



Public Health
England

Protecting and improving the nation's health

National Child Measurement Programme

**Changes in children's BMI between
2006/7 and 2012/13**

About Public Health England

Public Health England exists to protect and improve the nation's health and wellbeing, and reduce health inequalities. It does this through world-class science, knowledge and intelligence, advocacy, partnerships and the delivery of specialist public health services. PHE is an operationally autonomous executive agency of the Department of Health.

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1. Summary of key findings

	Reception		Year 6	
	Boys	Girls	Boys	Girls
<p>Changes in prevalence of obesity and excess weight</p> <p>Page 8</p>	<p>No significant trend 2006/07 to 2009/10. From 2009/10 to 2012/13 prevalence has fallen significantly, obesity by around 0.2% per year, and excess weight by 0.4% per year.</p>	<p>No significant trend 2006/07 to 2009/10. From 2009/10 to 2012/13 obesity and excess weight prevalence has decreased but this is not statistically significant.</p>	<p>Significant increase from 2007/08 to 2010/11, but no significant change from 2009/10 to 2012/13.</p>	<p>Significant increase in prevalence from 2007/08 to 2010/11. The rate of increase slowed from 2009/10 to 2012/13 and although there is still an upward trend it is not significant.</p>
<p>Changes in mean BMI for age</p> <p>Page 15</p>	<p>Mean BMI rose significantly from 2006/07 to 2009/10. From 2009/10 to 2012/13 mean BMI significantly decreased.</p>	<p>Significant rise from 2006/07 to 2009/10. Non-significant decline from 2009/10 to 2012/13.</p>	<p>Significant rise in mean BMI from 2007/08 to 2010/11.</p> <p>No significant change from 2009/10 to 2012/13, although slight decline for boys.</p>	
<p>Changes in BMI distribution</p> <p>Page 16</p>	<p>Increases from 2006/07 to 2009/10 were greatest in children with the lowest BMI for age. From 2009/10 to 2012/13 decrease is spread fairly evenly across the child population but the biggest decreases are in children with the highest BMI for age.</p>	<p>Increases from 2006/07 to 2009/10 occurred mainly in children with the lowest BMI for age. From 2009/10 to 2012/13 the data show small decreases in BMI which are greatest in children with the highest BMI for age.</p>	<p>Increases from 2007/08 to 2010/11 are spread fairly evenly across the whole BMI distribution.</p> <p>From 2009/10 to 2012/13 mean BMI has fallen slightly in children with the lowest BMI for age, but has risen slightly in children with a high BMI for age.</p>	
<p>Changes by socio-economic group</p> <p>Page 19</p>	<p>Socioeconomic inequalities widened 2006/07 to 2009/10 but narrowed from 2009/10 to 2012/13.</p>	<p>Socioeconomic inequalities have remained similar across all years of NCMP measurements.</p>	<p>Socioeconomic inequalities have continued to widen at a similar rate across all years of NCMP measurements.</p> <p>The inequalities gap, as measured by the difference in obesity prevalence between the most deprived and least deprived 10% of the child population, has shown a significant increase of around 0.5% per year on average.</p>	
<p>Changes in obesity prevalence by ethnic group</p> <p>Page 23</p>	<p>A small significant decline for White children but no significant change in other groups from 2007/08 to 2010/11. From 2009/10 to 2012/13 prevalence has fallen significantly in all three groups (White, Asian, Black).</p>	<p>No significant change for any of the three ethnic groups across all years.</p>	<p>From 2007/08 to 2010/11 there were significant increases for White and Asian children.</p> <p>The rate of change over time is higher for children of Asian ethnicity than for White children.</p> <p>From 2009/10 to 2012/13 there was a significant increase among children in the Black ethnic group and no significant change for other ethnic groups.</p>	

2. Introduction

This report is the fifth in a series of yearly reports which use National Child Measurement Programme (NCMP) data to examine the changes in children's body mass index (BMI) that have taken place since 2006/07.^{1,2,3,4}

The NCMP is a nationally mandated public health programme that measures the height and weight of children aged 4–5 years (Reception) and 10–11 years (Year 6) in England on an annual basis. The programme provides the data for the child excess weight indicators in the Public Health Outcomes Framework and is a key element in the Government's approach to tackling child obesity.

The 2012/13 NCMP was the seventh year of data collection^a and as such the programme is well-established, with high levels of participation across all areas of England. Data completeness and accuracy are also of high quality. NCMP analyses previously published by the Health and Social Care Information Centre (HSCIC), the National Obesity Observatory (NOO) and Public Health England (PHE) provide comprehensive descriptions of the distribution of obesity and excess weight prevalence across the NCMP age groups, as well as the patterns by socioeconomic and ethnic group.

This report focuses on identifying changes in prevalence and trends as well as changes in mean BMI, and the distribution of BMI by age and sex. This year, for the first time, the trends in excess weight and underweight prevalence are also described. Definitions of these BMI categories are given in Appendix 2. As in previous years the trends within different socioeconomic and ethnic groups are also examined to determine whether existing health inequalities are increasing further or showing signs of reducing.

^a In 2005/06 the National Childhood Obesity Database collected child measurements of school children in England, but the data from this programme are not detailed enough, nor of high enough quality, to be used for detailed analysis.

3. The National Child Measurement Programme dataset

The 2012/13 NCMP dataset contains the largest number of child measurements collected to date by the programme, with 1,076,824 valid measurements of children from state-maintained schools. Overall participation in the NCMP was 93.4% in 2012/13, a very similar figure to that achieved in 2011/12. Figure 1a shows the number of children measured by the NCMP by year of measurement, school year and sex. Figure 1b shows the level of participation in the NCMP for each year of measurement by school year.

In Reception, the number of children measured has risen for each year of measurement, with 587,678 children measured in 2012/13. Participation in the NCMP (ie the percentage of eligible children that are measured) has also risen over time for this age group, although there was a very small fall in 2012/13 – 94.0%, compared to 94.2% in 2011/12. In Year 6, a year on year decrease in the absolute number of boys and girls measured has occurred since 2009/10 because of demographic changes leading to a fall in the number of children of this age 'eligible for measurement'. Participation in this age group has continued to increase over time, reaching 92.7% in 2012/13 based on 489,146 child measurements.

The fact that the NCMP takes measurements from a very large number of children results in small confidence limits around most national estimates. Year to year variation around the prevalence figures does exist, however, and changes from one year to the next are not always indicative of the long term trend. For example, a statistically significant increase between one year of measurement and the next for any age/sex group may be followed by an apparent decrease the following year. It is therefore more informative to assess the trend over time using as many data points as possible rather than to examine the small changes from one year of measurement to the next closely. With seven years of NCMP measurements now available the detection of meaningful changes in Year R and Year 6 weight status over time is increasingly possible.

Figure 1a: Number of children measured by year of measurement, school year and sex

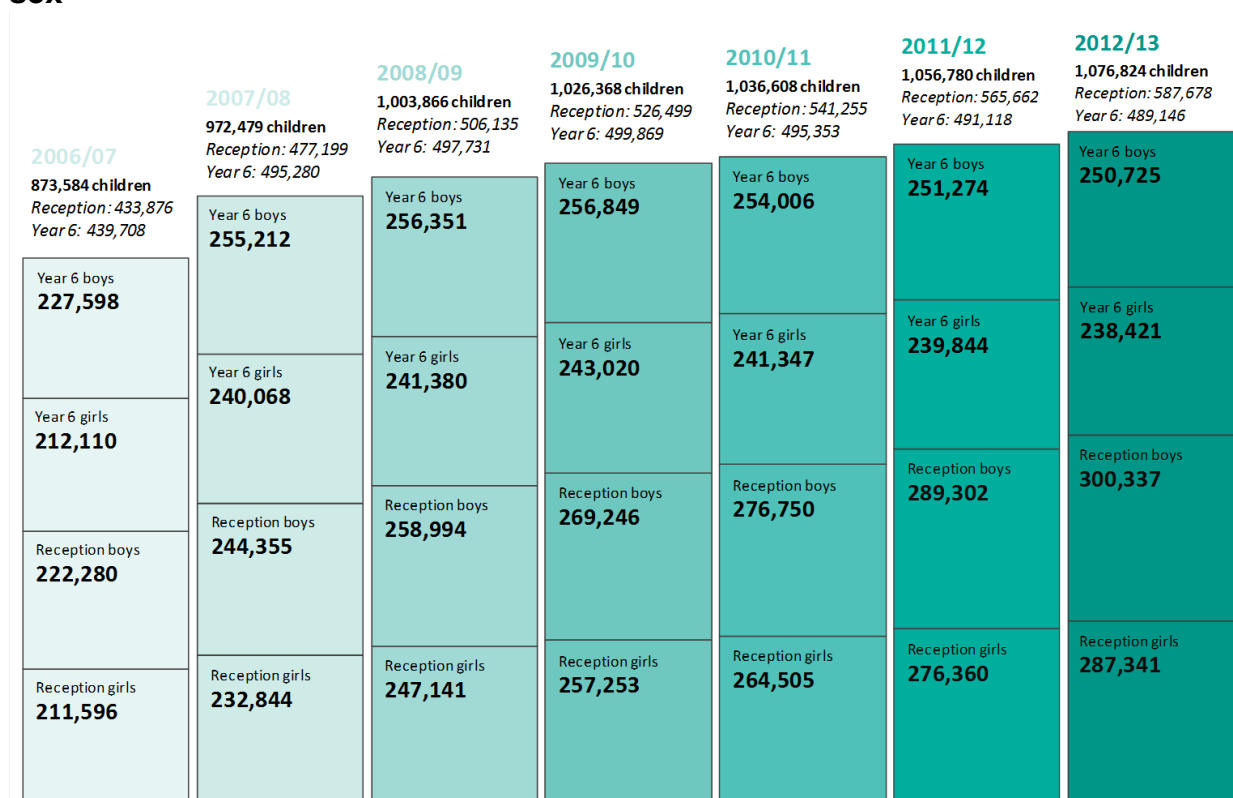
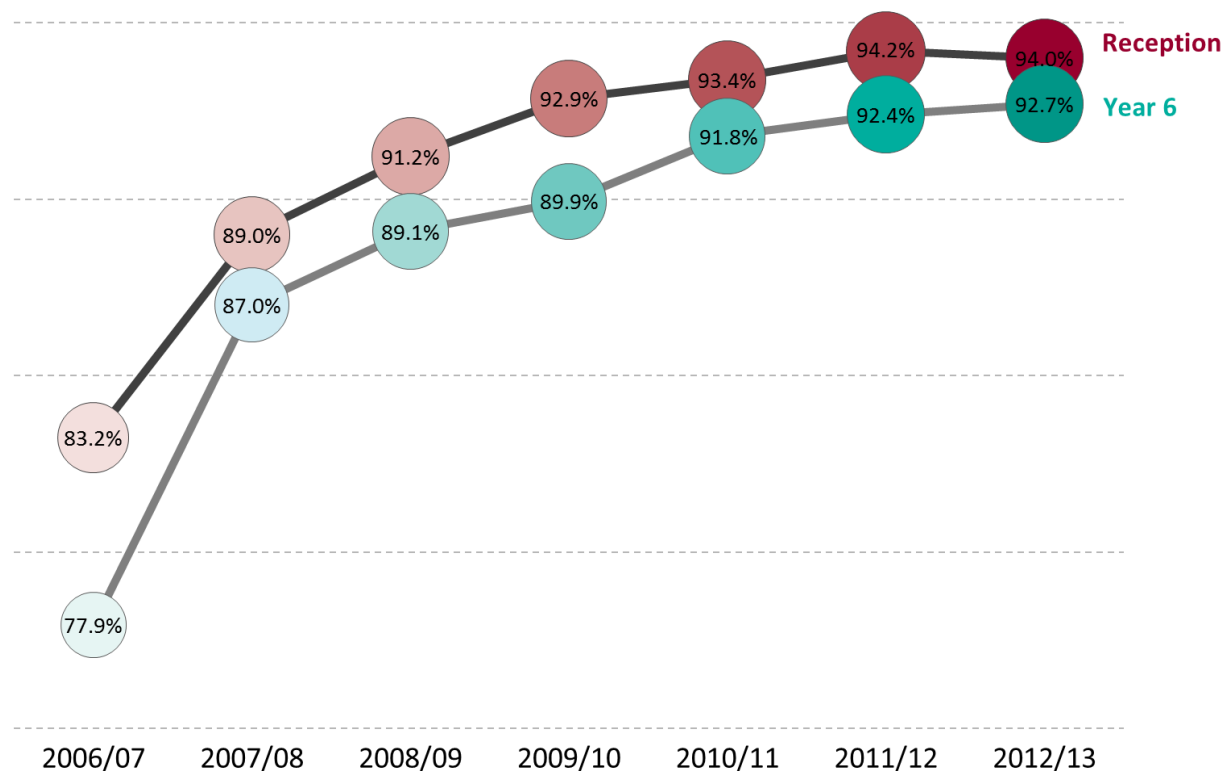


Figure 1b: Level of participation by year of measurement and school year



4. Changes in prevalence of obesity, excess weight and underweight

Overall trends in the prevalence of obesity, excess weight and underweight from NCMP data

Figure 2 shows the overall trend in the prevalence of obesity, excess weight and underweight by year of measurement, school year and sex. Within each cluster of points, each vertical bar represents one year of measurement, from 2006/07 on the left to 2012/13 on the right. The height of the annual markers shows the 95% confidence limits around each prevalence estimate and so represents the range in which the true value of that estimate is most likely to fall.

For each age and sex group the linear trend for the period covered by NCMP measurements is shown. The gradient of this line represents the annual rate of change in that indicator averaged over the period covered by the NCMP. The coefficient of determination (R-squared) value is also shown for each line, to give an indication of how well the individual values fit the line shown.^b Where the linear trend shown is significant at the 95% confidence limit the rate of increase and R-squared values are shown in bold. Due to the issues of low participation and incomplete data coverage around Year 6 data for 2006/07⁵ this has not been included in the regression analysis for this age group.

This analysis supports the findings presented in the previous version of this report of the trends in obesity prevalence. For the past six years of NCMP data there has been a significant trend of increasing obesity prevalence in girls in Year 6 ($p < 0.016$)^c which shows that obesity prevalence rose by around 0.23% per year on average (95% confidence limits of 0.12% to 0.34%). There has also been a significant linear trend of decreasing obesity prevalence in boys in Reception over the whole NCMP time period ($p = 0.002$), at a rate of around -0.14% per year on average (-0.19% to -0.09%).

The prevalence of excess weight follows a similar trend to that of obesity for these two population groups, and again shows a significant linear trend. Excess weight prevalence changed by +0.30% per year for girls in Year 6 (0.12% to 0.48%, $p = 0.03$) and -0.16% per year for boys in Reception (-0.25% to -0.05%, $p = 0.018$) for the whole period covered by the NCMP.

^b R-squared values close to one represent a perfect fit between the trendline and the individual data points. An R-squared value close to zero means the data appear to be scattered randomly around the trendline, and so will usually be associated with a trendline where the gradient suggests no change over time.

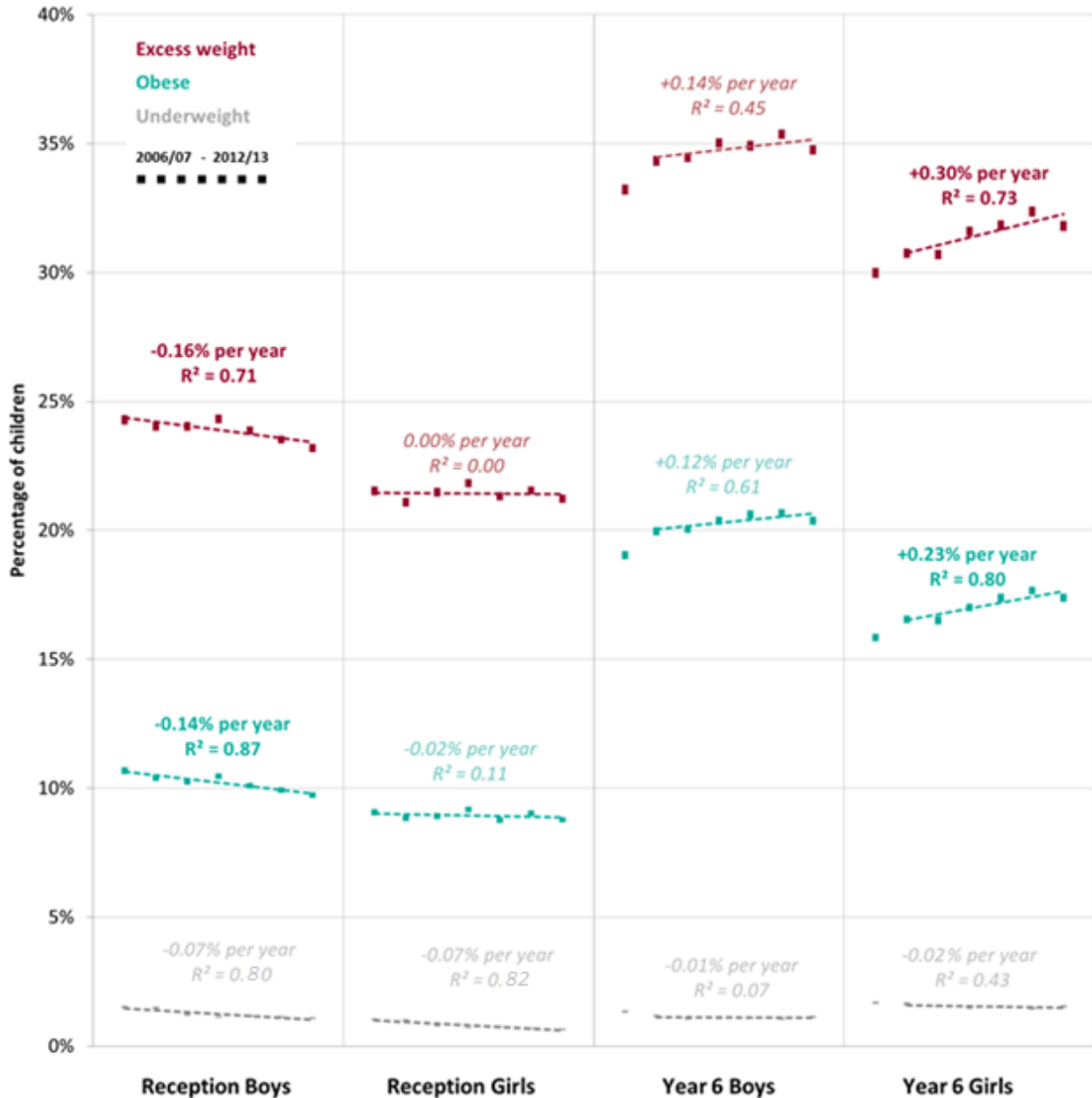
^c The criterion for 'statistically significant' at the 95% confidence level is a p-value of < 0.05 from the relevant statistical test.

Underweight prevalence in Reception has also shown a downward trend over the whole NCMP time period, although this is not quite significant at the 95% level. Underweight prevalence in Reception has fallen at a rate of around 0.07% per year since 2006/07 for both boys and girls (-0.4% to -0.1% and $p=0.06$ for boys and girls combined).

There are no other significant trends in prevalence at the 95% significance level for other population groups across the whole NCMP period.

Despite obesity prevalence decreasing for boys in Reception, and rising for girls in Year 6, prevalence of both obesity and excess weight remains higher for boys than for girls.

Figure 2: Prevalence of obesity, excess weight and underweight by year of measurement, school year and sex; NCMP 2006/07 to 2012/13. Height of annual markers represents 95% confidence limits



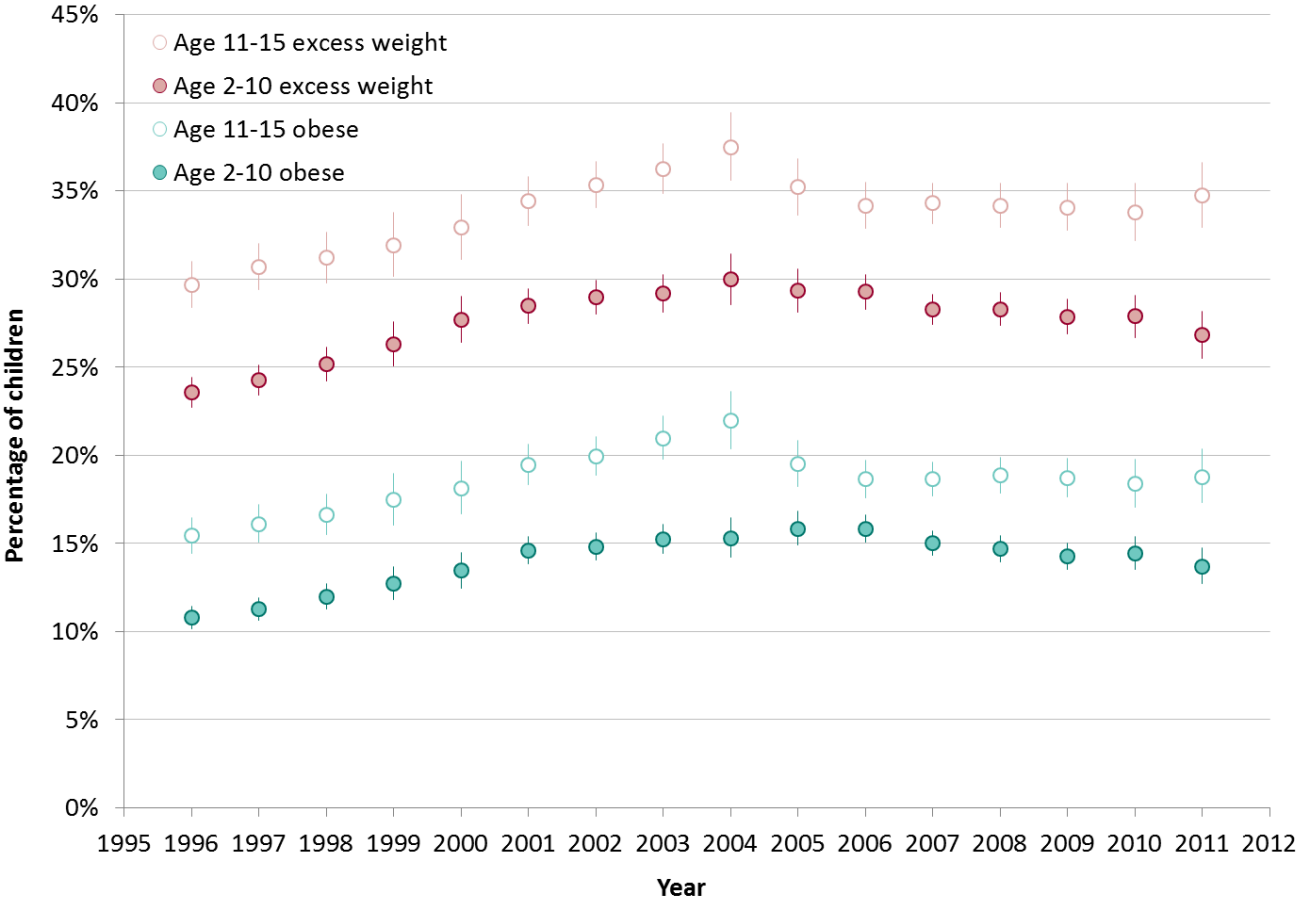
Trends in the prevalence of obesity and excess weight from HSE data

While NCMP measurements are available from 2006/07 only, child obesity and excess weight prevalence data are available for a longer time period from the Health Survey

for England (HSE).^d HSE data are routinely published in two age groups, 2–10 years and 11–15 years. Although these do not match the NCMP age groups, HSE data can be used to shed some light on the nature of the long term trend in obesity and excess weight prevalence.

Figure 3 shows the trend in child obesity and excess weight prevalence as reported by the HSE for the period 1995 to 2012.⁶ Three year rolling averages have been used to reduce the impact of year to year variation resulting from the relatively small sample size of the HSE compared to the NCMP, and approximate 95% confidence limits have been included.^e

Figure 3: Prevalence of obesity and excess weight (three year rolling average with 95% confidence limits) by year of measurement and age, HSE 1995 to 2012



^d The Health Survey for England (HSE) is an annual survey designed to measure health and health related behaviours in adults and children living in private households in England. The survey includes recording of measured height and weight. Since 1995 the survey has included children aged 2–15 years.

^e The confidence limits have been calculated using the combined total of the weighted sample size across the three years, as the un-weighted numbers are not published. In addition they do not take into account the complex sample design of the HSE and are therefore likely to slightly underestimate the true 95% confidence limits.

HSE data show that the rise in the prevalence of child obesity and excess weight in the late 1990s and early 2000s has slowed in recent years. These data suggest that the prevalence given by both indicators may have peaked around 2004, declining slightly since then. However, any decreases that have taken place have been relatively small and so the underlying rate of change over time in obesity and excess weight prevalence is likely to be small.

The HSE data provide strong evidence that the trend in obesity and excess weight prevalence has not followed a linear trajectory over the longer term. The size and direction of the trend has not remained constant, but has decreased in magnitude and possibly switched direction as the historical pattern of increasing prevalence has slowed and appears to have stabilised.

If obesity and excess weight prevalence among children in the NCMP is following a similar trajectory to that shown by the HSE data a simple linear analysis of the trend across the whole NCMP time period will not be able to pick up any change in the trend over time so a different approach was used in this analysis.

Detailed trends in the prevalence of obesity, excess weight and underweight from NCMP data

In order to assess the changes in the trend described by NCMP data this report analyses the trend using linear regression and divides the NCMP measurements into two time periods. The years were split in order to obtain the same number of years in each period. For Reception children the measurement years 2006/07 to 2009/10 were compared with 2009/10 to 2012/13. In Year 6 measurements from 2007/08 to 2010/11 were compared with 2009/10 to 2012/13. This approach is somewhat subjective but facilitates analysis of a possibly increasing or decreasing trend with linear modelling techniques. A different time period is used for Year 6 because of low participation for this age group in 2006/07.

To illustrate this approach, obesity prevalence for boys in Year 6 is shown in Figure 4. The dashed grey line shows the linear trend over the whole time period, equivalent to the trend line shown in Figure 2, which equates to an average increase of around 0.12% per year. However, in terms of statistical goodness of fit the trend is better described over this time period by a curve of decreasing gradient, as shown by the solid grey line.

Rather than summarise the trend over the whole period covered by NCMP measurements, an alternative view of the observed pattern over time is that obesity prevalence increased by around 0.2% points per year between 2007 and 2010 (dotted green line), but has remained constant since around 2010 (solid green line). The

gradient of the line of best fit for these two overlapping time periods can be summarised, as shown in the inset within Figure 4. This approach can be extended to describe the trend in obesity, excess weight, and underweight for girls and boys in Reception and Year 6, as shown in Figure 5.

When analysed in this way it is possible to see how the trend in obesity, excess weight, and underweight prevalence has changed over time. Among boys in Reception obesity showed no significant trend over the first four years of measurement, but has shown a significant linear decrease of around -0.23% per year across the last four years (-0.3% to -0.17%, $p=0.02$). Excess weight has shown a similar pattern, falling by 0.37% per year since 2009/10 (-0.42% to -0.33%, $p=0.003$). As the decrease in excess weight is larger than that seen for obesity alone we can conclude that the prevalence of overweight children is also decreasing and the change in excess weight is not driven solely by a reduction in the prevalence of obesity.

Overall the best estimate of the rate of change in obesity and excess weight over the most recent four years is always lower than that over the first four years (Figure 5). For girls in Reception obesity and excess weight appear to have remained broadly constant, or possibly increased slightly, over the first four years, but now may be starting to fall. Among Year 6 boys increases in obesity and excess weight over the first four years have been followed by prevalence remaining constant over the most recent years of measurement. Among girls in Year 6 obesity and excess weight may still be increasing slightly, but appear to be doing so at a slower rate than was the case over the first years of the NCMP. These changes are all non-significant.

The trend in decreasing underweight prevalence among Reception age children that was observed previously appears to have been concentrated in the first years of the NCMP. There was a significant decrease in underweight prevalence for both boys and girls over the first four years, but in the most recent four years prevalence of this measure has remained the same. Underweight prevalence in Year 6 appears to have remained relatively constant regardless of the time period used to assess the trend (Figure 5).

Figure 4: Prevalence of obesity (with 95% confidence limits) by year of measurement, for boys in Year 6; NCMP 2007/08 to 2012/13

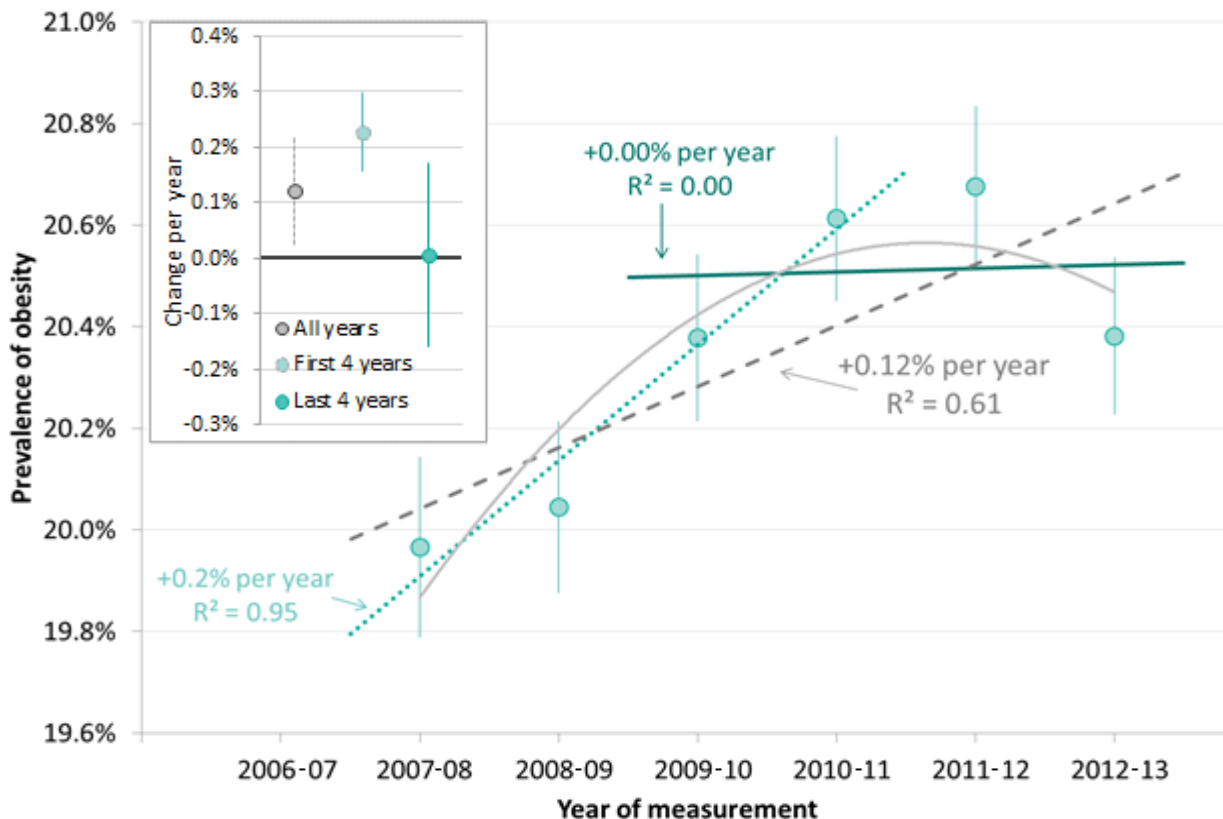
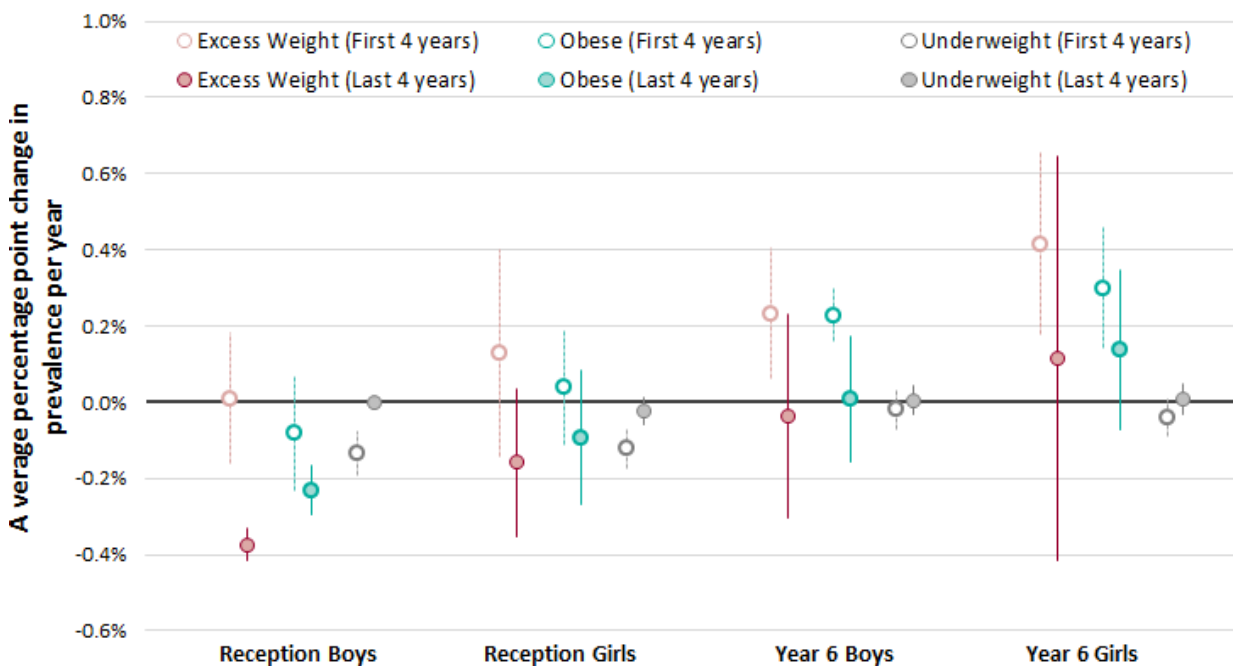


Figure 5: Change in prevalence of obesity, excess weight and underweight per year (with 95% confidence limits) by age and sex; NCMP 2006/07 to 2009/10^f and 2009/10 to 2012/13



^f For Year 6 the first four years are based on 2007/08–2010/11

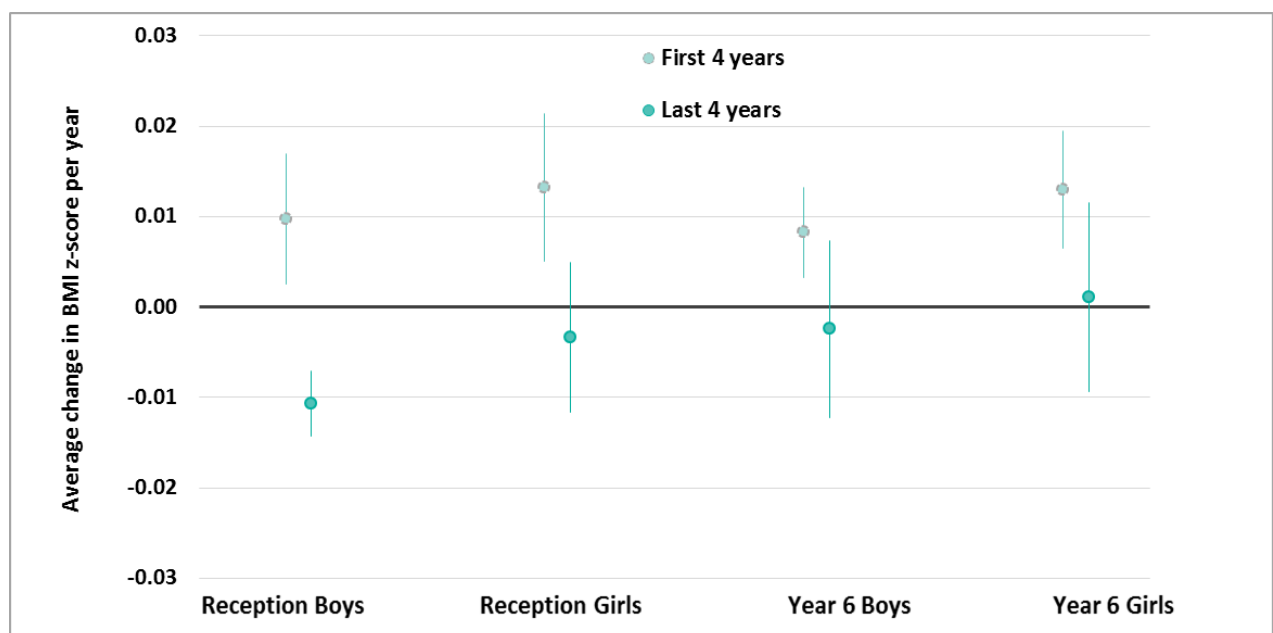
5. Changes in the distribution of children's BMI

Assessment of changes in mean BMI (using z-score) and the BMI distribution is also possible with NCMP data.

Changes in mean BMI z-score

In order to standardise for changes in the average age of measurement of children within Reception and Year 6 in different measurement years, BMI z-score has been used to examine change in mean BMI over time, rather than actual BMI values. BMI z-scores (measured in standard deviations from the mean) show how a child's BMI compares to the British 1990 reference population, taking the child's age and sex into account. Figure 6 shows the trend in mean BMI using the same methods applied to assess obesity prevalence. Over the first four years of the NCMP mean BMI increased for all population groups by around +0.01 standard deviations (SD) per year. However, in the most recent four years mean BMI displays no significant trend for all age and sex groups except among boys in Reception where there is a significant decrease of around -0.01SD per year (-0.014 to -0.007, $p=0.029$).

Figure 6: Change in mean BMI z-score per year (with 95% confidence limits) by age and sex; NCMP 2006/07 to 2009/10⁹ and 2009/10 to 2012/13



⁹ For Year 6 the first four years are based on 2007/08-2010/11

Changes in the BMI distribution

In order to examine how the observed changes in children's BMI are distributed across the population the data have been divided into 20 groups (twentiles) based on the child's BMI z-score for each age group and sex. The first twentile contains the 5% of the child population with the lowest BMI for age and sex, and the 20th twentile contains the 5% of the population with the highest BMI for age. Figures 7a and 7b show the trend over time in mean BMI z-score across these 20 groups. Once again the trend has been assessed over two four year time periods.

In all cases the trend in the last four years of NCMP measurement shows a lower rate of increase, or a bigger rate of decrease, than was seen across the first four years. The pattern of change between one twentile and the next is consistent and curves have been fitted to the data points to highlight the pattern across the BMI distribution.

Figure 7a: Change in mean BMI z-score per year in Reception (with 95% confidence limits) by twentile of BMI distribution and sex; NCMP 2006/07 to 2009/10 and 2009/10 to 2012/13

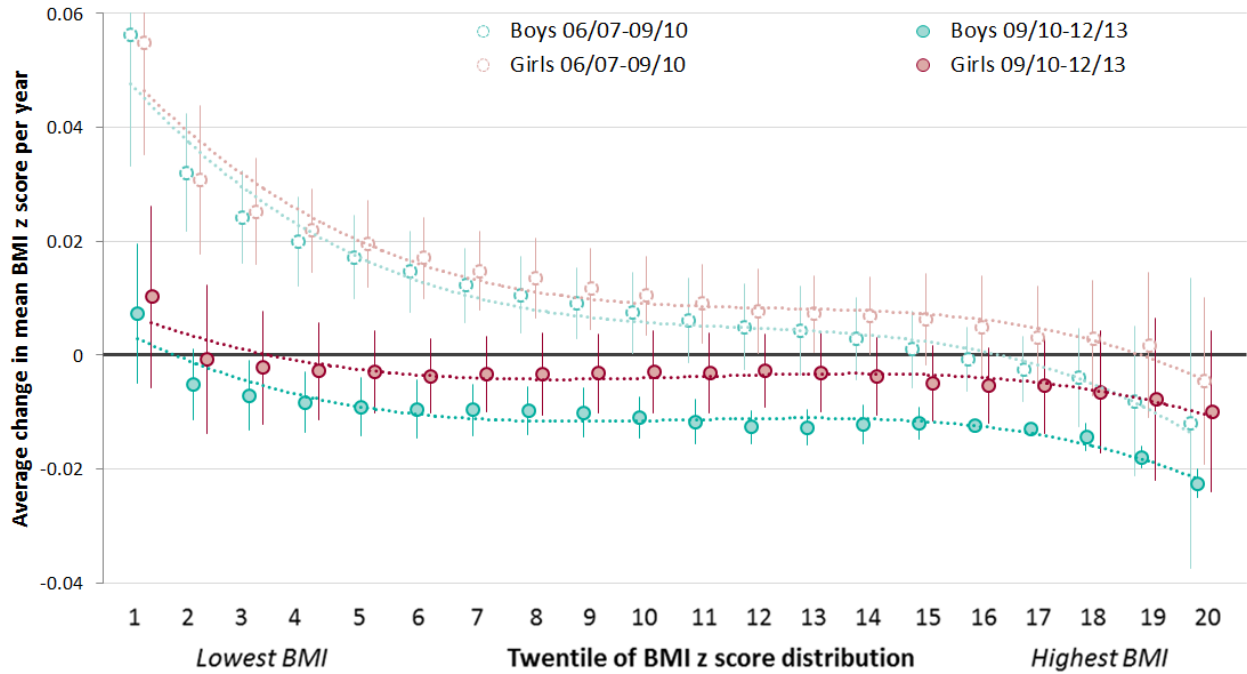
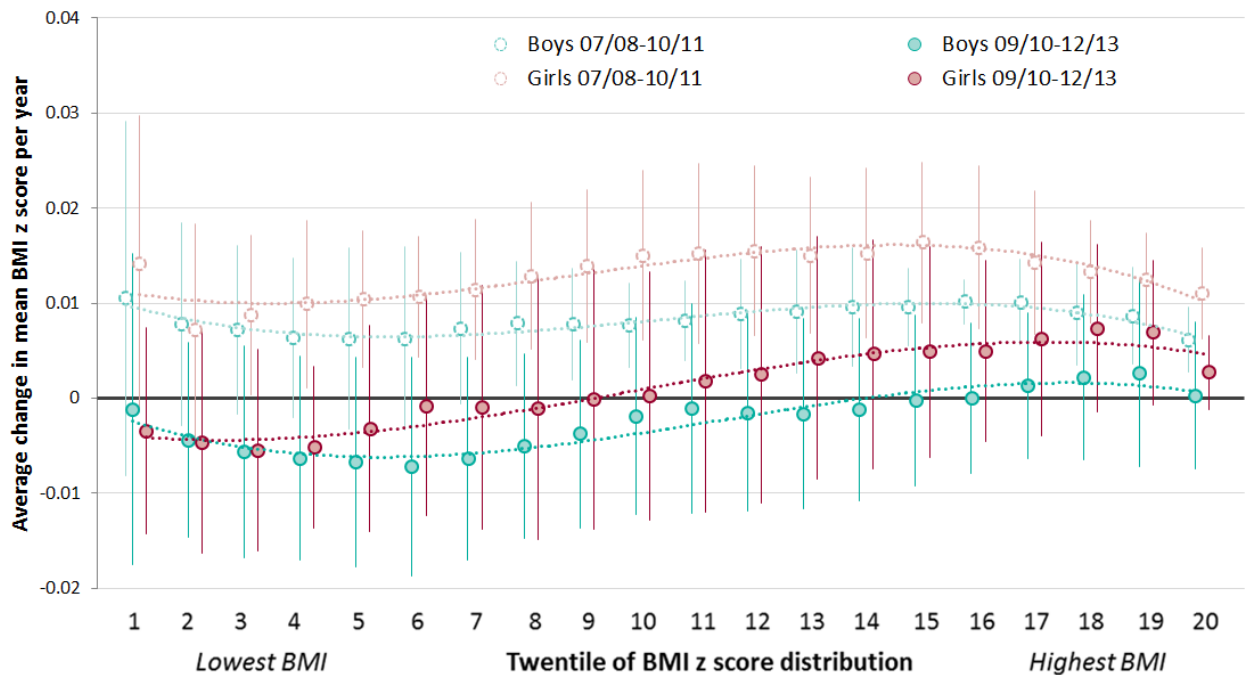


Figure 7b: Change in mean BMI z-score per year in Year 6 (with 95% confidence limits) by twentile of BMI distribution and sex; NCMP 2007/08 to 2010/11 and 2009/10 to 2012/13



For the first years of NCMP measurements the BMI of children in Reception increased across most of the BMI distribution, with large increases in children with the lowest BMI for age and sex and smaller increases, or even small decreases in the 5–10% of the population with the highest BMI for age.

The pattern of changes over the most recent four years is different. Firstly the changes are much more consistent across all percentiles, with similar rates of change at the top and bottom of the BMI distribution. Secondly, the overall pattern is one of decreases (more substantial for boys than for girls).

The only part of the BMI distribution in which BMI is still increasing is in the 5% of children with the lowest BMI for age. The biggest decreases in BMI, especially for boys, are taking place in children with the highest BMI – ie the part of the child population that would most benefit from such a change.

In Year 6 the trend in the first four years of the NCMP is of increases of around 0.1SD per year spread fairly evenly across the whole child BMI distribution. The increases were slightly larger for the 40–50% of children with the highest BMI than they were for the children with the lowest BMI, but the difference was small.

For the past four years no significant trend exists for any individual percentile in Year 6, in line with the trend in mean BMI. However, the overall pattern across all percentiles is of BMI decreases in the 30% of girls and 40% of boys in Year 6 with the lowest BMI for age.

By contrast, BMI has increased slightly in the past four years in the 40% of girls in Year 6 with the highest BMI. These children are mostly obese, overweight or close to the upper threshold for healthy weight. The pattern for boys is more promising. While BMI has increased in the 20% of boys in year 6 with the highest BMI, any increases are very small. However, as yet there is no sign of a decrease in BMI among Year 6 boys with the highest BMI.

6. Changes in obesity prevalence by socioeconomic group

Child obesity prevalence shows a close association with socioeconomic deprivation. Obesity prevalence among children living in the 10% most deprived areas around the country is nearly twice that for children living in the least deprived 10% of areas, and increases in a near linear fashion between these extremes.

In order to assess how obesity prevalence has changed across socioeconomic groups, the child population has been divided into ten deciles based on the Index of Multiple Deprivation (IMD) 2010 for each child's place of residence. In this analysis, decile 1 contains the least deprived 10% of the child population, and decile 10 contains the most deprived 10%.

Only children with valid geographical coding have been included in this analysis. The proportion of records with such coding has increased over the seven years of the NCMP. In 2006/07, the first year of the NCMP, around 57% of child records included valid coding for place of residence, increasing to 95% in 2007/08, and over 99% in 2008/09 and subsequent years.

As demonstrated previously the prevalence of obesity and the prevalence of excess weight have followed a similar trend over time for each NCMP age and sex group. As a result this analysis has been conducted for obesity prevalence only. The patterns in terms of excess weight prevalence have not been examined but are likely to be very similar.

Previous versions of this report have shown widening health inequalities within the NCMP data across the whole time period covered by the NCMP. Since 2006/07 obesity prevalence among children in Reception has fallen slightly in the least deprived areas, but stayed roughly the same in the most deprived areas. Since 2007/08 obesity prevalence among children in Year 6 has stayed broadly constant in the least deprived areas but risen in the most deprived areas. This pattern remains when the 2012/13 data are included if the trend is assessed using a linear model across all years of NCMP measurements.

It is again possible to assess the trend in obesity prevalence across socioeconomic groups using two time periods in order to test whether the trend has changed over time. Figures 8a and 8b show this analysis, comparing the average change in obesity

prevalence by decile of deprivation, age and sex, for the period 2006/07 to 2009/10 to the change seen over the years 2009/10 to 2012/13.^h

Due to the overlap between data points, and also due to the relatively wide confidence intervals around the estimates, it is not particularly easy to pick out the overall pattern. The chart therefore includes 'lines of best fit', calculated using linear regression, to highlight the overall pattern across all ten deciles. The gradient of these lines represents the extent to which health inequalities are widening or narrowing – an upwards gradient denotes widening of the inequalities gap.

Over the first four years of NCMP measurements the general trend was one of widening health inequalities for all population groups.

Over the past four years health inequalities appear to have remained relatively constant for children in Reception. Among boys obesity prevalence has fallen by around 0.2% per year across all deprivation deciles. This decrease approaches 0.3% per year among the most deprived children (Figure 8a). For girls in Reception there is some evidence of a greater decrease in obesity prevalence in the least deprived children than in the most deprived.

In Year 6 obesity prevalence among children living in the most deprived areas has risen at a rate of around 0.3% per year over the past four years of measurements but fallen by a similar amount among the least deprived children (Figure 8b).

^h For Year 6 the first four years are based on 2007/08–2010/11

Figure 8a: Change in prevalence of obesity per year in Reception (with 95% confidence limits) by decile of deprivation and sex; NCMP 2006/07 to 2009/10 and 2009/10 to 2012/13

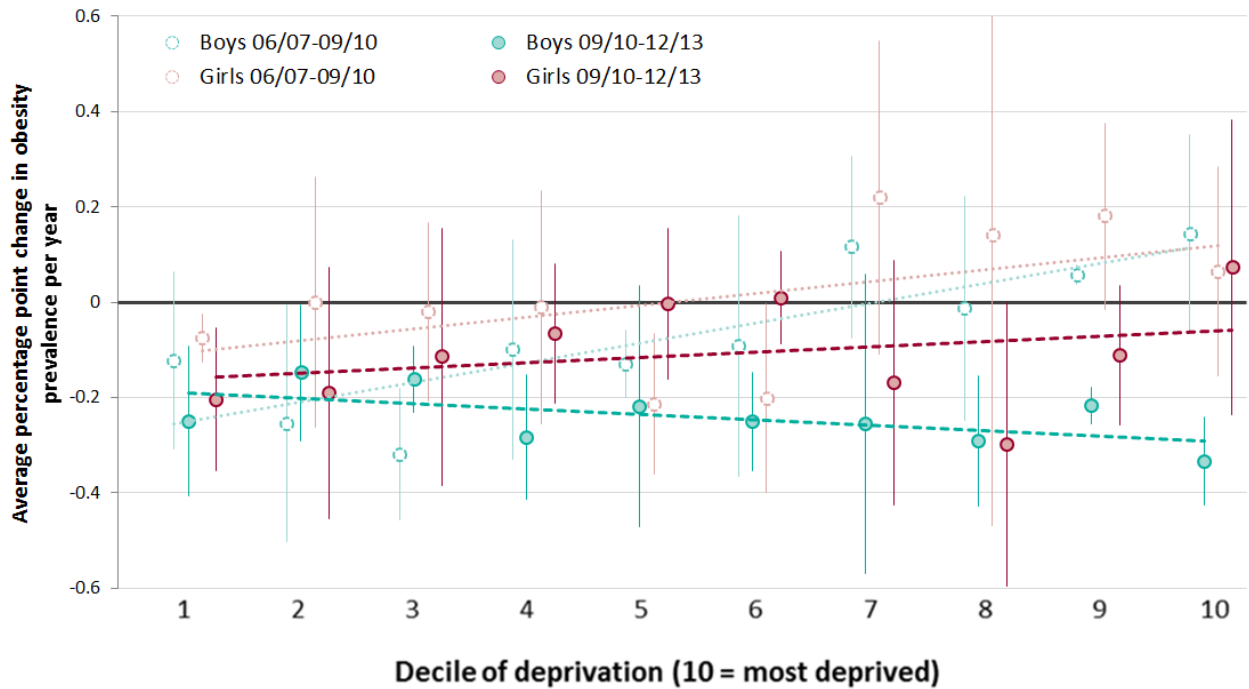
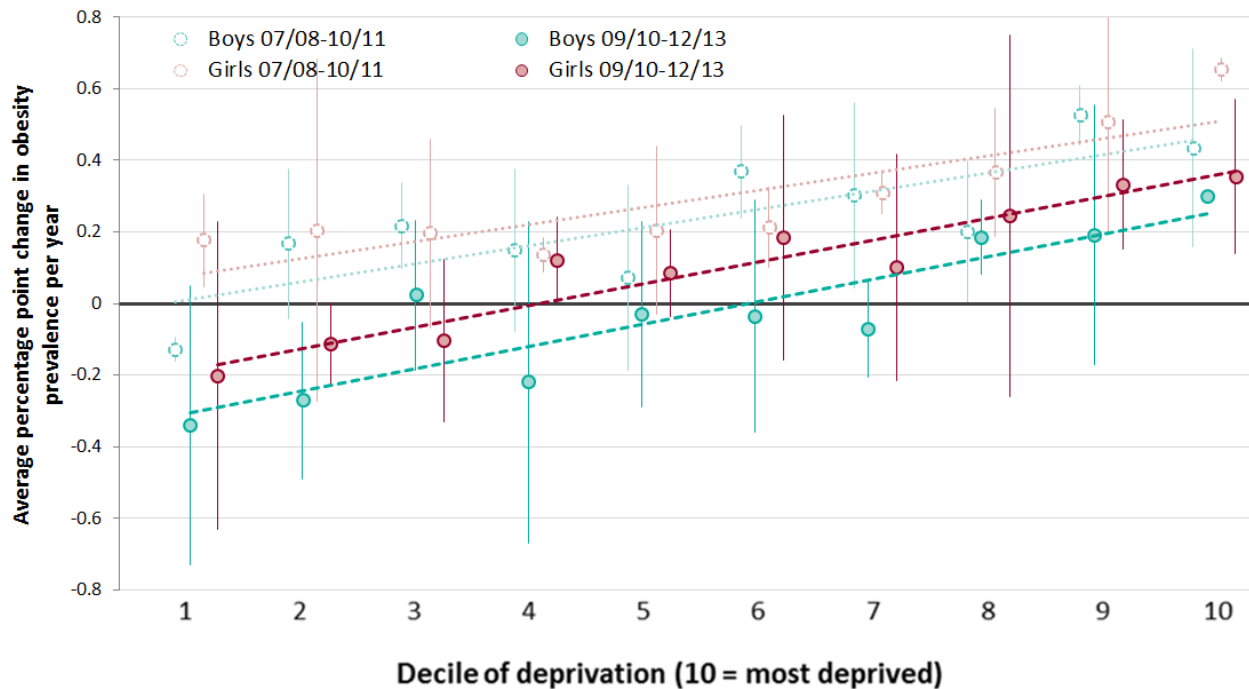
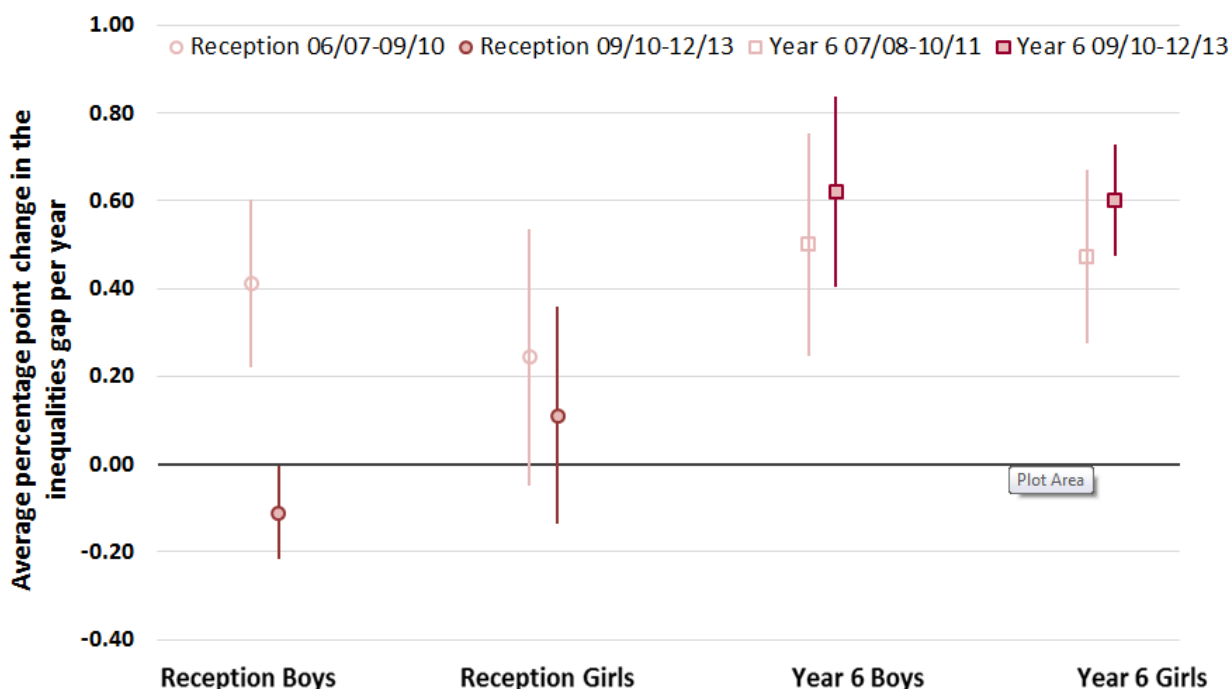


Figure 8b: Change in prevalence of obesity per year in Year 6 (with 95% confidence limits) by decile of deprivation and sex; NCMP 2007/08 to 2010/11 and 2009/10 to 2012/13



In order to more easily assess the trend in health inequalities, the gradient of the regression lines shown in Figures 8a and 8b can be used as a 'health inequalities index' for NCMP data (Figure 9). The y-axis in Figure 9 shows the rate of change in the gap in obesity prevalence between the most and least deprived IMD deciles per year.ⁱ

Figure 9: Change in the obesity 'inequalities gap' per year (with 95% confidence limits) by age and sex; NCMP 2006/07 to 2010/11^j and 2009/10 to 2012/13



Over the period 2006/07 to 2009/10 (2007/08 to 2010/11 for Year 6) the difference in obesity prevalence between the most deprived 10% of areas and the least deprived 10% of areas increased at a rate of around 0.4% per year for boys in Reception and 0.5% per year for both boys and girls in Year 6 (Figure 9). All of these increases are significant at the 95% confidence level. Over the same period there was no significant change in the inequalities gap in obesity prevalence for girls in Reception. Between 2009/10 and 2012/13 the inequalities gap increased at a rate of around 0.6% per year for both boys and girls in Year 6.

In Reception there was no significant change in the inequalities gap over the past four years for girls, although a small increase of 0.1% per year was observed. A significant decrease of a similar magnitude per year is seen for Reception boys over the same time period.

ⁱ The gradient of the 'lines of best fit' shown in Figures 8a and 8b have been multiplied by a factor of ten to provide an estimate of the change per year in the difference in obesity prevalence between decile 1 and decile 10.

^j 2007/08-2010/11 has been used for Year 6.

7. Changes in obesity prevalence by ethnic group

Previous analyses using both NCMP and HSE data have shown that child obesity prevalence varies substantially between ethnic groups.^{7,8} In general, such analyses show that children classed as White British have lower obesity prevalence than most other ethnic groups. Differences in obesity prevalence between ethnic groups remain when potentially confounding factors such as levels of deprivation and urban environment are controlled for.^{9,10}

The proportion of records with valid ethnicity coding has increased substantially over the five years of the NCMP. In 2006/07 only 32% of child records were provided with a valid ethnicity code. This increased to 67% in 2007/08, 77% in 2008/09, 83% in both 2009/10 and 2010/11, 85% in 2011/12 and 86% in 2012/13. The increase in coding means that the trend over time by ethnic group must be assessed with caution. To reduce the potential for changes in coding to impact on the analysis, data from 2006/07 have not been included in any regression analysis by ethnic group. Data have been examined only in terms of obesity prevalence, not overweight.

Previous analyses of the trend in obesity prevalence by ethnic group have found little in the way of consistent patterns. Annual estimates of obesity prevalence for different ethnic groups show a degree of year to year variation which makes it difficult to discern trends in most groups. In addition the specific ethnic groups that do show consistent patterns of change differ by age and sex, which limits the potential to draw broad conclusions about any differences in trend across ethnic groups.

The trend analysis conducted for this report has been based on the three broad ethnic groups that were used last year: White; Asian; and Black.^k While amalgamating ethnic groups is not ideal as groups with potentially diverging trends might be combined, this lends more power to the analyses. When the NCMP data are split by detailed ethnic group the confidence limits around the estimates of obesity prevalence are large, as is the amount of year on year variation within ethnic groups. This makes it difficult to assess whether there has been a significant linear trend over time. A more detailed ethnic breakdown is available in the HSCIC NCMP data tables available online.

^k White (White British, White Irish, Any Other White Background), Asian (Bangladeshi, Indian, Pakistani, Any Other Asian Background, Mixed White and Asian), and Black (Black African, Black Caribbean, Any Other Black Background, Mixed White and Black African, and Mixed White and Black Caribbean). Note the three broad ethnic categories do not include children of Chinese ethnicity.

The trend has again been assessed using a linear model over two time periods, from 2007/08 to 2010/11 and from 2009/10 to 2012/13. Figure 10 shows the average change in obesity prevalence per year for these three ethnic groups, split by school year and sex.

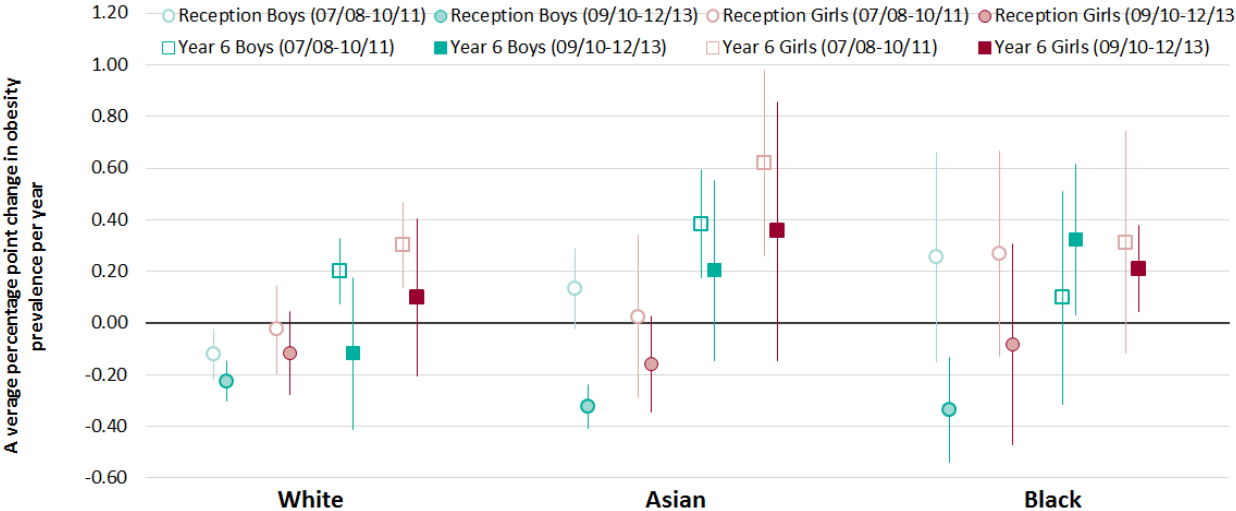
Between 2007/08 and 2010/11 obesity prevalence for boys in Reception showed a significant small decrease for the White ethnic group (Figure 10). There were no other significant changes over this time period for Reception boys, although the data indicate that obesity prevalence rose slightly for Asian and Black children.

Over the period 2009/10 to 2012/13 there were significant trends to decreasing obesity prevalence across all ethnic groups of boys in Reception. Obesity prevalence has fallen by around 0.2% per year for White boys in Reception, and around 0.3% per year for Black and Asian boys (Figure 10). These rates of change are not significantly different between ethnic groups.

For girls in Reception there is no significant trend for any ethnic group over either time period, although the data do show small decreases for all ethnic groups in the most recent four years. The first years of the NCMP show no change for White and Asian girls and increases for Black girls between 2007/08 and 2010/11.

In Year 6 the period 2007/08 to 2010/11 saw significant increases in obesity prevalence for White and Asian boys and White and Asian girls, but no significant trend for Black boys and girls. In the most recent four years of data there were significant increases over time for Black boys and girls, but no significant trends for the other groups (Figure 10). Although for both White and Asian ethnic groups the rate of increase is lower in 2009/10 to 2012/13 than 2007/10 to 2010/11, the data do show that there have been bigger increases in obesity prevalence among Asian boys and girls in Year 6 than among White boys and girls in Year 6 over both time periods. This indicates that health inequalities across ethnic groups are widening for children in Year 6, at least between White and Asian groups.

Figure 10: Average change in obesity prevalence per year (with 95% confidence limits) by broad ethnic group, school year and sex; NCMP 2007/08 to 2010/11 and 2009/10 to 2012/13



8. Discussion and conclusions

As more years of data become available the power of the NCMP to detect trends over time in the prevalence of obesity, overweight and underweight increases. Thorough analysis of the NCMP data, alongside data from other sources such as the HSE, increases our understanding of the changes that are taking place in the distribution of children's BMI in England.

Even with a dataset the size of the NCMP there is still variation around year to year estimates of indicators such as obesity prevalence, especially when split by age and sex or other population characteristics. It is unreliable to draw general conclusions about a trend from small changes between one individual year of measurement and the next. At least several years of data should be considered for robust examination of any trend.

Data from the most recent years of the HSE suggest that child obesity and excess weight may have begun to decrease across the population as a whole, although the size of any decrease is likely to be small. With the exception of boys in Reception (where there was prior evidence of a downwards trend), previous NCMP analysis has only been able to demonstrate that obesity prevalence might have stabilised in certain population groups. There has been no evidence of a consistent decrease in obesity prevalence for the other population groups covered by the NCMP.

As more years of NCMP data become available, it becomes increasingly possible to identify patterns within the data and detect changes in the trend over time. With seven years of robust NCMP data for the Reception year, and six years of data for Year 6, the data now cover a time period that is long enough to be split in two while still yielding reasonably robust results. Recent years of NCMP data can be compared with those from earlier years and trends in each period can be examined in more detail.

Trend in the prevalence of obesity, excess weight and underweight

Among boys in Reception, both obesity prevalence and excess weight remained broadly constant between 2006/07 and 2009/10 but showed significant falls of around 0.2% per year for obesity and 0.4% per year for excess weight between 2009/10 and 2012/13.

For girls of this age, there was no significant trend in obesity or excess weight prevalence for either of the time periods examined. Notwithstanding this, the data shows that levels of both indicators rose slightly over the first four years of the NCMP, but decreased slightly over the most recent four years.

In Year 6 both obesity and excess weight prevalence rose significantly for boys, by around 0.2% per year between 2007/08 and 2010/11. They remained constant between 2009/10 and 2012/13. For girls, statistically significant increases of around 0.4% per year in excess weight and 0.3% per year for obesity were seen over the first four years of measurement, but there has been no significant change over the most recent four years. Obesity prevalence is still rising, but the rate of increase has fallen to less than 0.2% per year.

The prevalence of underweight has fallen significantly among children in Reception between 2006/07 and 2009/10, but has remained unchanged since. There have been no significant changes over the whole NCMP period in underweight prevalence for children in Year 6.

Changes in the BMI distribution

Over the period for which NCMP measurements are available, mean BMI rose significantly during the first four years for both boys and girls in both age groups. Over the most recent four years there has been no significant change for boys and girls in Year 6, and girls in Reception, while mean BMI has fallen significantly for boys of Reception age. This shows that the rise in mean BMI has at least slowed down over the past years across the child population.

When these changes are examined across the whole BMI distribution the findings differ between Reception and Year 6. The decreases seen in the mean BMI of boys in Reception, and the stabilisation observed for girls of this age, appear to be spread fairly evenly across the child population. In Year 6 the overall result of 'no change' masks the fact that BMI is still increasing slightly among obese and overweight children, while falling among children whose BMI would already be considered healthy – although these increases and decreases are not statistically significant.

Trend in socioeconomic inequalities

Over the whole time period covered by the NCMP socioeconomic inequalities in child obesity have widened. This has occurred because obesity prevalence among children in Reception has decreased slightly in the least deprived areas, but has remained broadly the same in the most deprived areas. In Year 6 the most deprived areas have experienced increases in obesity prevalence between 2007/08 and 2012/13 whereas prevalence has remained relatively stable in the least deprived areas.

When the first four years of NCMP measures are compared against the most recent four years a slightly different picture emerges. In Reception the health inequalities gap increased significantly for boys at a rate of around 0.4% per year between the 2007/08 and 2010/11. Over the period 2009/10 to 2012/13 the data show that there is now a decrease in this gap of around 0.1% per year. This is because obesity appears to be decreasing for all boys of this age, but the biggest decreases seem to have occurred among the most deprived children. For girls in Reception there is no significant trend over either time period. The data do however suggest that while the obesity gap may still be widening, it is doing so at a relatively low rate, and the rate of increase is lower across the most recent four years of measurement than it was across the first years of measurement.

In Year 6 health inequalities have continued to widen at a similar rate across both time periods. The gap in obesity prevalence between the most and least deprived 10% of children in Year 6 is increasing by around 0.5% per year, and the data suggest that this figure may be even higher across the most recent four years. However in the more recent data this now results from the type of changes seen previously in Reception; obesity prevalence appears to be falling among the least deprived while rising slightly among the most deprived, rather than rising to some degree across all socioeconomic groups.

Trends by ethnic group

Across all ethnic groups the prevalence of obesity appears to be changing in a similar way to that seen in the child population as a whole.

Boys in Reception show significant decreases in prevalence over the past four years regardless of which ethnic group they belong to. In the first four years of the NCMP the data demonstrate a small significant decrease among White boys of this age, but non-significant increases among Asian and Black boys of this age.

Among girls in Reception obesity prevalence shows no significant change over either time period. The data show no change over the first four years of measurement for White and Asian girls, and increases for Black girls. Small decreases for all ethnic groups are observed over the time period 2010/11–2012/13.

Among Reception children the rate of change in obesity prevalence over the past four years seems to be similar across all ethnic groups, suggesting that health inequalities across ethnic groups are now remaining constant in the Reception year and not widening, as suggested by the earlier data.

In Year 6 there was a significant trend of increase in obesity prevalence among White and Asian children over the first four years of NCMP measurements, but there has been no significant change among children in these ethnic groups over the most recent four years. The data do however indicate that obesity prevalence is still increasing over time among children from Asian and Black ethnic groups while remaining fairly constant among White children. Health inequalities in child obesity across ethnic groups therefore may still be widening in Year 6.

Limitations of this analysis

Although the size of the NCMP dataset permits the sort of detailed analysis presented in this report, the nature of the NCMP dataset means that any observations made based on NCMP data need to be treated with a degree of caution.

Levels of participation, geographic coverage, and data quality appear to have been excellent for at least five years, however it cannot be discounted that small changes over time in these aspects of the measurement programme might have an effect on the resulting analysis. For example, the mean age at measurement for the NCMP has fallen slightly over time, and the completeness of data on area of residence and ethnicity has risen. This analysis has attempted to control for these changes (for example using BMI z-score rather than actual BMI values when assessing mean BMI, assessing deprivation in deciles and ethnicity using combined groups), but the potential impact of such factors cannot be ruled out.

In addition, although the NCMP covers the majority of the national population in the two age ranges included, it measures a completely different cohort of children each year (with the exception of Reception children measured in 2006/07, where the same year group were measured again in Year 6 in 2012/13). As a result it is possible that some variation between NCMP estimates for different years could result from small differences in the demographic and socioeconomic characteristics of the children sampled in each year. It is also possible that some variation between NCMP estimates for different years could result from a change in the nature of any response bias over time.

A number of factors also limit the ability to detect significant changes over time in the data. Firstly, although it is now possible to analyse the trend over two different time periods and look for differences between these results, with only seven years of data available it is still necessary for these time periods to overlap (by one year in Reception and by two years for Year 6 and when assessing changes by ethnic group). As some of the same data points are used in both sets of analysis this limits the power of this analysis to detect significant changes between the two time periods. The approach presented in this report is however likely to become increasingly powerful as

more years of NCMP data become available, and it becomes possible to use non-overlapping time periods and/or use more years of data within each period of analysis.

Secondly, given also the trend in obesity and excess weight prevalence shown by the HSE, obesity prevalence in the child population may be at a period where increases are transitioning to decreases. If the true underlying rate of change in prevalence is changing only slowly it may be masked somewhat by the natural variation around the year on year estimates. In addition, the application of linear analysis techniques to interpret data that are not moving in a linear fashion can be subjective, even when assessed over two relatively short time periods.

Conclusions

The addition of the 2012/13 NCMP provides more substantial evidence that levels of child obesity and excess weight have stabilised and may have begun to fall among some population groups, in line with the pattern observed in the HSE data. Although this analysis cannot explain why this has occurred, it does highlight those population groups where the biggest decreases are occurring and identify those groups where obesity and excess weight are still on the rise.

The positive changes in the BMI of children in England are most apparent among boys in Reception, where there is a consistent pattern of decreasing obesity and excess weight prevalence across the last four years of NCMP measurements. Mean BMI also shows a significant downward trend over this time for boys in Reception, and this change appears to be happening evenly across the whole BMI distribution. It is encouraging that similar decreases in obesity prevalence are taking place across all boys in this age group, regardless of their socioeconomic or ethnic group. As a result the inequalities in child obesity across the population of Reception boys seem to have remained constant across the last four years of NCMP measurements, and may even have begun to narrow slightly.

Few significant trends were identified among the data for girls in Reception, but the various analyses conducted on the most recent four years of NCMP data do show a relatively consistent pattern of small decreases in obesity, excess weight prevalence and mean BMI. In addition, when analysed by socioeconomic or ethnic group the NCMP data for children in Reception in the most recent four years indicate that the changes are spread across the child population as a whole and are not concentrated in specific socioeconomic or ethnic groups.

The trend for children in Year 6 also shows some encouraging signs, especially for boys. The prevalence of obesity and excess weight has stabilised for boys of this age, and for girls an earlier rise in the prevalence of obesity or excess weight has slowed

over time. While there are signs that obesity and excess weight prevalence may have begun to fall for some Year 6 children, any such decreases seem to be only among those parts of the child population where levels of obesity and excess weight are lowest; ie among relatively affluent children and those from the White ethnic group.

Mean BMI of children in Year 6 over the past four years has remained constant after increasing over the first four years of the NCMP. However, this disguises the fact that BMI is still increasing slightly among those children with high BMI while it is decreasing among children with a BMI that is below the population average.

Both HSE and NCMP data suggest that the prevalence of child obesity and excess weight among children in England may be at something of a turning point. After a long period of increases in prevalence over time, rates have begun to stabilise or even fall. Comparison of the trend between the first four years of the NCMP and the last four years shows a positive pattern of change over time (ie bigger decreases or smaller increases) in most analyses, but there are still marked differences in the rate of change of obesity prevalence across different population groups.

Boys show a more positive pattern of change than girls. Since boys still have a higher prevalence of obesity than girls the gap between the sexes is therefore likely to be narrowing slightly, as boys show bigger decreases or slower increases than girls.

Prevalence of both obesity and excess weight are substantially higher in Year 6 than Reception and so bigger decreases will be required among the older age group if obesity prevalence is to be lowered to a similar level for children of all ages. However, as obesity and excess weight prevalence seem to be currently increasing more rapidly in Year 6, the gap between the age bands will still be widening.

The trend in health inequalities also differs by age. In Reception the trend in obesity prevalence is similar across ethnic and socioeconomic groups. These data suggest health inequalities are remaining constant, and may even be narrowing for boys. By contrast, in Year 6 health inequalities appear to have increased at a similar rate over the past seven years, of around 0.5% per year on average.

It is important that NCMP data continue to be used to monitor how child BMI is changing over time. In order to improve the future health of the child population existing decreases in prevalence need to be maintained or increased, and obesity and excess weight need to fall among those areas of the child population where they have as yet not done so, for example among girls in Year 6. In addition these changes need to be distributed across the child population in a way that narrows, rather than increases, health inequalities. It is hoped that the methods presented in this report can be used to perform such monitoring in future years.

Appendix 1: Methods

This report is based on the NCMP datasets for the seven years 2006/07, 2007/08, 2008/09, 2009/10, 2010/11, 2011/12, and 2012/13.

Only data for pupils attending state-maintained schools have been included in the analysis. Only a very small proportion of independent and special schools are covered in the NCMP datasets and therefore, for consistency over time and between areas, these records have been excluded from the analysis for this and previous reports.

The number of valid records remaining after data cleaning by the HSCIC for the seven years of measurement is shown in Figure 1a, broken down by school year and sex. The whole sample for each survey year has been used for the analyses presented, unless specified otherwise.

Children with a BMI greater than or equal to the 95th centile of the British 1990 growth reference (UK90)¹¹ for BMI have been classified as obese and those with a BMI greater than or equal to the 85th centile have been classed as overweight. This definition is the most commonly used for child obesity prevalence figures in England, and is consistent with that used in the HSE and NCMP reports published by the HSCIC. In line with the HSCIC's NCMP analysis the 2nd centile of the UK90 reference has been used to define underweight.

Trends over time have been analysed using unweighted linear regression and the significance of the trend has been assessed using a t-test. Trend analysis for Year 6 excludes the 2006/07 data as the increase in participation between 2006/07 and later years may have had a disproportionately large effect on reported trends for this age group. Due to the low levels of completeness of ethnicity coding in 2006/07 all trend analysis based on ethnicity has been conducted using measurements from 2007/08 to 2012/13 only.

Where differences are described as significant they are statistically significantly different at the 95% significance level. 95% confidence limits and p values have been provided around key statistics.

Analyses were performed in Microsoft Access, Excel and Stata.

Appendix 2: BMI classification definitions

BMI has been classified according to the following table using the British 1990 growth reference (UK90) distribution:

Centile of UK90 BMI distribution	BMI classification
≤ 2	Underweight
> 2 and < 85	Healthy weight
≥ 85	Overweight including obese (excess weight)
≥ 95	Obese

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(All web links were accessed on 28/05/2014)

Reader information

Title	National Child Measurement Programme: Changes in children's body mass index between 2006/07 and 2012/13
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