up in Scotland study

GUS is a longitudinal research study which tracks the lives of thousands of children and their families in Scotland from the early years, through childhood and beyond. The main aim of the study is to provide new information to support policy-making in Scotland but it is also intended to provide a resource for practitioners, academics, the voluntary sector and parents.

To date, the study has collected information about three nationally representative cohorts of children: a child cohort and two birth cohorts. Altogether, information has been collected on around 14,000 children and families in Scotland.

This report draws mainly on data collected at the time children in the first GUS birth cohort were aged around 6 years old and had recently entered primary school (2010/11) and at the time they were aged 10 and in Primary 6 (2014/15). More detailed information about the data is provided in section 2.1.

### 1.5. Research questions

Building on the analysis undertaken in a previous GUS report examining overweight and obesity at age 6 (Parkes *et al*, 2012), this report focuses on levels of child overweight and obesity at age 10 and changes in BMI classification over the primary school years. It addresses the following questions:

1. What proportion of children are overweight/obese at age 10, compared with age 6, and what proportion move into and out of healthy weight/overweight/obese categories during that period?

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<sup>8</sup> See <https://sportscotland.org.uk/schools/active-schools/>

<sup>9</sup> See <https://sportscotland.org.uk/clubs/what-is-a-community-sport-hub/>

<sup>10</sup> See <http://legacy2014.co.uk/legacy-in-action/funding-for-physical-activity>

<sup>11</sup> See <https://beta.gov.scot/news/scotland-a-daily-mile-nation/>

2. How does overweight/obesity vary amongst 10 year old children according to demographic and socio-economic characteristics and is there any change in the social gradient of overweight/obesity between age 6 and age 10?
3. What other factors are associated with overweight/obesity at age 10?
4. Which factors are associated with a move out of or a move into overweight and obesity between ages 6 and 10?

Prevalence of overweight and obesity among children aged 10 and trajectories of movement into and out of healthy weight/overweight/obese categories between ages 6 and 10 are considered in chapter 3. Differences in levels of overweight/obesity amongst 10 year olds according to demographic and socio-economic characteristics are considered in chapter 4 whilst differences by other characteristics are considered in chapter 5.

Chapter 6 explores what experiences and circumstances are associated with a move into or out of overweight between age 6 and age 10. Finally, chapter 7 draws together key findings from the previous chapters and suggests what implications they have for policy makers and others seeking to reduce levels of overweight and obesity amongst children in Scotland.

# 2 METHODS

## 2.1. Sample and data overview

The analysis presented in this report uses data from the first GUS birth cohort (Birth Cohort 1 or 'BC1'). BC1 is comprised of a nationally representative sample of 5217 children living in Scotland when they were 10 months old who were born between June 2004 and May 2005.

Starting in 2005/06, data were collected annually from when the children were aged 10 months until they were just under 6 years old, and then biennially at age 7-8 and when the children were in Primary 6 (age 10). At the time of writing (2018), the ninth sweep of face-to-face data collection with this cohort is underway at the time the cohort children are in their first year of secondary school (age 12). This report draws primarily on data collected, firstly, at the time the children were aged just under 6 and were in their first or second year of primary school (in 2010/11), and secondly, at the time they were aged 10 and in Primary 6 (in 2014/15). However, for a number of the factors examined it also draws on data collected from other time points.

Because the cohort is comprised of a nationally representative sample of children the results should be understood to represent all children of the respective age living in Scotland at the time point in question who were also living in Scotland when they were 10 months old. For example, the results presented for the GUS children at the time they were aged 10 are broadly representative of all children in Scotland who were aged 10 in 2014/15.

The main data collection on GUS takes place through annual or biennial 'sweeps' of face-to-face interviews with children and parents in their homes. This report draws on data collected from a number of sources: from the cohort child's main carer at various age points; from objective measures of the child's height and weight at the ages 4, 6, 8 and 10; from the children themselves when they were aged 10.

## 2.2. Measuring height and weight

Height was measured using a portable stadiometer with a sliding head plate, base plate and four connecting rods marked with a metric measuring scale. Participants were asked to remove shoes. One measurement was taken, with the participant stretching to the maximum height and the head positioned in the Frankfort plane<sup>12</sup>.

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<sup>12</sup> The Frankfort Plane is an imaginary line passing through the external ear canal and across the top of the lower bone of the eye socket, immediately under the eye. Participants' heads are positioned with the Frankfort Plane in a horizontal position when height is measured using a stadiometer as a means of ensuring that, as far as possible, the measurements taken are standardised.

If the reading was between two millimetres it was recorded to the nearest even millimetre.

Weight was measured using either Seca or Tanita electronic scales, both of which use a digital display. Participants were asked to remove shoes and any bulky clothing. A single measurement was recorded to the nearest 100g.

In the analysis of height and weight, data from those who were considered by the interviewer to have unreliable measurements, for example those who had excessive clothing on, were excluded.

### **2.3. Child BMI classification**

BMI is defined for children in the same way as it is for adults: weight (kg)/square of height (m<sup>2</sup>). The International Obesity Task Force concluded that BMI is a reasonable measure of adiposity in children and it is the key measure of overweight and obesity for children used in the Scottish Government monitoring data series – the Scottish Health Survey and the Child Health Surveillance Programme.

Despite the relatively wide acceptance of the use of BMI as an adiposity indicator, the establishment of an agreed specific obesity and overweight classification system for children and young people remains challenging. Constant changes in body composition during growth mean that the relationship between weight-for-height and adiposity during childhood and adolescence is age-dependent, and this relationship is further complicated by both ethnicity and gender (Daniels et al, 1997).

The classification of children's BMI used in this chapter, set out below, has been derived from BMI percentiles of the UK 1990 reference curves (Cole et al, 1990; Cole et al, 1998) referred to as the national BMI percentiles classification; these have been used in previous analysis of GUS to date. The national BMI percentiles classification has been shown to be reasonably sensitive - i.e. not classifying obese children as non-obese - and specific - i.e. not classifying non-obese children as obese (Reilly, 2002; Reilly et al, 2002). SIGN (2010) recommends that these reference curves and thresholds should be used for population surveillance in Scotland. The 85th / 95th percentile cut-off points are commonly accepted thresholds used to analyse overweight and obesity in children. These thresholds have been widely used to describe childhood overweight and obesity prevalence trends in the UK as follows:

- At or below 2nd percentile: at risk of underweight
- Above 2nd percentile and below 85th percentile: healthy weight
- At or above 85th percentile and below 95th percentile: at risk of overweight
- At or above 95th percentile: at risk of obesity

# GROWING UP IN SCOTLAND

## OVERWEIGHT AND OBESITY AT AGE 10

GUS uses a method developed by ISD Scotland and similarly applied on the Scottish Health Survey to plot the exact ages of the children in the sample against the reference population data. While children's exact age was used to calculate the BMI grouping prevalence rates (based on the interview date and the date of birth), results are presented using grouped ages based on age at last birthday.

Note that the terms 'overweight (including obese)', 'overweight or obese' and 'overweight/obese' are used interchangeably throughout the report to describe children whose BMI was at or above the 85<sup>th</sup> percentile.

# 3 OVERWEIGHT AND OBESITY AT AGES 4, 6, 8 AND 10

## 3.1. Introduction

As discussed in the introductory chapter, levels of overweight and obesity among children have become of increasing concern in recent years, particularly in Scotland. One of the key questions we wish to examine is how levels progress with increasing age. Of particular interest, and something which can only be addressed using longitudinal data, which in Scotland realistically means data from the Growing Up in Scotland study, is movement into or out of overweight and obesity.

This chapter will look at the proportion of children who are identified as overweight and obese at ages 4, 6, 8 and 10, as well as the proportions of children moving into and out of overweight and obese between the ages of 6 and 10.

## 3.2. Key findings

- Levels of overweight and obesity increase with age. At age 6, 24% of children were overweight including 11% who were obese. By age 10, 34% of children were overweight including 19% who were obese. On average, BMI had increased by 2.5 for all children.
- Most (79%) children who were a healthy weight at age 6 remained a healthy weight at age 10. However, around 12% became overweight and a further 8% became obese.
- Children already overweight or obese at age 6 were more likely to remain so or see their BMI increase over the primary school period than to show a reduction in their BMI. Amongst children who were overweight at age 6, 34% remained overweight and 33% became obese. Around 34% returned to a healthy weight.
- For children who were obese at age 6, the vast majority (79%) remained so. Thirteen percent became overweight and just 8% became a healthy weight.
- Even amongst those children who remained in the same BMI category at both ages, increases in BMI are evident. For children who remained a healthy weight, BMI increased by an average of 1.4 points. For those who were overweight and those who were obese at both time points BMI increased by 2.3 and 4.8 points respectively.

# GROWING UP IN SCOTLAND

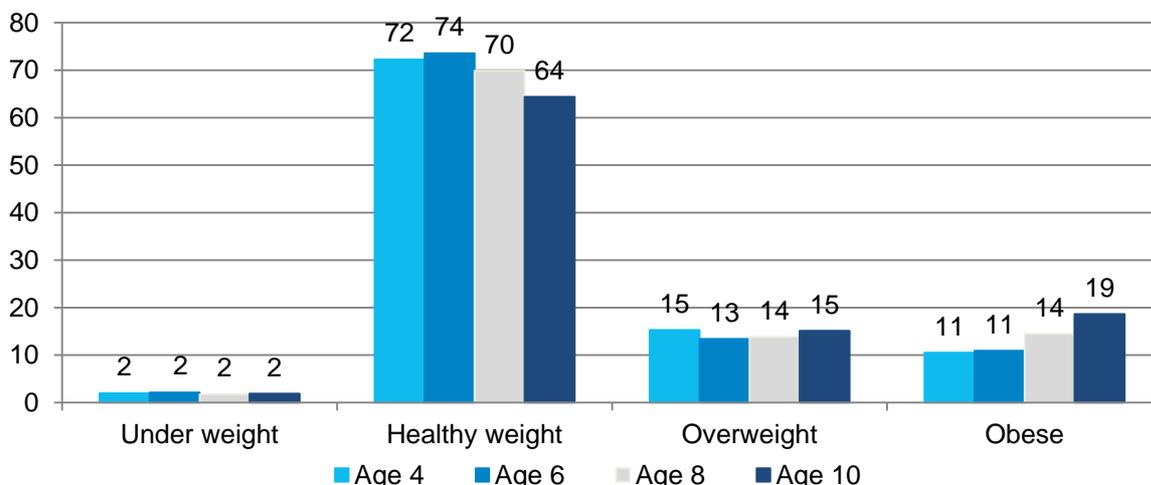
## OVERWEIGHT AND OBESITY AT AGE 10

### 3.3. Prevalence of overweight and obesity

Figure 3-1 illustrates the proportion of children categorised as underweight, healthy weight, overweight and obese at ages 4, 6, 8 and 10 years.

As the graph shows, levels of overweight and obesity clearly and significantly increase with age. At age 6, 24% of children were overweight including 11% who were obese. By age 10, 34% of children were overweight including 19% who were obese. The proportion of children who were a healthy weight correspondingly decreased over the same period from 74% at age 6 to 64% at age 10.

**Figure 3-1 Children’s BMI classification by age**



Unweighted bases: Age 4 – 3676; Age 6 - 2710; Age 8 - 2752; Age 10 – 2754

### 3.4. Change in overweight and obesity

Change in BMI between ages 6 and 10 is considered in two ways: first, in relation to the extent to which children move between BMI classifications; second in relation to mean change in BMI score for children who remain in or move between different classifications over time.

#### 3.4.1. Change in BMI classification

The change in children’s BMI classifications between ages 6 and 10 are illustrated in Table 3-1 and Table 3-2.

Taking children’s BMI at age 6 as a starting point, the data in Table 3-1 show that the majority of children (79%) who were obese at age 6 were also obese at age 10. The remainder showed a decrease in BMI over time with 13% reducing to overweight and 8% to a healthy weight. Children who were overweight at age 6 were more likely to remain overweight or to move into the obese category than to show a drop in BMI: 34% moved to healthy weight whilst 34% showed no change and 33% moved into

# GROWING UP IN SCOTLAND

## OVERWEIGHT AND OBESITY AT AGE 10

the obese category. Most children (67%) who were underweight at age 6 were a healthy weight at age 10.

The results are broadly comparable with similar UK research. For example, analysis of data from the Millennium Cohort Study showed that the proportion of healthy, overweight and obese 5 year olds becoming or remaining obese by age 11 were 6%, 32% and 68% respectively (Mead *et al*, 2016). Comparative figures from analysis of administrative data from the National Child Measurement Programme (NCMP)<sup>13</sup> in England were 8%, 43% and 77% (Copley *et al*, 2017).

**Table 3-1 Children’s BMI classification at age 10 by BMI classification at age 6**

	BMI Age 6			
	Underweight	Healthy weight	Overweight	Obese
	%	%	%	%
BMI Age 10				
Underweight	29	2	-	-
Healthy weight	67	79	34	8
Overweight	-	12	34	13
Obese	4	8	33	79
<i>Unweighted bases</i>	51	1977	366	263

Starting with BMI classification at age 10 (Table 3-2), the results show that the majority of children who were obese at age 10 were already overweight or obese at age 6. For example 46% of obese children at age 10 were also obese at age 6 whilst 24% had increased from being overweight at age 6 and 30% from being a healthy weight. Children who were overweight (not obese) at age 10 had mostly (61%) been a healthy weight at age 6 whilst some (30%) had already been overweight. A small proportion (9%) had reduced their BMI from obese.

The most consistent group was those who were a healthy weight at age 10 – 90% had also been a healthy weight at age 6. Meanwhile those underweight at age 10 had mostly lowered their BMI since age 6 – 67% having been a healthy weight at that age.

<sup>13</sup> The NCMP is a child health surveillance programme which measures the height and weight of children in England in the first (Reception, age 4-5) and final (Year 6, age 10-11) years of primary school.

# GROWING UP IN SCOTLAND

## OVERWEIGHT AND OBESITY AT AGE 10

**Table 3-2 Children’s BMI classification at age 6 by BMI classification at age 10**

	BMI Age 10			
	Underweight	Healthy weight	Overweight	Obese
	%	%	%	%
BMI Age 6				
Underweight	33	2	-	<1
Healthy weight	67	90	61	30
Overweight	-	7	30	24
Obese	-	1	9	46
<i>Unweighted bases</i>	<i>47</i>	<i>1758</i>	<i>391</i>	<i>461</i>

Bases and source information go here.

### 3.4.2. Mean changes in BMI

Examining change through use of BMI classifications can mask underlying changes in BMI, particularly for those children who remain within the same classification at both ages. Furthermore, some children may change classification via a relatively small increase in their BMI score.

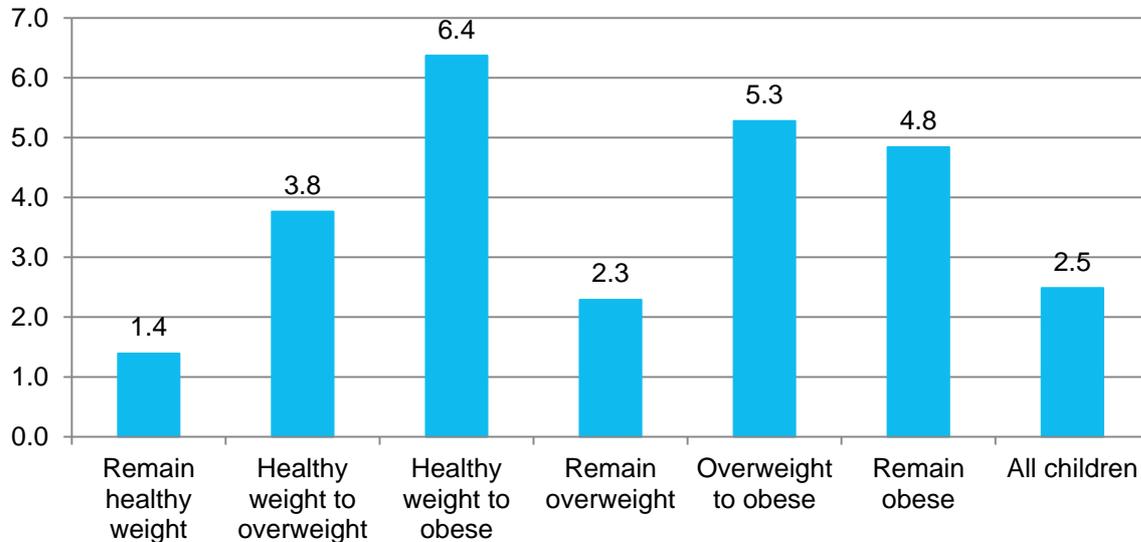
To explore this variation further, children whose BMI had increased so that they moved category and those whose BMI category remained the same were placed in the following groups according to their BMI status at ages 6 and 10<sup>14</sup>:

- Remain healthy weight
- Move from healthy weight to overweight
- Move from healthy weight to obese
- Remain overweight
- Move from overweight to obese
- Remain obese

The mean change in BMI for children in each category is shown in Figure 3-2.

<sup>14</sup> Children who were underweight at age 6 were not included given the small base sizes

**Figure 3-2 Mean change in BMI by change in BMI classification between ages 6 and 10**



Between the ages of 6 and 10, BMI increased by an average of 2.5 for all children. As may be expected, the largest changes are observed amongst those children who move into overweight or obese categories. For example, children who move from a healthy weight to obese record an average BMI change of 6.4 whilst those who move from overweight to obese show an average change of 5.3. Notably, even amongst those children who remain in the same category, increases are evident. In particular, children who are obese at both time points show an average BMI increase of 4.8.

# 4 SOCIO-ECONOMIC AND DEMOGRAPHIC VARIATIONS IN OVERWEIGHT AND OBESITY AT AGE 10

## 4.1. Introduction

Research on both child and adult overweight and obesity consistently demonstrates differences in rates among children with different socio-economic characteristics. For example, results from the 2016 Scottish Health Survey show that levels of overweight and obesity ranged from 33% and 32% amongst children living in areas in the two most deprived quintiles to around 25% for children living in less deprived areas (McLean *et al*, 2017). Previous analysis of GUS data has also borne out this trend. At age 6, 19% of children whose mother was degree educated were overweight or obese compared with 23% of children whose mother had qualifications up to Standard Grade or equivalent (Parkes *et al*, 2012).

This chapter will compare rates of overweight and obesity at ages 6, 8 and 10 according to sex and ethnicity and between children with different socio-economic backgrounds as measured by household income, parental level of education and area deprivation.

## 4.2. Key findings

- Between age 6 and age 10, rates of overweight and obesity increase similarly both for boys and girls, and for children of white and other ethnicities. For example, boys increased from 25% to 34%, girls from 23% to 34%. There were no significant differences in the proportion of children overweight/obese by sex or ethnicity.
- Increasing levels of overweight and obesity was also observed across all socio-economic sub-groups. For example, amongst children in the lowest income group overweight including obesity increased from 23% at age 6 to 36% at age 10 and for children in the highest income group from 20% to 29%.
- Children in more disadvantaged groups showed a greater increase in overweight including obesity with age than children in more advantaged groups. As a result, social inequalities in levels of overweight and obesity widen between ages 6 and 10.

### 4.3. Demographic variations in overweight/obesity

Differences in the proportion of children overweight including obese by sex and ethnicity at each age point are shown in Table 4-1. In both instances, the data show a clear and similar increase in rates of overweight (including obese) both for boys and girls, and for children of white and other ethnicities. None of the differences between sub-groups at any age point are statistically significant.

**Table 4-1 Percent of children overweight (incl. obese) at age 6, 8 and 10 years by sex and ethnicity, household income, parental level of education and area deprivation**

	Age 6	Age 8	Age 10
<b>Sex</b>	NS	NS	NS
Boys	25	27	34
Girls	23	30	34
<i>Unweighted bases – boys</i>	1372	1400	1400
<i>Unweighted bases – girls</i>	1338	1352	1354
<b>Ethnicity</b>	NS	NS	NS
White	25	29	34
Other ethnicity	19	24	30
<i>Unweighted bases – White</i>	2617	2657	2660
<i>Unweighted bases – Other ethnicity</i>	91	93	92

NS = Not statistically significant; \* p <.05; \*\* p <.01; \*\*\* p<.001

### 4.4. Socio-economic variations in overweight/obesity

The increase in the proportion of children who were overweight including obese between ages 6 and 10 can also be observed across all socio-economic sub-groups (Table 4-2). For example, rates of overweight (including obesity) increased amongst children in all income groups<sup>15</sup>, including from 23% at age 6 to 36% at age 10 amongst the lowest income group and from 20% to 29% amongst the highest income group.

Notably, the rates of change between sub-groups appear to be different with children in more disadvantaged groups showing a greater increase in overweight including obesity with age than children in more advantaged groups. Amongst children living in

<sup>15</sup> The income measure used here was collected at the age 10 data collection

# GROWING UP IN SCOTLAND

## OVERWEIGHT AND OBESITY AT AGE 10

areas in the least deprived quintile<sup>16</sup>, for example, there is very little change in rates of overweight including obese – rising just 3 percentage points from 22% at age 6 to 25% at age 10. In contrast, the proportion of children living in areas in the most deprived quintile that were overweight including obese increased by 15 percentage points from 24% to 39%. The result is that inequalities in the prevalence of overweight including obesity already observed at age 6 persist and have widened markedly by age 10.

**Table 4-2 Percent of children overweight (incl. obese) at age 6, 8 and 10 years by household income, parental level of education and area deprivation**

	% overweight including obese		
	Age 6	Age 8	Age 10
<b>Equivalised household income</b>	*	NS	**
Bottom Quintile (<£11,944)	23	29	36
2nd Quintile (≥£11,944 <£19,643)	29	30	37
3rd Quintile (≥£19,643 < £29,166)	26	29	35
4th Quintile (≥£29,166 < £37,500)	22	24	28
Top Quintile (≥£37,500)	20	25	29
<i>Unweighted bases – bottom quintile</i>	437	443	437
<i>Unweighted bases – 2<sup>nd</sup> quintile</i>	529	538	535
<i>Unweighted bases – 3<sup>rd</sup> quintile</i>	502	505	506
<i>Unweighted bases – 4<sup>th</sup> quintile</i>	549	556	563
<i>Unweighted bases – 5<sup>th</sup> quintile</i>	563	568	570
<b>Highest parental level of education</b>	**	***	***
No qualification	30	28	44
Lower level Standard Grades and Vocational qualifications / other qualifications	29	37	45
Upper level Standard Grades and Intermediate Vocational qualifications	25	32	38
Higher grades and Upper level vocational qualifications	28	31	36
Degree level academic and vocational	19	22	26

<sup>16</sup> Area deprivation measured using the 2012 Scottish Index of Multiple Deprivation

# GROWING UP IN SCOTLAND

## OVERWEIGHT AND OBESITY AT AGE 10

qualifications			
<i>Unweighted bases – No qualifications</i>	82	86	85
<i>Unweighted bases – Lower level Standard Grades</i>	94	95	95
<i>Unweighted bases – Upper level Standard Grades</i>	418	419	419
<i>Unweighted bases – Higher Grades etc</i>	894	922	923
<i>Unweighted bases – Degree level</i>	1217	1225	1228
<b>Area deprivation (quintiles)</b>	NS	NS	***
1 Least deprived	22	24	25
2	23	26	33
3	25	28	34
4	29	32	38
5 Most deprived	24	31	39
<i>Unweighted bases – Least deprived</i>	664	681	687
<i>Unweighted bases – 2</i>	665	668	673
<i>Unweighted bases – 3</i>	547	557	553
<i>Unweighted bases – 4</i>	464	473	469
<i>Unweighted bases – Most deprived</i>	370	373	372

NB: Income, education and area deprivation measured at age 6

\* p <.05, \*\* p <.01. \*\*\* p<.001, NS = Not statistically significant

# 5 VARIATIONS IN OVERWEIGHT AND OBESITY AT AGE 10 BY OTHER FACTORS

## 5.1. Introduction

The causes of childhood obesity are known to be many and complex (Obesity Action Scotland, 2017). They range from features of early life such as birth weight and early nutrition, to parental behaviours and characteristics such as eating habits and maternal BMI. Children's diet, along with their levels of physical activity and sedentary behaviour, is also known to be important.

The comprehensive nature of topics included in GUS data collection permits an exploration of the relationship between some of these related factors and child overweight and obesity at age 10. In this chapter we therefore examine associations between overweight and obesity and various child, parent and family circumstances and experiences from birth to age 10, though focused mainly on the period between ages 6 and 10.

Note that where statistically significant associations are found, these do not prove a causal relationship.

## 5.2. Key findings

- Children whose mothers are overweight or obese are significantly more likely to be overweight including obese at age 10 than children whose mothers have a healthy BMI. For example, 29-32% of children whose mother was obese were also obese compared with 11% of children whose mother was a healthy weight.
- Longer typical screen time and irregular breakfast habits were associated with overweight/obesity. For example, 31% of children who always ate breakfast were overweight including obese compared with 44% of those who only occasionally ate breakfast. Both factors also varied considerably by social background with children in more disadvantaged circumstances more likely to have higher screen time and irregular breakfast habits.
- Children with a television in their bedroom were more likely to be overweight including obese than those without – 38% compared with 26%. Having less than the recommended amount of sleep was also associated with overweight/obesity.

# GROWING UP IN SCOTLAND

## OVERWEIGHT AND OBESITY AT AGE 10

- Neither child longstanding illness, frequency of unhealthy snacking for children or parents, level of physical activity at age 6, nor participation in sport were statistically significantly associated with child overweight/obesity at age 10.
- Thirty-five percent of parents whose children were obese and 88% of those whose children were overweight perceived them to be of normal weight. Sixty-three percent of children who were obese and 78% of those who were overweight perceived themselves to be 'about the right size'.
- Children who were obese were less likely to be very happy about the way they looked than healthy weight children (53% compared with 62%).
- Analysis to explore which factors were most closely associated with being overweight or obese at age 10 when all factors of interest were taken into account found relationships with being overweight or obese at age 6, having a mother who was obese, an average weekly screen time of 14 hours or more, only occasionally eating breakfast and having a TV in the child's bedroom. Of these, BMI status at age 6 was by far the strongest predictor of overweight/obesity at age 10.

### 5.3. Child health, birth weight and maternal BMI

Differences in children's BMI status at age 10 was examined according to variations in birth weight, maternal BMI and child health.

**Table 5-1 Children's BMI classification at age 10 by birth weight**

	Birth weight					
	<2.5kg	2.5 to <3kg	3 to <3.5 kg	3.5 to <4 kg	4 to <4.5 kg	4.5 kg or above
	%	%	%	%	%	%
BMI age 10						
Underweight	5	4	2	1	-	-
Healthy weight	69	64	67	63	56	64
Overweight	12	15	13	17	19	18
Obese	14	17	18	19	25	18
<i>Unweighted bases</i>	<i>157</i>	<i>378</i>	<i>995</i>	<i>840</i>	<i>319</i>	<i>63</i>

Birth weight was reported by parents during the first sweep of data collection when the child was aged 10 months. Data was collected in both imperial and metric units,

# GROWING UP IN SCOTLAND

## OVERWEIGHT AND OBESITY AT AGE 10

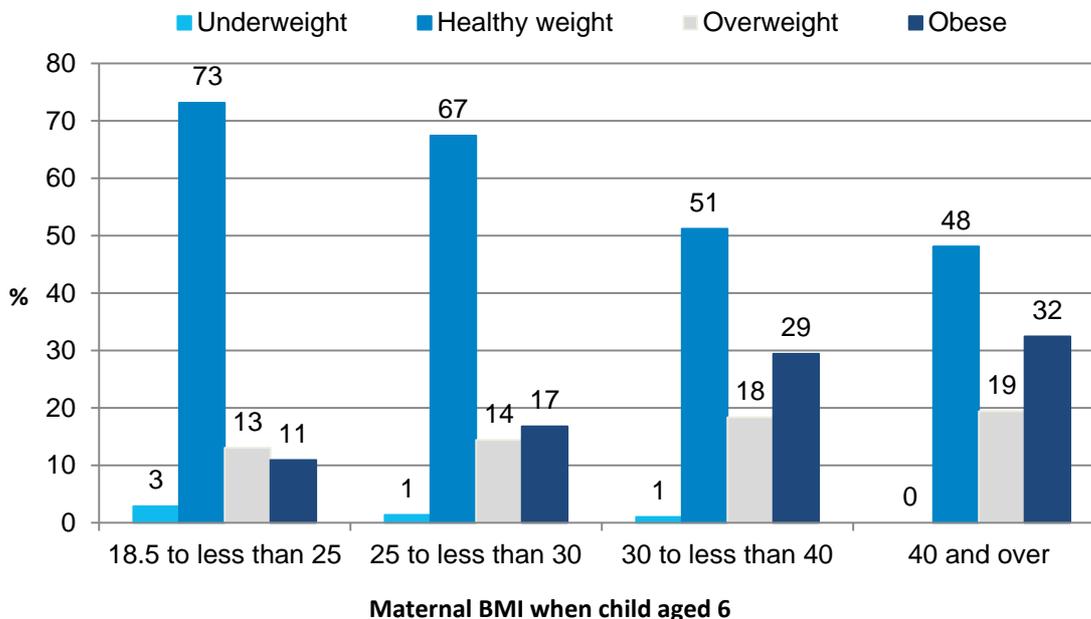
with imperial weights converted to create a single variable indicating weight ranges from < 2.5kg to  $\geq$  4.5kg. Results are shown in Table 5-1.

Children with a low birth weight (of less than 2.5kg) are less likely to be overweight or obese at age 10 than children with higher birth weights (Table 5-2). Likelihood of being overweight or obese generally increases with birth weight with children who weighed between 4 and 4.5kg at birth being considerably more likely to be overweight or obese than those with lower birth weights.

Maternal (biological mother's) BMI was measured when the child was aged 6. As with cohort children, the height and weight of mothers was measured by survey interviewers during the household visit. BMI was then calculated and grouped into standard classifications. For most adults, a BMI of 18.5 to 24.9 kg/m<sup>2</sup> is considered healthy, 25.0 to 29.9 kg/m<sup>2</sup> is overweight and over 30 kg/m<sup>2</sup> is obese.

As shown in Figure 5-1, child and maternal BMI are closely related. Children whose mothers are overweight or obese are significantly more likely to be overweight or obese themselves at age 10 than children whose parents have a healthy BMI. For example, 29% of children whose mother was obese and 32% whose mother was severely obese were also obese compared with 11% of children whose mother was a healthy weight.

**Figure 5-1 Children's BMI classification at age 10 by maternal BMI\***



\*Note mothers with BMI < 18.5 kg/m<sup>2</sup> were excluded due to low base sizes

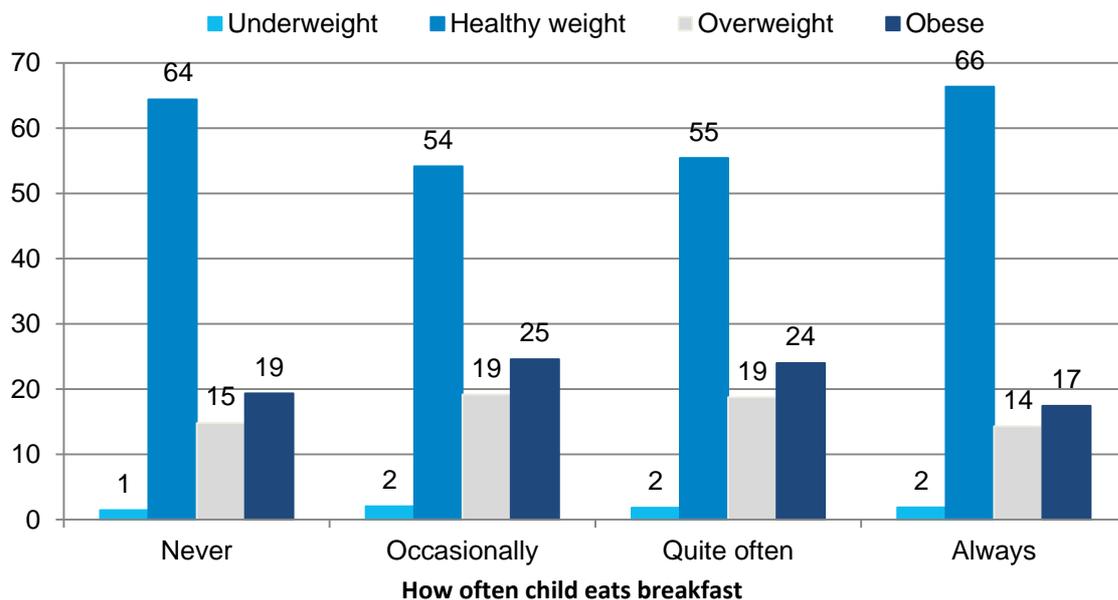
The relationship between child health and BMI at age 10 was explored using a measure of child longstanding illness. At each sweep of data collection, parents are asked whether the child has an illness or disability that has troubled or is likely to trouble him/her over a period of time. Responses given when the child was aged 6, 8 and 10 were combined to create a variable indicating whether the child was reported to have an illness at age 10, at ages 6 or 8 but not 10, or at none of these ages. There was no statistically significant relationship between child longstanding illness and child overweight/obesity at age 10.

### 5.4. Eating habits

Two measures of the child’s eating habits at age 10 were selected for analysis. The first combines data from three questions on how often the child ate sweets or chocolates, crisps, and drank sugary drinks into a summary measure of unhealthy snacking. The second asked how often the child ate breakfast.

Frequency of unhealthy snacking was not statistically significantly associated with overweight/obesity at age 10. This is perhaps not surprising given that the questions do not provide information on portion sizes nor wider eating habits (such as the nutritional content of main meals).

**Figure 5-2 Children’s BMI classification at age 10 by how often eats breakfast**



Eating breakfast was related to BMI at age 10. As shown in Figure 5-2, children who always ate breakfast were more likely to be a healthy weight and less likely to be

# GROWING UP IN SCOTLAND

## OVERWEIGHT AND OBESITY AT AGE 10

overweight or obese than children who ate breakfast occasionally or quite often<sup>17</sup>. Among children who always ate breakfast, 31% were overweight or obese compared with 44% of those who only occasionally ate breakfast.

This relationship may be driven by socio-economic variations in how often children eat breakfast. In general, children from more disadvantaged backgrounds – who are also more likely to be overweight or obese – were more likely than those from more advantaged backgrounds to have breakfast only occasionally or quite often. For example, 17% and 13% of children in the lowest income group had breakfast occasionally or quite often compared with 3% and 5% in the highest income group. In contrast, 91% of children in the highest income group always had breakfast compared with 66% in the lowest income group.

Using similar questions on sweets, crisps and sugary drinks, a measure of parental unhealthy snacking – again measured when the child was aged 10 - was also derived. This was not statistically significantly associated with child BMI at age 10 nor was it associated with maternal BMI when the child was aged 6.

### **5.5. Child activities**

Measures of child activity considered include levels of physical activity and participation in sport, sedentary behaviour, unsupervised time and sleep.

#### **5.5.1. Physical activity and organised sport**

Levels of physical activity were measured using the approach applied in the Scottish Health Survey. When the child was aged 6, parents were asked about their child's participation in four types of physical activity (for at least 5 minutes) in the past week. For activities outside school, these included walking, organised sports or exercise activities such as swimming lessons or a gymnastics class, and other active behaviour such as running about, riding a bicycle or kicking a ball around. Mothers were also asked whether their child had taken part in walking, sports, exercise or other active things when the child was at school.

For each of these different types of physical activity, mothers were asked for the number of weekdays and the number of weekend days on which their child had engaged in the activity, and for the duration of each type of activity on both a weekday and a weekend day in the past week. Average duration was recorded using a 10-point scale, running from (1) at least 5 minutes but under 15 minutes to (10) 4 hours or more. This information was used to estimate typical total physical activity time per week and to classify children into three groups:

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<sup>17</sup> Very few children were reported as never eating breakfast meaning the base size for this group is particularly small (<50). As such, results for the never group should be interpreted with caution.

- those active for 60 minutes or more on all seven days
- those active for between 30 and 59 minutes on all seven days
- those with lower levels of activity

Excluding activity at school, the vast majority of children (84%) were reported as having been active for 60 minutes or more on every day in the past week. Just 8% had been active for between 30 and 59 minutes on each day and 8% less so. When activity at school is included, 86% had been active for 60 minutes or more every day. Whether including or excluding activity at school, level of physical activity at age 6 was not associated with overweight or obesity at age 10.

When the child was aged 6 and 8, parents were also asked whether the child regularly participated in out-of-school activities including organised team and individual sports.

Data from both time points was combined to create a variable indicating whether the child participated in organised sport at ages 6 and 8, at one or other age, or at neither age. Fifty-six percent of children were regularly participating in sport at each age<sup>18</sup>, 25% only at either 6 or 8 years and 19% at neither age. This was not statistically significantly associated with overweight or obesity at age 10.

### **5.5.2. Sedentary behaviour**

Screen time was used as a measure of sedentary behaviour. When the child was aged 6, 8 and 10, parents were asked how long their child spent watching television (including DVDs and videos), and how long they spent using a computer or games console, on a typical weekday and a typical Saturday. Duration was recorded in hours, or fractions of hours. Weekly hours of screen time were calculated for each age and then averaged over the three ages.

Almost one-third (29%) of children were reported to have less than 14 hours of screen time per week with a similar, though slightly larger proportion, having between 14 and 21 hours (36%). Twenty-two percent spent between 21 and 28 hours per week on screen-based activity and 14% 28 hours or more (equating to 4 or more hours per day).

Weekly screen time was associated with BMI at age 10, with children with higher typical screen time more likely to be overweight or obese than those with lower screen time. As shown in Figure 5-3, 40-41% of children with over 21 hours per week of screen time were overweight or obese compared with 34% of children with between 14 and 21 hours, and 25% of children with less than 14 hours.

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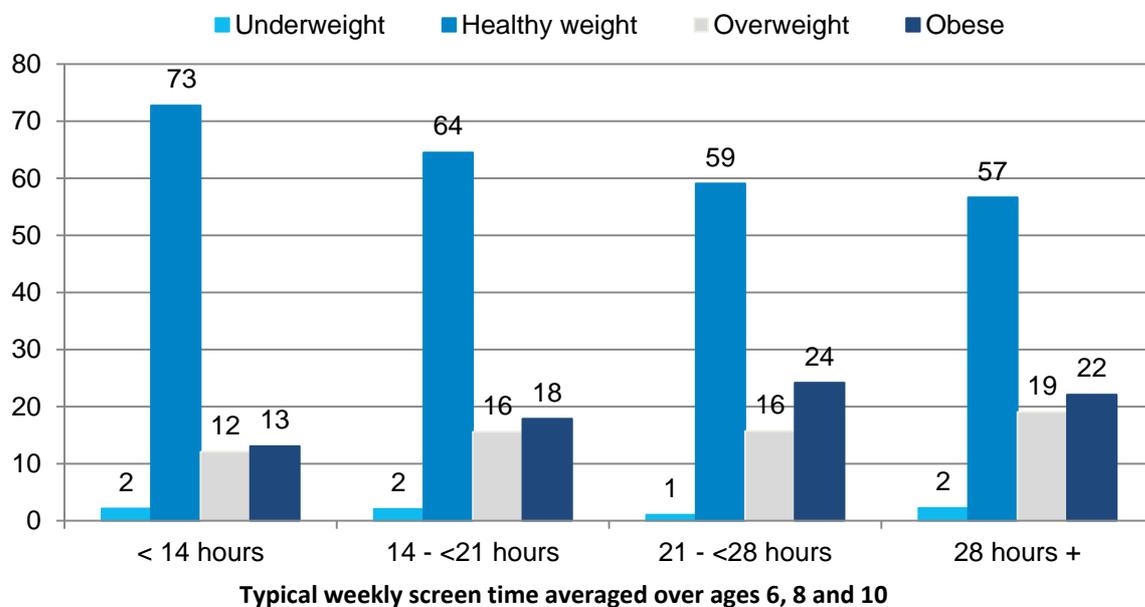
<sup>18</sup> 63% of children were regularly participating in sport at age 6 and 74% were doing so at age 8.

# GROWING UP IN SCOTLAND

## OVERWEIGHT AND OBESITY AT AGE 10

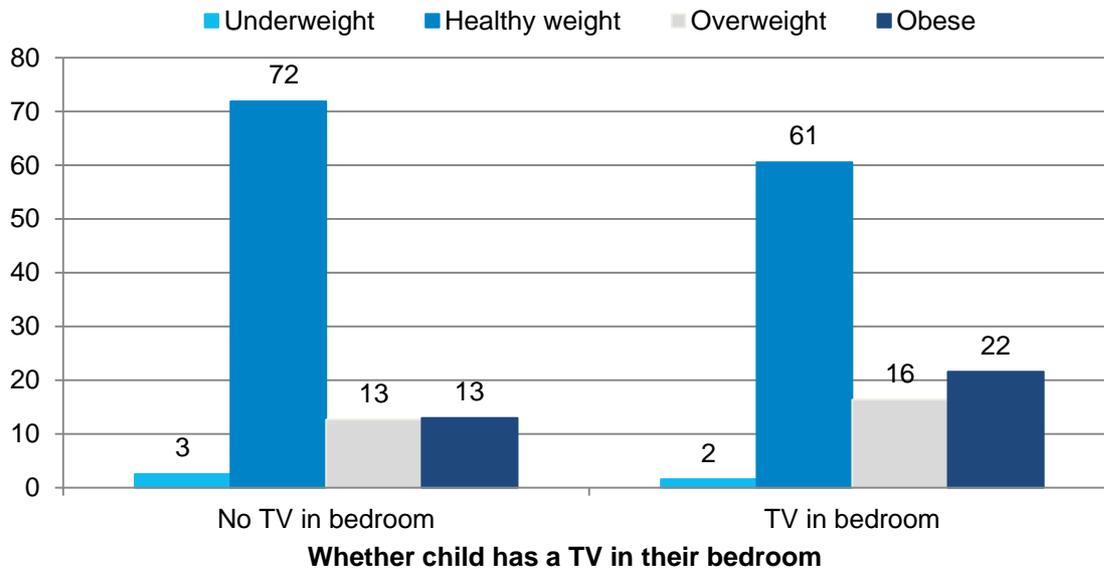
Socio-economic variations are again notable here, and they may be driving some of the differences in rates of overweight and obesity. Children in lower income groups were considerably more likely to have higher weekly screen time than children in higher income groups. For example, 49% of children in the lowest income group were reported to have 21 hours or more of screen time per week compared with 24% of children in the highest income group.

**Figure 5-3 Children’s BMI classification at age 10 by typical weekly screen time**



A factor which may influence levels of screen time and thus overweight and obesity, is whether or not a child has a television in their bedroom. The analysis found that children with a television in their bedroom were more likely to be overweight or obese than those without (Figure 5-4).

**Figure 5-4 Children’s BMI classification at age 10 by whether has a TV in bedroom**



Children in more disadvantaged circumstances were significantly more likely than those in more advantaged circumstances to have a television in their bedroom which may be affecting the relationship with BMI. Four out of five children (82%) in the lowest income households had a television in their bedroom compared with just over two out of five (44%) children in the highest income households.

### 5.5.3. Unsupervised time

Differences in BMI were also analysed according to a measure of parental supervision. The hypothesis is that parents who report higher levels of supervision generally may extend that level of regulation to aspects of their child’s life associated with their health, including overweight and obesity – for example their diet and levels of physical activity.

To measure level of supervision, parents were asked how often the child spent time with his/her friends, but without adults, doing things like playing in the park, going to the shops or just hanging around after school. There was no association between frequency of unsupervised time and BMI at age 10.

### 5.5.4. Sleep

A number of research studies have found an association between lack of sleep and obesity (Reilly *et al*, 2005; Taveras *et al*, 2008). In GUS, sleep duration is measured by asking parents what time the child is typically in bed and ready to sleep and what time the child wakes up on a school day. Duration of sleep was measured at ages 6, 8 and 10 and compared with the recommended sleeping time for children at these

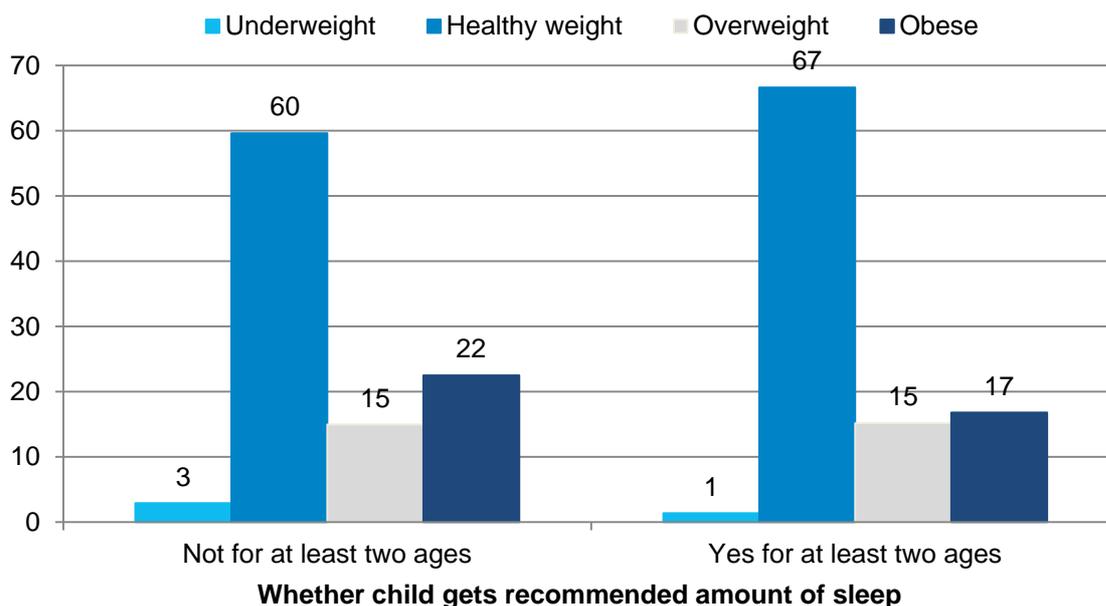
# GROWING UP IN SCOTLAND

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ages<sup>19</sup>. A variable was created which indicated whether or not the child was reported to have less than the recommended amount of sleep for at least two out of the three age points.

Children who were reported to have had less than the recommended amount of sleep were a little more likely to be overweight or obese than those who did get the recommended amount of sleep (Figure 5-5). Of those who had less than the recommended amount of sleep at two or three ages, 37% were overweight or obese at age 10 compared with 32% of those who had the recommended amount of sleep.

**Figure 5-5 Children’s BMI classification at age 10 by whether child gets enough sleep**



Variations in whether children got less than the recommended amount of sleep by social background may be influencing the relationship with BMI. Forty percent of children in the lowest income group were reported to have had less than the recommended amount of sleep compared with 30% of those in the highest income group.

<sup>19</sup> As advised by NHS Choices from recommendations by the Millpond Children’s Sleep Clinic, <https://www.nhs.uk/Livewell/Childrendefsleep/Pages/howmuchsleep.aspx>

### 5.6. Perceived body size and body image

#### 5.6.1. Parent and child perceptions of weight

A parent's perception of their child's weight status and recognising the potential health risks from being overweight or obese is important in influencing the facilitation or 'modelling' of healthy behaviours (i.e. when parents themselves undertake health promoting activities and behaviour). Similarly, if children themselves do not recognise that they are overweight or obese they may be less inclined to take action to reduce their weight or prevent further increases in BMI.

When children were aged 10, parents were asked how they would describe their child's weight from four categories: underweight, normal weight, somewhat overweight or very overweight. Similarly, children were themselves asked whether they thought their body was much too thin, a bit too thin, about the right size, a bit too fat or much too fat.

The results in Table 5-2 show that whilst many parents accurately classify their child's weight, a significant proportion whose children are overweight or obese tend to think their children are a normal weight. For example, 35% of parents whose children were obese and 88% of those whose children were overweight perceived them to be of normal weight.

**Table 5-2 Parental perception of child's weight by BMI classification at age 10**

	BMI classification at age 10				
	Underweight	Healthy weight	Overweight	Obese	All
	%	%	%	%	%
Parent's perception of child's weight					
Underweight	29	7	-	-	5
Normal weight	71	92	88	35	80
Somewhat overweight	-	1	12	63	14
Very overweight	-	-	-	2	<1
<i>Unweighted bases</i>	<i>50</i>	<i>1813</i>	<i>408</i>	<i>476</i>	<i>2806</i>

As shown in Table 5-3, 63% of children who were obese and 78% of those who were overweight perceived themselves to be 'about the right size'. This may suggest that a

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sizeable proportion of children who may be at risk of poorer health outcomes due to overweight or obesity may not be aware of this. 16% of healthy weight children thought they were either a bit or much too thin.

**Table 5-3 Child's perception of his/her weight by BMI classification at age 10**

BMI classification at age 10					
	Underweight	Healthy weight	Overweight	Obese	All
	%	%	%	%	%
Child's perception of weight					
Much too thin	10	4	1	1	3
A bit too thin	36	12	2	1	9
About the right size	54	80	78	63	76
A bit too fat	-	4	18	30	11
Much too fat	-		1	5	1
<i>Unweighted bases</i>	<i>49</i>	<i>1803</i>	<i>407</i>	<i>472</i>	<i>2770</i>

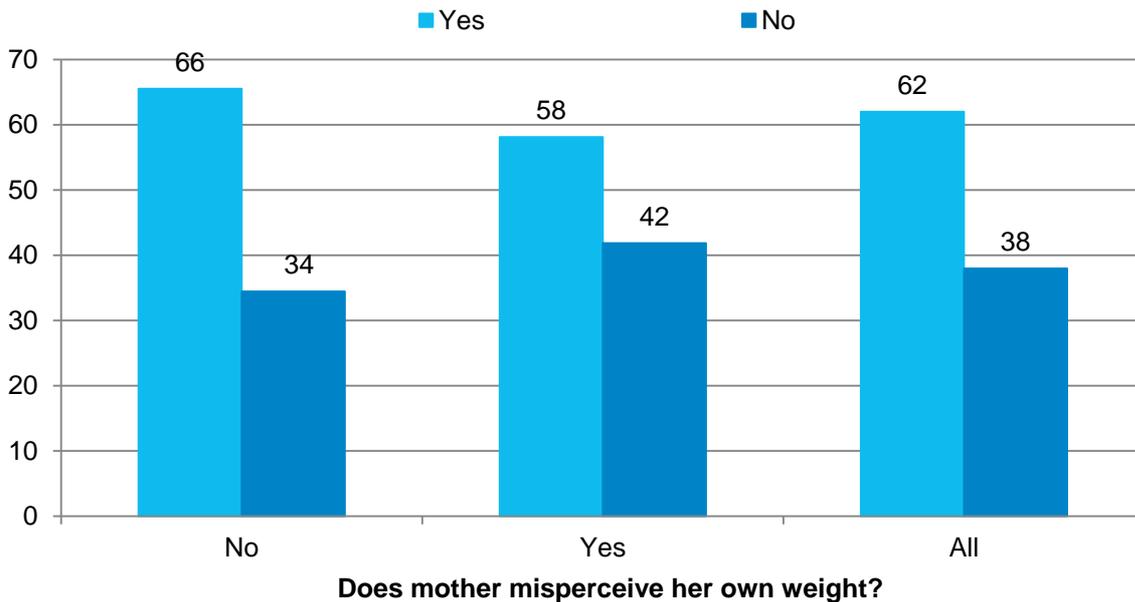
Parents' perceptions of their child's weight were compared with the child's view (Table 5-4). Other than for healthy weight, there was no overwhelming correspondence between what parents and children reported. Whilst for 80% of cases where a parent perceived their child to be normal weight the child also deemed themselves to be about the right size, only in 40% of cases where a parent perceived the child to be overweight did the child deem themselves too fat.

**Table 5-4 Child's perception of his/her weight by parent's perception of child's weight**

Parent's perception of child's weight			
	Underweight	Normal weight	Overweight
	%	%	%
Child's perception of weight			
Too thin	43	12	1
About the right size	56	80	59
Too fat	1	8	40
<i>Unweighted bases</i>	<i>144</i>	<i>2241</i>	<i>378</i>

Further analysis was conducted to examine whether mothers who misperceived their own weight were more likely than those who correctly perceived their own weight to misperceive their child's weight (Figure 5-6). The majority of mothers correctly identified their child's weight status at age 10, 62% having done so. Even amongst mothers who incorrectly perceived their own weight status, most (58%) accurately identified their child's status. However, those mothers who misperceived their own weight were more likely than those who correctly perceived their own weight to judge their child's weight incorrectly. Forty-two percent of mothers who were incorrect about their own weight were also incorrect about their child's weight compared with 34% of mothers who were correct about their own weight.

**Figure 5-6 Whether mother correctly classified child's weight at age 10 by mother's classification of her own weight**



### 5.6.2. Child's satisfaction with body image

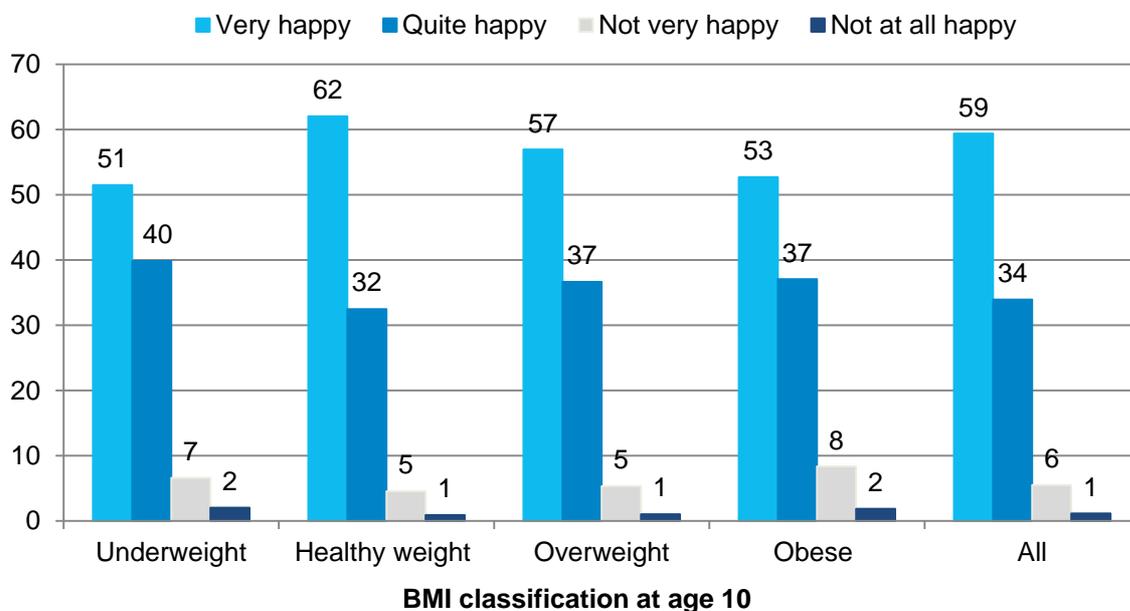
The relationship between body satisfaction and increasing weight status has been demonstrated in a number of research studies. In GUS, body satisfaction was measured by asking children how they felt about the way they look. A four-point response set was used ranging from 'very happy' to 'not at all happy'.

The vast majority of children were either very (59%) or quite (34%) happy with the way they looked. There were no statistically significant differences by sex, with similar proportions of boys and girls being happy and unhappy with how they look.

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**Figure 5-7 Children’s BMI classification at age 10 by body satisfaction**



**Table 5-5 Body satisfaction by child’s BMI status and sex**

	Child’s BMI classification at age 10			
	Underweight	Healthy weight	Overweight	Obese
	%	%	%	%
<b>Body satisfaction - boys</b>				
Very happy	*	60	55	57
Quite happy	*	35	38	33
Not very happy	*	5	6	8
Not at all happy	*	1	-	1
<b>Body satisfaction - girls</b>				
Very happy	*	64	59	48
Quite happy	*	30	35	41
Not very happy	*	4	5	8
Not at all happy	*	1	2	2
<i>Unweighted bases – boys</i>	27	901	210	247
<i>Unweighted bases - girls</i>	22	901	199	226

\*Base sizes are too small to report.

However, body satisfaction did vary by weight status. As shown in Figure 5-7, most children across all BMI groups were happy with how they looked. However, children who were obese were less likely to be very happy and more likely to be not very happy than healthy weight children (53% compared with 62% and 8% compared with 5% respectively). Differences in body satisfaction between children who were overweight and healthy weight were not statistically significant.

There was no statistically significant difference in the relationship between weight status and body satisfaction between boys and girls (Table 5-5). For both groups, most children were happy with how they looked across each weight classification. The data suggests that girls who are obese may be less likely to be very happy with how they look than boys who are obese (48% compared with 57%); however the difference is not statistically significant. Almost identical proportions of obese boys and girls were not happy with how they looked (9% and 10%).

### **5.7. Multivariable analysis of factors predicting overweight or obesity at age 10**

Analysis in the previous sections has shown relationships between a range of children's characteristics, circumstances and experiences and their weight status at age 10. In particular, section 4 demonstrated the considerable socio-economic differences in levels of overweight and obesity. The subsequent analysis of other factors – such as how often children eat breakfast - suggested that it may be the underlying variations in these factors by social background which is driving the relationship with overweight and obesity. In other words the association between eating breakfast and weight status exists because those children who eat breakfast less often tend to be from more disadvantaged backgrounds, the same children who are more likely to be overweight or obese.

To control for these inter-connected relationships between social background characteristics and other factors, multivariable logistic regression analysis was undertaken. This allows some insight into those factors which are independently associated with overweight and obesity at age 10.

The analysis was conducted in a series of steps:

- First, a regression model was run which included only demographic (sex, ethnicity) and socio-economic variables (household income, parental educational qualifications, social class and area deprivation)
- Second, weight status at age 6 was added to a model containing only significant variables from amongst the demographic and socio-economic variables
- Third, a separate model was run including those other factors found to be statistically significantly associated with weight status in the cross-sectional

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analysis conducted earlier in section 5 (birth weight, maternal BMI, frequency at which breakfast eaten, screen time, TV in bedroom, sleep).

- Finally, a combined model was then run including the statistically significant variables from the first three steps.

In all models, the outcome variable was whether or not the child was overweight or obese at age 10.

**Table 5-6 Factors predicting overweight/obesity at age 10 – SES and demographic variables – summary results<sup>20</sup>**

	Sig.	Odds ratio
<b>Highest parental educational qualification (ref: degree level)</b>	< .001	
No qualification		1.822
Lower level Standard Grades and Vocational qualifications / other qualifications		2.238
Upper level Standard Grades and Intermediate Vocational qualifications		1.397
Higher grades and Upper level vocational qualifications		1.562
<b>Area deprivation – quintiles (ref: 1 - least deprived 20% of areas)</b>	< .05	
2		1.168
3		1.411
4		1.571
5 Most deprived		1.515
<b>Child sex (ref: female)</b>	NS	
<b>Child ethnicity (ref: White)</b>	NS	
<b>Household annual equivalised income (ref: Top quintile &gt;=£39,216)</b>	NS	
<b>Socio-economic classification (ref: Managerial and professional)</b>	NS	

Pseudo R squared = .04

A summary of results from the first step are provided in Table 5-6. Of the various demographic and socio-economic variables considered, only two - parent's level of

<sup>20</sup> Full results are shown in Table A-1 in the Appendix

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## OVERWEIGHT AND OBESITY AT AGE 10

education and area deprivation - remained significant after controlling for differences in the other variables. The findings indicate that, after controlling for other demographic and socio-economic differences, compared with children whose parents were degree-educated, those whose parents had lower qualifications were more likely to be overweight or obese at age 10. Similarly, compared with children living in the 20% least deprived areas, those living in the three most deprived quintiles were more likely to be overweight or obese.

Table 5-7 provides a summary of the results of the regression analysis from step two when BMI at age 6 is added alongside parent's level of education and area deprivation.

**Table 5-7 Factors predicting overweight/obesity at age 10 – combined age 6 weight status and SES variables – summary results<sup>21</sup>**

	Sig.	Odds ratio
<b>Child's BMI classification at age 6 (ref: underweight/healthy weight)</b>	< .001	
1.00 Missing		3.045
3.00 Overweight		8.307
4.00 Obese		44.692
<b>Highest parental educational qualification (ref: degree level)</b>	< .05	
No qualification		1.632
Lower level Standard Grades and Vocational qualifications / other qualifications		2.071
Upper level Standard Grades and Intermediate Vocational qualifications		1.352
Higher grades and Upper level vocational qualifications		1.314
<b>Area deprivation – quintiles (ref: 1 - least deprived 20% of areas)</b>	< .05	
2		1.128
3		1.362
4		1.461
5 Most deprived		1.585

Pseudo R squared = .36

<sup>21</sup> Full results are shown in Table A-2 in the Appendix

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## OVERWEIGHT AND OBESITY AT AGE 10

Being overweight, and in particular, being obese, is very strongly associated with being overweight or obese at age 10 after controlling for differences in social background. For children who were overweight at age 6 and for those who were obese, the odds of being overweight/obese at age 10 were 8 and 45 times higher than those for children who were a healthy weight or underweight at age 6.

Even after controlling for weight status at age 6, social background remained an important predictor of overweight or obesity at age 10. Lower parental qualifications and higher area deprivation were each associated with overweight or obesity at age 10.

When running the third step, all variables except the child's sleep duration were found to be statistically significantly associated with overweight/obesity at age 10 (Table 5-8). These included: a birthweight of 4kg or more (compared with a birthweight of 3 to 3.499kg); having a mother who was overweight or obese; eating breakfast less often than 'always'; screen time of 14 hours or more (compared with less than 14 hours) and a having a TV in the child's bedroom. Of the factors considered, having a mother who was obese had the strongest association with the child being overweight or obese at age 10. Notably, having missing data on screen time was also strongly associated with overweight/obesity. Whilst this may suggest that those who did not provide a response to this question are perhaps more likely to have children with high screen time durations, only a relatively small number of cases ( $n = 46$ ) in the model fell into this category. Therefore any such interpretation should be treated with caution.

After the statistically significant socio-economic and other factors were combined into a single model along with age 6 weight status, neither area deprivation, parental level of education nor birthweight were associated with overweight/obesity at age 10. The remaining variables all showed some independent association with overweight/obesity, as shown in Table 5-9.

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**Table 5-8 Factors predicting overweight/obesity at age 10 – Other variables – summary results<sup>22</sup>**

	Sig.	Odds ratio
<b>Birth weight (ref: 3 to 3.499kg)</b>	< .05	
< 2.5 kg (low birth weight)		.631
2.5 - <3kg		.996
3.5 - <4 kg		1.145
4 kg or above		1.484
<b>Maternal BMI (ref: less than 25)</b>	< .001	
Missing		2.109
25 to less than 30		1.375
30 and over		2.772
<b>How often child eats breakfast (ref: always)</b>	< .05	
Never		.888
Occasionally		1.476
Quite often		1.376
<b>Average weekly screen time (ref: less than 14 hours)</b>	< .001	
Missing		3.377
14 - <21 hours		1.340
21 - <28 hours		1.753
28 hours or more		1.665
<b>Whether child has TV in bedroom (ref: No)</b>	< .001	
Yes		1.397
<b>Whether child gets recommended amount of sleep</b>	NS	

Pseudo R squared = 0.10

<sup>22</sup> Full results are shown in Table A-3 in the Appendix

# GROWING UP IN SCOTLAND

## OVERWEIGHT AND OBESITY AT AGE 10

**Table 5-9 Factors predicting overweight/obesity at age 10 – combined age 6 BMI, SES, demographic and other variables – summary results<sup>23</sup>**

	Sig.	Odds ratio
<b>Child's BMI classification at age 6 (ref: underweight/healthy weight)</b>	< .001	
1.00 Missing		2.609
3.00 Overweight		8.099
4.00 Obese		43.231
<b>Maternal BMI (ref: less than 25)</b>	< .001	
Missing		1.647
25 to less than 30		1.240
30 and over		2.297
<b>How often child eats breakfast (ref: always)</b>	< .05	
Never		0.956
Occasionally		1.533
Quite often		1.552
<b>Average weekly screen time (ref: less than 14 hours)</b>	< .001	
Missing		4.088
14 - <21 hours		1.329
21 - <28 hours		1.638
28 hours or more		1.661
<b>Whether child has TV in bedroom (ref: No)</b>	< .01	
Yes		1.303
<b>Highest parental educational qualification (ref: degree level)</b>	NS	
<b>Area deprivation – quintiles (ref: 1 - least deprived 20% of areas)</b>	NS	
<b>Birth weight (ref: 3 to 3.499kg)</b>	NS	

Pseudo R squared = 0.40

Weight status at age 6 remains the strongest predictor of overweight/obesity at age 10 with odds ratios similar to those noted in Table 5-7. Having a mother who was

<sup>23</sup> Full results are shown in Table A-4 in the Appendix

# GROWING UP IN SCOTLAND

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obese when the child was aged 6 was the next strongest predictor. After controlling for weight status at age 6 and social background, the odds of children with an obese mother being overweight/obese at age 10 were 2.3 times higher than the odds for children whose mother was a healthy weight (or underweight, BMI < 25). Average weekly screen time, only occasionally eating breakfast, and whether the child had a TV in their bedroom all remained statistically significantly associated with overweight/obesity at age 10.

Overall, the explanatory power of the combined model was moderately strong with around 40% of the variance in overweight/obesity being explained. The majority of this is accounted for by weight status at age 6. The additional variables explain only a small additional amount of difference in children's levels of overweight/obesity.

# 6 FACTORS ASSOCIATED WITH CHANGE IN BMI CATEGORY BETWEEN AGES 6 AND 10

## 6.1. Introduction

The previous chapter considered – amongst the relevant data available in GUS - factors associated with a child being overweight or obese at age 10. As demonstrated in earlier sections, a reasonable proportion of children who were overweight or obese at age 10 had been a healthy weight at age 6. Similarly, some of those children who were overweight or obese at age 6 were a healthy weight at age 10. In relation to identifying issues relevant for tackling and preventing childhood overweight and obesity, both of these groups are of interest.

In this section we explore the factors associated with a move into and a move out of overweight and obesity between the ages of 6 and 10. The analysis uses the same variables explored in the previous chapter.

## 6.2. Key findings

- A higher proportion of children living in more deprived areas moved into overweight than did children living in less deprived areas. Seventeen percent of children living in areas in the most deprived quintile became overweight or obese compared with 11% of those living in areas in the least deprived quintile.
- Higher rates of moving into overweight were also seen amongst children whose mothers were obese, children who only occasionally or quite often ate breakfast, those with higher weekly screen time and those with a TV in their bedroom. For example, 16% of children with a TV in their bedroom moved into overweight compared with 11% of those who did not have a TV in their bedroom.
- A greater proportion of children with heavier birth weights than those with lighter birth weights moved out of overweight. Higher rates of moving out of overweight were also seen amongst those who snacked on unhealthy items less frequently and children who did not have a TV in their bedroom. For example, 10% of children who ate unhealthy snacks up to once a day moved out of overweight compared with 4% of those who consumed unhealthy snacks more often.

- The results of analysis undertaken to examine which factors were most closely associated with moving into overweight when all factors of interest were taken into account found that having a higher weekly screen time and a mother who was obese were statistically significantly associated with moving into overweight. The results also tentatively suggest that having a TV in the child's bedroom and not always eating breakfast may also be associated with moving into overweight, though the relationship was not statistically significant.
- Similar analysis found that moving out of overweight was associated with lower household income, less frequent consumption of unhealthy snacks and not having a TV in the child's bedroom.

### 6.3. Defining and identifying change

By comparing a child's BMI status at age 6 with the same measure at age 10, in section 3.4, we were able to identify the proportion of healthy weight children who become overweight or obese and the proportion of overweight or obese children who become a healthy weight. Using these two variables, a new variable was derived which captured transitions in BMI status between the two age points. This variable had the following categories:

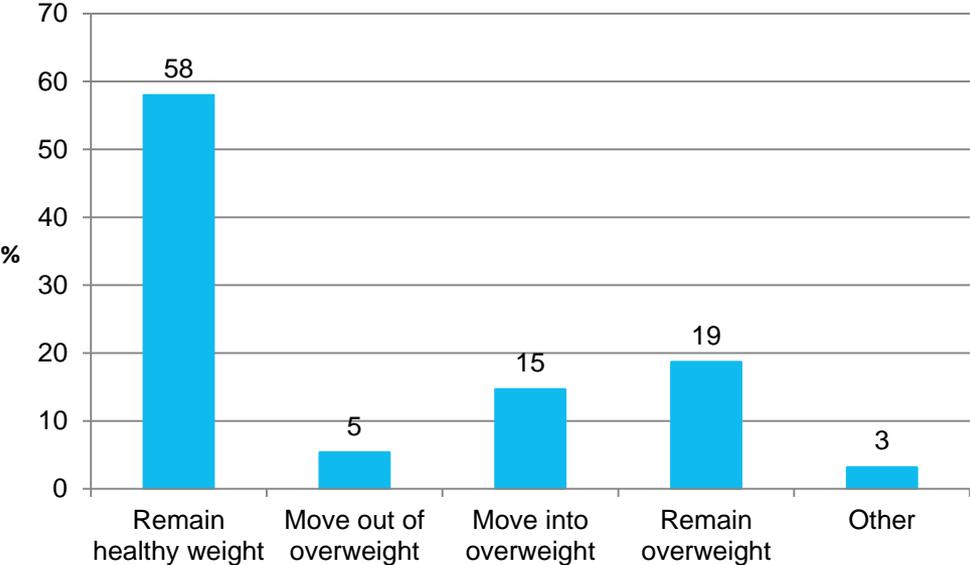
- Remain healthy weight: children whose BMI was classified as healthy weight at both ages
- Move out of overweight: children who were overweight or obese at age 6 and healthy weight or underweight at age 10
- Move into overweight: children who were healthy weight or underweight at age 6 and overweight or obese at age 10
- Remain overweight: children who were overweight or obese at age 6 and age 10
- Other: children who were underweight at age 6 and age 10 or who moved between being underweight and healthy weight

The proportion of children in each category is shown in Figure 6-1. Fifty-eight percent of all children were a healthy weight at age 6 and age 10. As may be expected given earlier results, children were more likely to move into than out of overweight. Fifteen percent moved into overweight whilst 5% moved out of overweight. A significant minority (19%) remained overweight whilst 3% fell into the 'other' category.

# GROWING UP IN SCOTLAND

## OVERWEIGHT AND OBESITY AT AGE 10

**Figure 6-1** Change in children’s BMI classification between age 6 and age 10

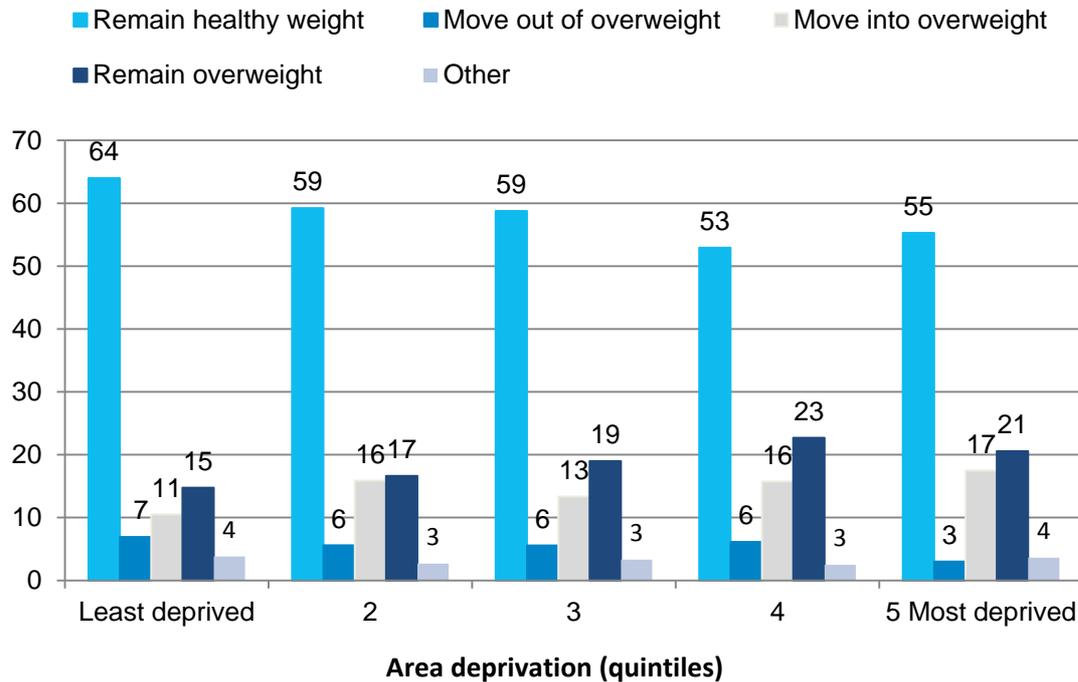


### 6.4. Demographic and socio-economic factors

Amongst the demographic and socio-economic factors considered – the child’s sex, ethnicity, household income, parental education, socio-economic classification and area deprivation – none were associated with a move *out of* overweight and only area deprivation showed any statistically significant relationship with the proportion of children who moved *into* overweight.

As shown in Figure 6-2, 17% of children living in areas in the most deprived quintile moved into overweight compared with 11% of children living in areas in the least deprived quintile.

**Figure 6-2 Change in children’s BMI classification between age 6 and age 10 by area deprivation**



### 6.5. Other factors

Different factors were found to be associated with moving into and moving out of overweight.

#### 6.5.1. Moving into overweight

In terms of moving into overweight, statistically significant differences were found according to maternal BMI, how regularly the child ate breakfast, average weekly screen time and whether or not the child had a TV in his/her bedroom. The results are summarised in Table 6-1.

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OVERWEIGHT AND OBESITY AT AGE 10

**Table 6-1 Percent of children who move into overweight between ages 6 and 10 by selected characteristics**

		Move into overweight	Unweighted bases
<b>Maternal BMI</b>			
Less than 18.5	%	9	19
18.5 to less than 25	%	11	1040
25 to less than 30	%	14	736
30 to less than 40	%	20	489
40 or over	%	18	62
<b>How often does child eat breakfast</b>			
Never	%	15	44
Occasionally	%	21	176
Quite often	%	23	187
Always	%	13	2250
<b>Average weekly screen time</b>			
Missing	%	32	34
Less than 14 hours	%	10	864
14 - <21 hours	%	15	942
21 - <28 hours	%	16	532
28 hours or more	%	18	285
<b>Whether child has TV in bedroom</b>			
Yes	%	16	1582
No	%	11	1075

Children whose mothers were overweight or obese were more likely to move into overweight than those whose mothers were a healthy weight. Twenty percent of children whose mother's BMI was between 30 and 40 moved into overweight compared with 11% of those whose mother's BMI was between 18.5 and 25. Those who only occasionally or quite often ate breakfast were more likely to move into overweight than those who always ate breakfast (21% and 23% compared with 13% respectively). Higher weekly screen time and having a TV in the child's bedroom were both associated with a move into overweight. For example, 16% of children with

# GROWING UP IN SCOTLAND

## OVERWEIGHT AND OBESITY AT AGE 10

a TV in their bedroom moved into overweight compared with 11% of those who did not have a TV in their bedroom.

### 6.5.2. Moving out of overweight

Birth weight, frequency of eating unhealthy snacks and having a TV in the child's bedroom were all associated with moving out of overweight. A summary of the results is shown in Table 6-2.

**Table 6-2 Percent of children who move out of overweight between ages 6 and 10 by selected characteristics**

		Move out of overweight	Unweighted bases
<b>Birth weight</b>			
< 2.5 kg (low birth weight)	%	4	152
2.5 - <3kg	%	3	364
3 - <3.5 kg	%	5	963
3.5 - <4 kg	%	6	811
4 - <4.5 kg	%	8	306
4.5 kg or above	%	3	59
<b>Frequency of eating unhealthy snacks</b>			
Up to once a day	%	10	606
More than once a day, up to twice a day	%	4	966
More than twice a day, up to three times a day	%	4	596
More than three times a day	%	4	489
<b>Whether child has TV in bedroom</b>			
Yes	%	5	1582
No	%	7	1075

Children with heavier birth weights were more likely to move out of overweight than those who were lighter at birth. Eight percent of children who weighed between 4kg and 4.5kg moved out of overweight compared with 3% of children who weighed between 2.5kg and 3kg. Snacking on unhealthy items less frequently was associated with moving out of overweight. Ten percent of children who ate unhealthy snacks up to once a day moved out of overweight compared with just 4% of those who consumed unhealthy snacks more often. Children who did not have a TV in their bedroom were more likely to move out of overweight than those who did (7%

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## OVERWEIGHT AND OBESITY AT AGE 10

compared with 5%). This was the only variable that was associated with both moving into and out of overweight.

### **6.6. Multivariable analysis of factors predicting moving into and out of overweight**

As noted earlier, given the considerable socio-economic differences both in levels of overweight and obesity and in other factors related to overweight and obesity, it is necessary to control for these underlying relationships in order to obtain some insight into those factors which are independently associated with moves into and out of overweight.

As previously, multivariable logistic regression was undertaken to explore which factors identified in the initial analysis remain statistically significantly associated with move into or out of overweight after controlling for other variations.

#### **6.6.1. Moving into overweight**

Given the small number of variables showing statistically significant differences in the initial analysis, all variables – area deprivation, maternal BMI, how regularly the child ate breakfast, weekly screen time, whether child has a TV in his/her bedroom, and whether child gets recommended amount of sleep - were entered into a single model. The outcome variable indicated whether the child had moved into overweight/obesity from being healthy or underweight between age 6 and age 10 with the reference category being children who were healthy or underweight at age 6 and had remained so at age 10. Children who were already overweight/obese at age 6 were excluded from the analysis.

A summary of the results is provided in Table 6-3. Of the various variables considered, two – maternal BMI and weekly screen time - remained statistically significant after controlling for differences in the other variables whilst a further two – TV in child's bedroom and breakfast habits – narrowly missed statistical significance<sup>24</sup> but appear to still be of some importance. The findings indicate that, after controlling for other differences between them, compared with children whose mothers were healthy or underweight, those whose mother was obese were more likely to move into overweight between ages 6 and 10. The odds of moving into overweight for children whose mother was obese were 2.5 times those for children whose mother was a healthy weight or underweight. Similarly, compared with children who were reported as having less than 14 hours of screen time per week, those with longer durations of screen time were more likely to move into overweight. The results also tentatively suggest that having a TV in their bedroom and eating breakfast only occasionally or quite often, as opposed to always – whilst narrowly

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<sup>24</sup> That is, the significance level or 'p-value' was just outside the 0.05/95% cut-off.

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missing statistically significance – may nevertheless also have some association with a move into overweight, after controlling for other differences between the children, including the level of area deprivation.

**Table 6-3 Factors predicting a move into overweight between age 6 and age 10 – summary results<sup>25</sup>**

	Sig.	Odds ratio
<b>Maternal BMI (ref: less than 25)</b>	< .001	
Missing		1.939
25 to less than 30		1.338
30 and over		2.512
<b>Average weekly screen time (ref: less than 14 hours)</b>	< .01	
Missing		4.743
14 - <21 hours		1.536
21 - <28 hours		1.800
28 hours or more		1.773
<b>Whether child has TV in bedroom (ref: No)</b>	NS (0.06)	
Yes		1.282
<b>How often child eats breakfast (ref: always)</b>	NS (0.06)	
Never		0.874
Occasionally		1.584
Quite often		1.676
<b>Area deprivation – quintiles (ref: 1 - least deprived 20% of areas)</b>	NS	
<b>Whether child gets recommended amount of sleep</b>	NS	

Pseudo R squared = 0.08

## 6.6.2. Moving out of overweight

Again, because only a small number of variables showed statistically significant relationships in the initial analysis, all variables – frequency of unhealthy snacks, whether the child had a TV in his/her bedroom and birth weight - were entered into a

<sup>25</sup> Full results are shown in Table A-5 in the Appendix

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single model. To control for differences in these variables by social background characteristics, each of the social background variables was also added – household income, parental education, socio-economic classification and area deprivation<sup>26</sup>. The outcome variable indicated whether the child had moved out of overweight/obesity between age 6 and age 10 with the reference category being children who were overweight/obese at age 6 and who had remained so at age 10. Children who were a healthy weight or underweight at age 6 were excluded from the analysis.

The results are summarised in Table 6-4. They indicate that, after controlling for other differences between them, compared with children in highest income group, those in lower income groups were more likely to move out of overweight between ages 6 and 10. Area deprivation was not associated with a move out of overweight.

Children who ate unhealthy snacks more often and those with a TV in their bedroom were less likely to move out of overweight. The relationship with unhealthy snacks was not linear which may reflect the accuracy of the measure. Nevertheless, the odds of children who had an unhealthy snack (sweets, chocolate or crisps) once or more a day of moving out of overweight were around 60% lower than those of children who had such a snack less often. Similarly, the odds of children with a TV in their bedroom moving out of overweight were 40% lower than those of children without a TV in their bedroom.

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<sup>26</sup> In the model predicting moving *into* overweight, area deprivation – a measure of social background – was statistically significantly associated with moving into overweight in the cross-sectional analyses and therefore included in the multivariable model. There was no need to include the other social background measures. For moving *out of* overweight, none of the social background variables were significant in the cross-sectional analyses. It was therefore not possible to choose a single social background measure to include in the model. As such, all measures were included in order that differences in social background were controlled for.

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**Table 6-4 Factors predicting a move out of overweight between age 6 and age 10 – summary results<sup>27</sup>**

	Sig.	Odds ratio
<b>Household annual equivalised income (ref: Top quintile &gt;=£39,216)</b>	< .05	
Missing		1.424
Bottom Quintile (<£13,450)		1.061
2nd Quintile (>=£13,451 <£22,827)		2.423
3rd Quintile (>=£22,827 < £29,375)		1.375
4th Quintile (>=£29,375 < £39,216)		1.257
<b>Frequency of unhealthy snacks (ref: up to once a day)</b>	< .01	
Once or twice a day		.427
Three times a day		.390
Four or more times a day		.493
<b>Whether child has TV in bedroom (ref: No)</b>	< .05	
Yes		.598
<b>Area deprivation – quintiles (ref: 1 - least deprived 20% of areas)</b>	NS (0.09)	
2		.552
3		.663
4		.665
5 Most deprived		.295
<b>Highest parental educational qualification (ref: degree level)</b>	NS	
<b>Socio-economic classification (ref: Managerial and professional)</b>	NS	
<b>Birth weight (ref: 3 to 3.499kg)</b>	NS	

<sup>27</sup> Full results are shown in Table A-6 in the Appendix

# 7 SUMMARY AND CONCLUDING REMARKS

## 7.1. Summary

Childhood obesity is a significant international public health challenge and with one of the highest levels of childhood obesity amongst OECD countries, it is a particularly significant challenge for Scotland.

Using unique data from GUS, this report has sought to provide further insight into the prevalence of overweight and obesity amongst 10 year old children in Scotland, how this varies between children with different characteristics, whether social and demographic variations in levels of overweight/obesity change between ages 6 and 10, and how individual weight status changes over that period.

Building on the previous analysis undertaken on GUS the report addressed the following questions.

**What proportion of children are overweight/obese at age 10, compared with age 6, and what proportion move into and out of healthy weight/overweight/obese categories during that period?**

The majority of children are a healthy weight at both ages. However, the findings demonstrate clearly that levels of overweight and obesity increase with age. Whilst at age 6 24% of children were overweight, including 11% who were obese, by age 10 this had increased to 34%, including 19% who were obese. On average, BMI had increased for all children, including those who remained in the same BMI category at both ages. In particular, children who were obese at both time points showed an average BMI increase of 4.8 points whilst children who remained a healthy weight showed an average increase of 1.4 points. Amongst all children the average increase was 2.5 points.

Children who were overweight or obese by age 6 were more likely to remain so or to show an increase in BMI by age 10 than to show a decrease in BMI. Similarly, most children who were a healthy weight at age 6 remained so. This may suggest that tackling or preventing overweight at younger ages will help reduce levels of overweight and obesity at later ages. However, being overweight or obese at age 6 does not inevitably mean having the same status at age 10; a minority of children, particularly amongst those who were overweight rather than obese at age 6, saw their BMI reduce over the period, moving into lower risk categories. Nevertheless, the majority of children who were overweight (not obese) at age 10 had been a healthy weight at age 6, suggesting that preventing and tackling overweight/obesity in early

childhood alone would not be sufficient in reducing later levels of overweight/obesity and must be sustained over the primary school period.

### **How does overweight/obesity vary amongst 10 year old children according to demographic and socio-economic characteristics and is there any change in the social gradient of overweight/obesity between age 6 and age 10?**

Levels of overweight and obesity did not differ significantly between boys and girls or between children of white and other ethnicities at either age 6 or age 10. These groups also saw similar levels of increase in the proportion of children who were overweight and obese.

The prevalence of overweight and obesity did vary significantly amongst children in different socio-economic circumstances. For example, at age 10, 25% of children living in the least deprived areas were overweight or obese compared with 39% of children living in the most deprived areas.

An increase in levels of overweight and obesity between ages 6 and 10 was observed across all socio-economic sub-groups. Notably, however, children in more disadvantaged groups were more likely to become overweight or obese during this period than children in more advantaged groups. The result is a widening social inequality in the prevalence of overweight including obesity between age 6 and age 10. This suggests policies aimed at addressing childhood overweight and obesity may benefit from some targeting of children and families at greater risk and tailoring to address the specific issues and circumstances experienced by those families.

### **What other factors are associated with overweight/obesity at age 10?**

As may be expected, a number of lifestyle and dietary factors were found to be associated with overweight/obesity at age 10. Of particular note was mother's BMI. Children whose mother was obese were significantly more likely to be overweight or obese themselves at age 10. This suggests that for these children the family environment – including meals and activities – may be more obesogenic than for children whose mothers are a healthy weight, having a negative effect on the family as a whole. Relatedly, the findings also demonstrated that many parents of overweight and obese children did not accurately perceive their children to be overweight. In such scenarios we may assume that parents will not necessarily be taking steps to address some of the factors which may be maintaining the child's overweight status. Together these findings support the need for family-based interventions to tackle childhood overweight and obesity.

Other factors associated with overweight/obesity were also largely measures of children's experiences and activities at home. Only limited measures of diet were included in the analysis, of these irregular breakfast habits (only occasionally having breakfast) was associated with overweight/obesity. Having less than the

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recommended amount of sleep was also associated with overweight/obesity though this did not remain significant after controlling for other differences.

Children's sedentary behaviour was also important. Children who were reported as having higher weekly screen time were more likely to be overweight/obese at age 10. And whilst not a direct measure of sedentary time, children with a TV in their bedroom – perhaps facilitating greater opportunity for sedentary behaviour – were more likely to be overweight or obese at age 10 than those without. Both factors remained significant after controlling for other differences between the children.

By far the strongest predictor of overweight/obesity at age 10 was BMI status at age 6. After taking into account social background and other differences, children who were overweight or obese at age 6 were significantly more likely than those of a healthy weight to be overweight or obese at age 10. Echoing the finding already discussed above this further strengthens the rationale for education and intervention during the earliest years of children's lives.

### **Which factors are associated with a move out of or a move into overweight and obesity between ages 6 and 10?**

The longitudinal nature of GUS and the ability to track children's weight change over time provide an opportunity to assess factors associated with a change in BMI between ages 6 and 10. The factors found to be associated with such changes were similar to those associated with overweight/obesity at age 10.

After taking into account social background and other differences between the children, moving into overweight was independently associated with having a mother who was obese and higher weekly screen time. The results also tentatively suggest having a TV in the child's bedroom and irregular breakfast habits may also be linked, though the relationships were not statistically significant. These findings reflect those discussed above, demonstrating some influence from the child's family environment and parental behaviours.

Again, after controlling for differences in other variables, moving out of overweight was associated with lower household income, less frequent consumption of unhealthy snacks and not having a TV in the child's bedroom. Thus a different, but logical, combination of factors suggesting that reducing BMI between ages 6 and 10 was associated with a healthier diet and lower levels of inactivity. The relationship with household income may reflect that a higher proportion of children from lower income households were overweight/obese at age 6 creating more opportunity for children to move out of overweight than amongst children from the highest income group. It nevertheless presents an encouraging message that, whilst inequalities in overweight do increase between ages 6 and 10, positive change can be achieved amongst higher risk groups.

### 7.2. Concluding remarks

This report has demonstrated a notable increase in rates of overweight and obesity in children between age 6 and age 10. Indeed, BMI increased by an average of 2.5 points for all children over this period. The findings also show that inequalities in levels of overweight/obesity between children from different social backgrounds – which already exist at age 6 – have widened by age 10. This makes subsequently reducing that inequality more difficult as children move into adolescence and through onto adulthood.

A key factor shown to predict overweight and obesity at age 10 was being overweight or obese at age 6. Similarly, the majority of children who were a healthy weight at age 6 were also a healthy weight at age 10. This suggests that addressing factors associated with being overweight in the early years and thus increasing the proportion of younger children of healthy weight would have a knock on effect, reducing levels of overweight in later childhood.

Earlier analysis of GUS data (Parkes *et al*, 2012) found mother's overweight/obesity, frequency of unhealthy snacks and other indicators of a poorer diet, and low parental supervision to be associated with overweight/obesity at age 6. Many of these aspects of children's family environment and experiences appear to continue to be linked with overweight and obesity as they move through primary school. Notably, though, inactivity – and perhaps particularly a home environment which facilitates higher levels of inactivity - appears to play a more important role when children are slightly older.

Poor parental recognition of child overweight/obesity may also be problematic. The findings suggest that many parents are ill-informed or find overweight hard to recognise, a sensitive issue to address. Thus interventions to reduce child overweight and obesity would likely benefit from the involvement of parents and the wider family along with steps to address issues in the home environment.

It should be noted that the analysis within this report does not demonstrate causal relationships between the factors considered and overweight/obesity. Associations may be due to other confounding factors that have not been studied, including influences that pre-date the birth of the child and inherited effects. Nevertheless, the findings do provide some indication of the key influencing factors amongst children's day-to-day environments and experiences which may be modifiable in order to prevent and tackle increasing levels of overweight and obesity between early and middle childhood.

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# 9 APPENDIX

## 9.1. Summary of the multivariable analysis

A key point of interest in this report is to examine what features of children's lives are associated with them being overweight or obese at age 10 and which are associated with movement into and out of overweight/obesity between the ages of 6 and 10.

When examining such associations it is important to consider the influence of underlying factors and the inter-relationships between such factors and other things we are interested in.

For example, as well as being associated with BMI status, the number of hours per week children spend on screens is likely to be related to household/parental rules about such activities as well as household income level. Simple analysis may identify an association between duration of screen time and children's BMI status – for example, that children who spend greater amounts of time using screens have higher levels overweight/obesity than children who have lower screen time. However, this association may be occurring simply because of an underlying relationship between screen time and household income. Thus, rather than screen time being associated with children's BMI in its own right, the relationship found in the analysis may be due to the influence of other factors, particularly social background factors such as household income.

To 'control' for the influence of other factors (e.g. household income) multivariable regression analysis was used. This form of analysis allows the examination of the relationships between an outcome variable (e.g. overweight/obesity) and multiple explanatory variables (e.g. weekly screen time, household income) whilst controlling for the inter-relationships between each of the explanatory variables. This means it is possible to identify whether there is an association between any single explanatory variable and the outcome variable also when other relevant variables have been controlled for. For example, to look at whether there is a relationship between screen time and overweight/obesity that does not simply occur because screen time and household income are related.

To examine whether the various demographic, social background and other factors selected were associated with children's overweight/obesity at age 10, for each factor, bivariate analysis was first undertaken to look at the relationship between the measures and each of the following outcomes: overweight/obesity at age 10; moving into overweight between ages 6 and 10; moving out of overweight between ages 6 and 10.

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Where the bivariate analysis showed a statistically significant association between the factor and the outcome in question, that factor was included in a multivariable regression model.

A different approach to the regression modelling was used for examining factors associated with overweight/obesity at age 10 and for examining factors associated with moving into or out of overweight between ages 6 and 10.

To examine factors associated with overweight/obesity at age 10, the regression analysis was conducted in a series of steps:

- First, a regression model was run which included only demographic (sex, ethnicity) and socio-economic variables (household income, parental educational qualifications, social class and area deprivation)
- Second, weight status at age 6 was added to a model containing only significant variables from amongst the demographic and socio-economic variables
- Third, a separate model was run including those other factors found to be statistically significantly associated with weight status in the cross-sectional analysis conducted earlier in section 5 (birth weight, maternal BMI, frequency at which breakfast eaten, screen time, TV in bedroom, sleep).
- Finally, a combined model was then run including the statistically significant variables from the first three steps.

In all models, the outcome variable was whether or not the child was overweight or obese at age 10.

For analysis of factors associated with moving into or out of overweight between ages 6 and 10, only a small number of variables showed a statistically significant relationship with the outcome variable in the initial bivariate analysis. As such, all statistically significant variables from this initial step were entered into a single model. In one model the outcome variable indicated whether the child had moved into overweight/obesity between age 6 and age 10. In the other model the outcome variable indicated whether the child had moved out of overweight/obesity between age 6 and age 10. In both cases, the reference category was all other children.

### 9.2. Interpreting the tables

The results for the binary logistic regression analysis are presented as odds ratios, all of which have a significance value and 95% confidence intervals attached. Logistic regression compares the odds of a reference category (shown in the tables) with that of the other categories. An odds ratio of greater than one indicates that the group in question is more likely to demonstrate this characteristic than is the chosen reference category. An odds ratio of less than one means they are less likely. For example, in

the 'odds ratio' column of Table A:1 which contains the results of the first step of the regression analysis seeking to identify factors related to a child being overweight or obese at age 10, the category of 'No qualification' returns an odds ratio of 1.82. This indicates that the odds of children whose parents have no qualifications being overweight or obese at age 10 are 1.82 times greater than they are for children whose parents are degree educated (the reference category) whilst holding all other variables in the model constant.

Note that an odds ratio cannot be interpreted in the same way as a co-efficient. An odds ratio of 2 does not mean 'two times as likely' but instead means 'the odds are two times higher'. To understand an odds ratio we first need to describe the meaning of odds. The definition of odds is similar but significantly different to that of probability. This is best explained in the form of an example. If 200 individuals out of a population of 1000 experienced persistent poverty, the probability ( $p$ ) of experiencing persistent poverty is  $200/1000$ , thus  $p=0.2$ . The probability of not experiencing persistent poverty is therefore  $1-p = 0.8$ . The odds of experiencing persistent poverty are calculated as the quotient of these two mutually exclusive events. So, the odds in favour of experiencing persistent poverty to not experiencing persistent poverty, is therefore  $0.2/0.8=0.25$ . Suppose that 150 out of 300 people living in social rented housing experience persistent poverty compared to 50 out of 150 who live in owner occupied housing. The odds of a person living in social rented housing of experiencing persistent poverty are  $0.5/0.5=1.0$ . The odds of a person living in owner occupied housing of experiencing persistent poverty is  $0.33/0.66=0.5$ . The odds ratio of experiencing persistent poverty is the ratio of these odds,  $1.0/0.5=2.0$ . Thus the odds of experiencing persistent poverty are twice as high among people who live in social rented housing (compared to people who live in owner occupied housing – the 'reference category'). This is not the same as being 'twice as likely' to experience the outcome.

Categories which have a p-value greater than 0.05 are not considered to be statistically significant. However, cases where the p-value is only a little beyond this (e.g. 0.06) have been reported. These can be indicative of other variables which are having some impact on the model and if a lower significance threshold was set (e.g. of 0.10/90% rather than 0.05/95%) would be considered statistically significant.

### 9.3. Results

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## 9.3.1. Factors associated with overweight or obesity at age 10

Appendix table A:1 Demographic and socio-economic variables only

	n (weighted)	p-value	Odds ratio	95% confidence interval	
				Lower	Upper
<b>Child's sex (ref: Female)</b>	1419	.951			
Male	1331		1.01	0.83	1.22
<b>Child's ethnicity (ref: White)</b>	2635	.239			
Other	115		0.75	0.47	1.21
<b>Household equivalised income quintile (ref: Top Quintile (&gt;=£39,216))</b>	409	.613			
Missing	182		0.78	0.50	1.20
1 Bottom Quintile (<£13,450)	699		0.91	0.64	1.31
2nd Quintile (>=£13,451 <£22,827)	549		0.78	0.58	1.06
3rd Quintile (>=£22,827 < £29,375)	502		0.98	0.76	1.27
4th Quintile (>=£29,375 < £39,216)	409		0.88	0.67	1.17
<b>Highest Education level of Respondent and Partner (ref: Degree or equivalent)</b>	1056	.000			
No qualifications	155		1.82	1.13	2.94
Lower level Standard Grades and Vocational qualifications / other qualifications	128		2.24	1.27	3.94
Upper level Standard Grades and Intermediate Vocational qualifications	499		1.40	1.02	1.91
Higher grades and Upper level vocational qualifications	913		1.56	1.27	1.92
<b>Household NS-SEC (ref: Managerial and professional)</b>	1342	.589			
Intermediate occupations	389		1.03	0.76	1.38
Small employers and own account workers	225		1.35	0.93	1.96
Lower supervisory and technical occupations	193		1.08	0.72	1.60
5.00 occupations	602		1.04	0.73	1.49
<b>Area deprivation – SIMD 2012 quintiles (ref: Least deprived .936 - 7.936)</b>	570	.015			
2 7.938 - 13.674	582		1.17	0.89	1.53
3 13.674 - 20.970	536		1.41	1.05	1.90
4 20.976 - 33.807	498		1.57	1.18	2.09
5 Most deprived 33.817 - 89.894	564		1.51	1.08	2.12

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**Appendix table A:2 Age 6 BMI status and socio-economic variables only**

	n (weighted)	p-value	Odds ratio	95% confidence interval	
				Lower	Upper
<b>Child's BMI at age 6 (ref: underweight/healthy weight (&lt; 85th percentile))</b>	2010	<.001			
Missing	102		3.04	1.86	4.99
Overweight (85th to < 95th percentile)	354		8.31	6.37	10.84
Obese (95th percentile or above)	285		44.69	28.93	69.04
<b>Highest Education level of Respondent and Partner (ref: Degree or equivalent)</b>	1056	.038			
No qualifications	155		1.632	0.909	2.930
Lower level Standard Grades and Vocational qualifications / other qualifications	128		2.071	1.059	4.050
Upper level Standard Grades and Intermediate Vocational qualifications	499		1.352	0.946	1.931
Higher grades and Upper level vocational qualifications	913		1.314	1.036	1.667
<b>Area deprivation – SIMD 2012 quintiles (ref: Least deprived .936 - 7.936)</b>	570	.035			
2 7.938 - 13.674	582		1.128	0.813	1.565
3 13.674 - 20.970	536		1.362	0.990	1.874
4 20.976 - 33.807	498		1.461	1.024	2.084
5 Most deprived 33.817 - 89.894	564		1.585	1.125	2.232

# GROWING UP IN SCOTLAND

OVERWEIGHT AND OBESITY AT AGE 10

**Appendix table A:3 Other factors associated with overweight and obesity**

	n (weighted)	p-value	Odds ratio	95% confidence interval	
				Lower	Upper
<b>Child's birth weight in kilograms (ref: 3 - &lt; 3.5 kg)</b>	990	.019			
< 2.5 kg (low birth weight)	180		0.63	0.40	0.99
2.5 - <3kg	408		1.00	0.72	1.37
3.5 - <4 kg	820		1.14	0.91	1.45
4 kg or above	352		1.48	1.04	2.12
<b>Mother's BMI (ref: less than 25)</b>	1015	<.001			
Missing	420		2.11	1.51	2.95
25 to less than 30	717		1.38	1.06	1.78
30 and over	598		2.77	2.12	3.63
<b>How often does child eat breakfast (ref: always)</b>	2223	.043			
Never	66		0.89	0.42	1.86
Occasionally	242		1.48	1.09	2.00
Quite often	219		1.38	0.93	2.03
<b>Average weekly screen time (ref: less than 14 hours)</b>	788	<.001			
Missing	47		3.38	1.56	7.29
14 - <21 hours	971		1.34	1.09	1.64
21 - <28 hours	578		1.75	1.35	2.28
28 hours or more	367		1.67	1.22	2.28
<b>Child has TV in bedroom (ref: No)</b>	934	<.001			
Yes	1816		1.40	1.18	1.66
<b>Child gets recommended amount of sleep (ref: Yes for at least two age points)</b>	1862	.447			
Not for at least two age points	888		1.08	.88	1.33

# GROWING UP IN SCOTLAND

OVERWEIGHT AND OBESITY AT AGE 10

**Appendix table A:4 Combined model with demographic, socio-economic and other factors**

	n (weighted)	p-value	Odds ratio	95% confidence interval	
				Lower	Upper
<b>Child's BMI at age 6 (ref: underweight/healthy weight (&lt; 85th percentile))</b>	2010	< .001			
Missing	102		2.609	1.570	4.336
Overweight (85th to < 95th percentile)	354		8.099	6.071	10.804
Obese (95th percentile or above)	285		43.231	28.288	66.068
<b>Highest Education level of Respondent and Partner (ref: Degree or equivalent)</b>	1056	.636			
No qualifications	155		1.209	0.678	2.156
Lower level Standard Grades and Vocational qualifications / other qualifications	128		1.691	0.802	3.566
Upper level Standard Grades and Intermediate Vocational qualifications	499		1.097	0.757	1.589
Higher grades and Upper level vocational qualifications	913		1.104	0.863	1.413
<b>SIMD 2012 quintiles (ref: 1 Least deprived .936 - 7.936)</b>	570	.868			
2 7.938 - 13.674	582		1.016	0.729	1.418
3 13.674 - 20.970	536		1.110	0.807	1.525
4 20.976 - 33.807	498		1.189	0.817	1.730
5 Most deprived 33.817 - 89.894	564		1.112	0.757	1.632
<b>Child's birth weight in kilograms (ref: 3 - &lt; 3.5 kg)</b>	990	.600			
< 2.5 kg (low birth weight)	180		0.845	.499	1.431
2.5 - <3kg	408		1.152	.790	1.681
3.5 - <4 kg	820		1.173	.899	1.529
4 kg or above	352		1.260	.862	1.840
<b>Mother's BMI (ref: less than 25)</b>	1015	<.001			
Missing	420		1.647	1.108	2.449
25 to less than 30 (Overweight)	717		1.240	0.947	1.625
30 and over (Obese)	598		2.297	1.650	3.196
<b>How often does child eat breakfast (ref: always)</b>	2223	.046			
Never	66		0.956	.428	2.138
Occasionally	242		1.533	1.069	2.198
Quite often	219		1.552	.976	2.469
<b>Average weekly screen time (ref: less than 14 hours)</b>	788	<.001			
Missing	47		4.088	1.779	9.394

# GROWING UP IN SCOTLAND

## OVERWEIGHT AND OBESITY AT AGE 10

14 - <21 hours	971		1.329	1.030	1.715
21 - <28 hours	578		1.638	1.258	2.133
28 hours or more	367		1.661	1.182	2.335
<b>Child has TV in bedroom (ref: No)</b>	934	.017			
Yes	1816		1.303	1.043	1.629

### 9.3.2. Findings: Factors associated with a move into or out of overweight or obesity between ages 6 and 10

Appendix table A:5 Factors predicting a move into overweight or obesity between ages 6 and 10

	n (weighted)	p-value	Odds ratio	95% confidence interval	
				Lower	Upper
<b>SIMD 2012 quintiles (ref: Least deprived .936 - 7.936)</b>	407	.473			
2 7.938 - 13.674	432		1.37	0.95	1.97
3 13.674 - 20.970	365		1.08	0.74	1.56
4 20.976 - 33.807	362		1.30	0.85	1.99
5 Most deprived 33.817 - 89.894	445		1.12	0.75	1.69
<b>Mother's BMI (ref: less than 25)</b>	826	<.001			
Missing	235		1.94	1.17	3.21
25 to less than 30	554		1.34	0.98	1.82
30 and over	395		2.51	1.75	3.61
<b>How often does child eat breakfast (ref: always)</b>	1627	.063			
Never	50		0.87	0.35	2.18
Occasionally	172		1.58	1.03	2.43
Quite often	160		1.68	1.02	2.75
<b>Average weekly screen time (ref: less than 14 hours)</b>	607	.001			
Missing	36		4.74	1.97	11.40
14 - <21 hours	712		1.54	1.10	2.14
21 - <28 hours	400		1.80	1.27	2.56
28 hours or more	254		1.77	1.12	2.81
<b>Child has TV in bedroom (ref: No)</b>	720	.057			
Yes	1289		1.28	0.99	1.66
<b>Child gets recommended amount of sleep (ref: Yes for at least two age points)</b>	1370	.314			
Not for at least two age points	639		1.14	0.88	1.47

# GROWING UP IN SCOTLAND

OVERWEIGHT AND OBESITY AT AGE 10

**Appendix table A:6 Factors predicting a move out of overweight or obesity between ages 6 and 10**

	n (weighted)	p-value	Odds ratio	95% confidence interval	
				Lower	Upper
<b>Household equivalised income quintile (ref: Top Quintile (&gt;=£39,216))</b>	83	.040			
Missing	40		1.42	0.53	3.80
Bottom Quintile (<£13,450)	186		1.06	0.46	2.47
2nd Quintile (>=£13,451 <£22,827)	126		2.42	1.27	4.63
3rd Quintile (>=£22,827 < £29,375)	120		1.38	0.71	2.67
4th Quintile (>=£29,375 < £39,216)	81		1.26	0.61	2.60
<b>Highest Education level of Respondent and Partner (ref: Degree or equivalent)</b>	181	.355			
No qualifications	42		3.27	0.95	11.22
Lower level Standard Grades and Vocational qualifications / other qualifications	42		0.54	0.11	2.68
Upper level Standard Grades and Intermediate Vocational qualifications	132		0.96	0.53	1.74
Higher grades and Upper level vocational qualifications	239		1.13	0.66	1.92
<b>Household NS-SEC (ref: Managerial and professional)</b>	287	.249			
Intermediate occupations	89		0.87	0.52	1.46
Small employers and own account workers	64		0.36	0.13	0.98
Lower supervisory and technical occupations	41		0.63	0.24	1.69
Semi-routine and routine occupations	154		0.52	0.19	1.40
<b>SIMD 2012 quintiles (ref: Least deprived .936 - 7.936)</b>	113	.086			
2 7.938 - 13.674	123		0.55	0.30	1.01
3 13.674 - 20.970	117		0.66	0.34	1.31
4 20.976 - 33.807	146		0.66	0.29	1.50
5 Most deprived 33.817 - 89.894	137		0.30	0.12	0.70
<b>Child's birth weight in kilograms (ref: 3 - &lt; 3.5 kg)</b>	218	.685			
< 2.5 kg (low birth weight)	21		1.34	0.41	4.36
2.5 - <3kg	69		0.82	0.37	1.83
3.5 - <4 kg	207		1.16	0.75	1.80
4 kg or above	122		0.78	0.41	1.45
<b>Child frequency of eating unhealthy snacks (ref: Up to once a day)</b>	141	.005			
More than once a day, up to twice a day	227		0.43	0.24	0.75

# GROWING UP IN SCOTLAND

## OVERWEIGHT AND OBESITY AT AGE 10

More than twice a day, up to three times a day	130		0.39	0.22	0.69
More than three times a day	139		0.49	0.25	0.96
<b>Child has TV in bedroom (ref: No)</b>	184	.038			
Yes	452		0.60	0.37	0.97



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Any enquiries regarding this publication should be sent to us at  
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EH1 3DG

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