Public Health England

Protecting and improving the nation's health

National Child Measurement Programme

Changes in children's body mass index between 2006/7 and 2014/15

Version 1.0/ October 2016

About Public Health England

Public Health England exists to protect and improve the nation's health and wellbeing, and reduce health inequalities. We do this through world-class science, knowledge and intelligence, advocacy, partnerships and the delivery of specialist public health services. We are an executive agency of the Department of Health, and are a distinct delivery organisation with operational autonomy to advise and support government, local authorities and the NHS in a professionally independent manner.

Public Health England
Wellington House
133-155 Waterloo Road
London SE1 8UG
Tel: 020 7654 8000
www.gov.uk/phe
Twitter: @PHE_uk
Facebook: www.facebook.com/PublicHealthEngland

Prepared by: Vicky Copley and Catherine Bray, Public Health England

Published October 2016
PHE publications gateway number: 2016364

Contents

Summary of key findings 2006/7 to 2014/15

	Reception		Year 6	
	Boys	Girls	Boys	Girls
Changes in prevalence of obesity Page 7	Significant downward trend, decreasing at a faster rate compared with last year		Significant upward trend, though rate of increase slowing down compared with last year	
Changes in prevalence of excess weight Page 7	Significant downward trend, decreasing at a faster rate compared with last year	No significant upward or downward trend	Significant upward trend, though rate of increase slowing down compared to last year	
Changes in prevalence of overweight Page 7	Significant downward trend, decreasing at a faster rate compared with last year	No significant upward or downward trend	No significant upward or downward trend	
Changes in prevalence of underweight Page 7	Significant downward trend		No significant upward or downward trend, downward trend has levelled off compared with last year	
Changes by deprivation quintile Page 9	Widening inequality in excess weight, obesity and overweight prevalence		Widening inequality in excess weight, obesity and overweight prevalence	
Changes in weight category prevalence by ethnic group[a] Page 13	Significant downward trends in excess weight and obesity in Black Caribbean and White British boys	Significant downward trends in underweight prevalence in Black African, Pakistani and White British girls	Significant upward trends in excess weight and obesity prevalence in Bangladeshi, Black African, Indian and Pakistani boys	Significant upward trends in excess weight and obesity prevalence in Bangladeshi, Indian, Pakistani and White British girls
Changes in mean BMI for age[b] Page 19	No significant upward or downward trend	Significant increase over time in mean underweight BMI for age. No significant upward or downward trend in any other weight category	Mean BMI for age in the excess weight and obesity categories shows significant small increases over time	

[a] The proportion of records with valid ethnicity coding has increased substantially over the nine years of the NCMP. This variation in coding means that trends over time by ethnic group must be interpreted with caution.

[b] Mean body mass index (BMI) for age is measured using BMI *z*-scores. These are measured in standard deviations from the mean and show how a child's BMI compares to the British 1990 reference population, taking the child's age and sex into account.

Key messages

Obesity prevalence shows a significant downward trend in both Reception boys and girls overall in the 2006/7 to 2014/15 period covered by the NCMP.

The trends in obesity in Year 6 boys and girls continue to show year-on-year increases but the rates of increase are slowing down compared with data to 2013/14.

Underweight prevalence has stabilised in Year 6 boys and girls and no longer shows a significant downward trend, though there is a significant small annual declining trend in underweight prevalence in Reception boys and girls.

Analysis by Index of Multiple Deprivation (IMD) quintile continues to show a widening inequality gap in the overweight, obese and excess weight categories for Reception boys and girls and Year 6 boys and girls.

Obesity and excess weight prevalence in Black Caribbean Reception boys are now showing significant annual declines, as is overweight prevalence in White British Reception boys. The upward trend in obesity prevalence in Indian Year 6 boys has become significant.

Significant increases in mean BMI *z*-score over time in obesity and excess weight among Year 6 boys and girls indicate that the children in these weight categories are on average getting heavier (given their height) over time.

Obese children living in more deprived areas are on average heavier, given their height, than obese children in less deprived areas.

Analysis of repeat measured cohorts shows that the 2006/7 to 2012/13 NCMP cohort exhibits a lower relative increase in obesity prevalence from Reception to Year 6 than the two later repeating cohorts (2007/8 to 2013/14 and 2008/9 to 2014/15). The relative rates of obesity prevalence increase shown by the cohort year pairs are higher in more deprived IMD quintiles and in boys.

Introduction

This report is the seventh in a series of annual reports which use National Child Measurement Programme (NCMP) data to examine the changes in children's body mass index (BMI) that have taken place in England since 2006/7.[1,2,3,4,5,6]

The NCMP is a nationally mandated public health function of local authorities which involves measurement of the height and weight of children aged four to five years (Reception) and 10 to 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[7] and is a key element in the government's approach to tackling child obesity. The 2014/15 NCMP was the ninth year of this system of national child measurement.[c]

The NCMP has very high levels of participation across all areas of England.[8] Data completeness and accuracy are very good.[9] The NCMP publication for 2014/15 from the Health and Social Care Information Centre (HSCIC) has National Statistics status[10] and, together with previous reports from the National Obesity Observatory (NOO) and Public Health England (PHE), provides a comprehensive description 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 trends in prevalence over the full period of NCMP measurements. It examines trends in obesity, overweight, excess weight and underweight prevalence as well as changes in mean BMI over time. Trends within different socioeconomic and ethnic groups are also examined to determine whether existing health inequalities are widening or narrowing.

BMI classification definitions

BMI is classified according to the following table using the British 1990 growth reference (UK90)[11] distribution. Other statistical methods are described in Appendix 1.

BMI classification	Centile of UK90 BMI distribution
Underweight	Less than or equal to 2
Healthy weight	Greater than 2 and less than 85
Overweight	Greater than or equal to 85 and less than 95
Obese	Greater than or equal to 95
excess weight	Greater than or equal to 85 (overweight plus obese)

[c] In 2005/6 the National Childhood Obesity Database collected child measurements of school children in England but participation was low and the data from this programme are not detailed enough, nor of high enough quality, to be used for analysis.

Changes in prevalence of obesity, excess weight, overweight and underweight

NCMP takes measurements from a very large number of children and this results in small confidence limits around most annual national estimates. However, the prevalence figures do vary year to year and changes from one year to the next are not always indicative of a long term trend. For example, a statistically significant increase between one year of measurement and the next for any age group or sex may be followed by a decrease the following year. Consequently this report uses all nine annual data points in order to estimate trends more robustly.

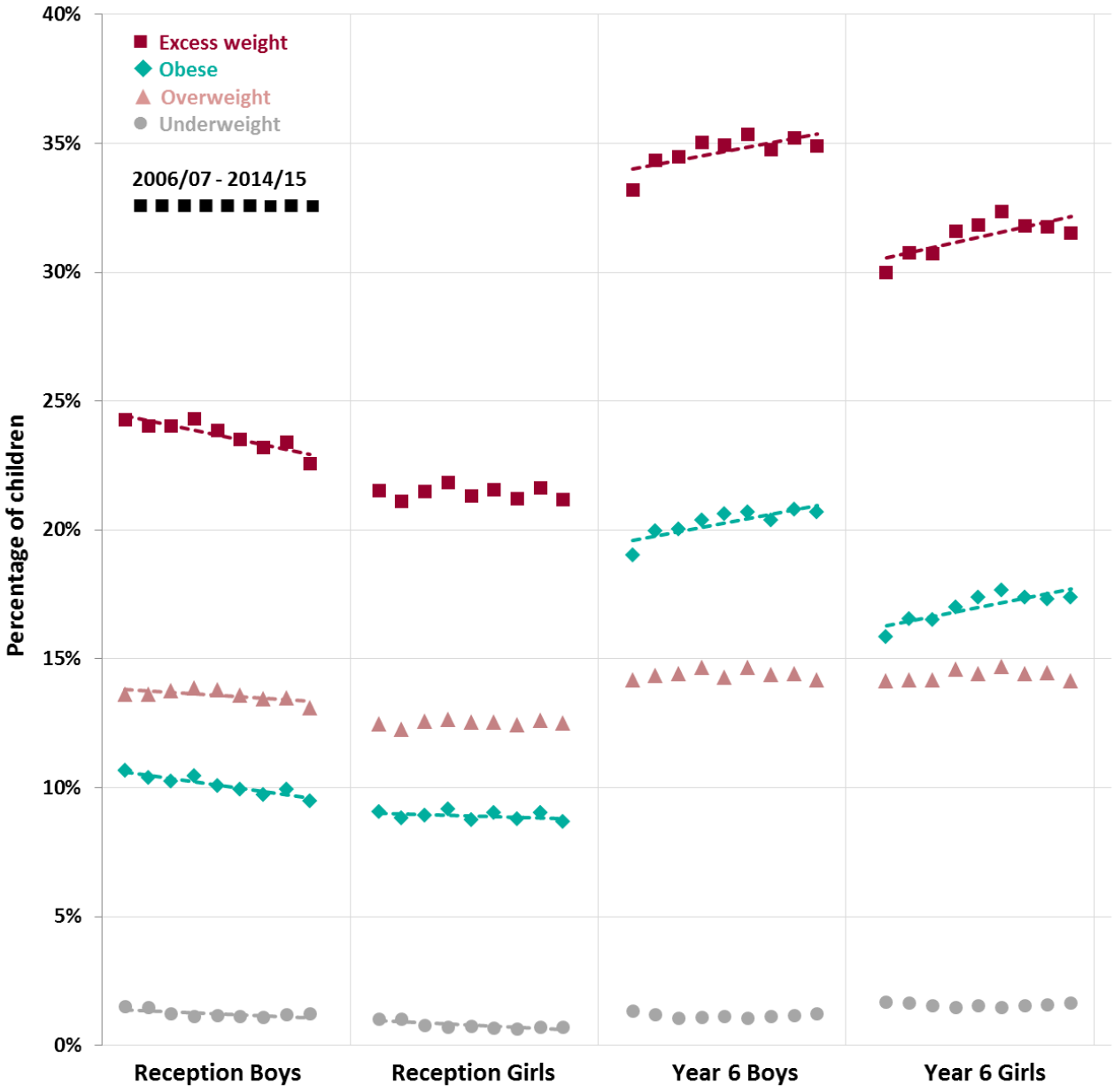
Trend in the prevalence of obesity, excess weight, overweight and underweight from NCMP data

Figure 1 shows the overall trend in the prevalence of obesity, excess weight, overweight and underweight by year of measurement, school year and sex. Within each cluster of points, each point represents one year of measurement, from 2006/7 on the left to 2014/15 on the right.

Significant trends are shown in Figure 1 using a dashed line. Significant upward linear trends in prevalence over the time period were found for obesity and excess weight in Year 6 boys and girls. However, the estimated increases in prevalence per year are all slightly smaller than seen last year[1] indicating that the rates of increase are slowing down. For example, the estimated average increase in obesity prevalence per year in Year 6 girls was 0.22 percentage points last year but, with the 2014/15 data, has fallen to 0.18 percentage points. The estimated average annual rate of increase in overweight prevalence in Year 6 girls is also lower than seen last year and is no longer statistically significant.

Significant downward trends in prevalence were found for obesity and underweight in Reception boys and girls, and excess weight and overweight in Reception boys. The downward trend in obesity prevalence in Reception girls has become steeper compared with the trend found last year and is now statistically significant. A steeper downward trend means that prevalence is decreasing at a faster rate than before. The estimated annual rates of decline in excess weight, obesity and overweight prevalence in Reception boys are also steeper compared with the trend up to 2013/14. The downward trends in underweight prevalence found in last year's report for Year 6 boys and girls are no longer significant, indicating a levelling off.

Figure 1. Prevalence of obesity, excess weight, overweight and underweight by year of measurement, school year, and sex. NCMP 2006/7 to 2014/15.
Significant upward or downward linear trends are shown with a dashed line.



Changes by socioeconomic group

Child obesity prevalence shows a strong association with socioeconomic deprivation. Obesity prevalence in children living in the 10% most deprived areas of the country is more than double that of children living in the least deprived 10% of areas.[12]

To assess how obesity prevalence has changed over time by socioeconomic status, all children surveyed by the NCMP were been grouped into five equal sized bands (quintiles) based on the 2011 IMD for each child's place of residence. In this analysis, quintile 5 contains the least deprived 20% of the child population and quintile 1 contains the most deprived 20%.

Figures 2a to 2d show the association between prevalence of each weight category and deprivation by year of NCMP measurement.

Figure 2a shows significant declines in prevalence of excess weight and obesity in Reception boys. The declines are steeper in the least deprived IMD quintiles, indicating that the inequality gap is still widening. The rates of decline in excess weight and obesity prevalence have steepened in all quintiles compared with the trend up to 2013/14 and the downward trend in excess weight in the most deprived quintile is now significant. Estimated year-on-year declines in underweight prevalence are all significant, though smaller than the trends up to 2013/14, indicating a levelling off.

Obesity and excess weight continue to show significant declines among Reception girls in the least deprived quintile 5 (Figure 2b). The downward trend in obesity in quintile 4 is greater than the trend up to 2013/14 and has become significant. The only significant upward trend in Figure 2b is for excess weight prevalence in the most deprived quintile 1. However the estimated annual increase is lower than the trend up to 2013/14. Taken together, these opposing trends indicate a widening inequality gap in Reception girls.

Significant declining trends in excess weight, obesity and overweight are seen among Year 6 boys in the least deprived quintile 5 (Figure 2c). The estimated annual rate of decline has steepened in all of these groups compared with the trend up to 2013/14. For example, the annual decline in excess weight prevalence in quintile 5 was estimated to be 0.10 percentage points per year last year (with data up to 2013/14) and 0.19 percentage points this year (with data up to 2014/15). The declining trend in overweight prevalence in quintile 5 is now significant. Significant upward trends in excess weight and obesity continue to be seen in quintiles 1 to 3. The associated estimated rates of annual increase are lower this year compared to last with the exception of obesity in quintile 2 where the estimated annual rate of increase in prevalence has increased slightly compared to last year (0.25 percentage points per year compared to 0.24

percentage points per year). Overall the differences in trends between quintiles indicates a widening inequality gap in obesity and excess weight prevalence in Year 6 boys.

Compared to last year's report[1] there is no change in the prevalence trends for Year 6 girls which are statistically significant (Figure 2d). However the estimated rates of increase per year are all lower. For example, there is an estimated annual rate of increase in obesity prevalence in quintile 1 of 0.38 percentage points compared to 0.43 percentage points last year. For quintile 1 excess weight the figures are 0.47 and 0.54 respectively. These indicate that the rates of increase in excess weight and obesity prevalence are slowing down. However, rates of increase remain highest in the most deprived quintiles, giving a widening inequality gap.

Figure 2a. Prevalence of obesity, excess weight, overweight and underweight by year of measurement and IMD quintile: Reception, boys.
Significant upward or downward linear trends are shown with a dashed line.

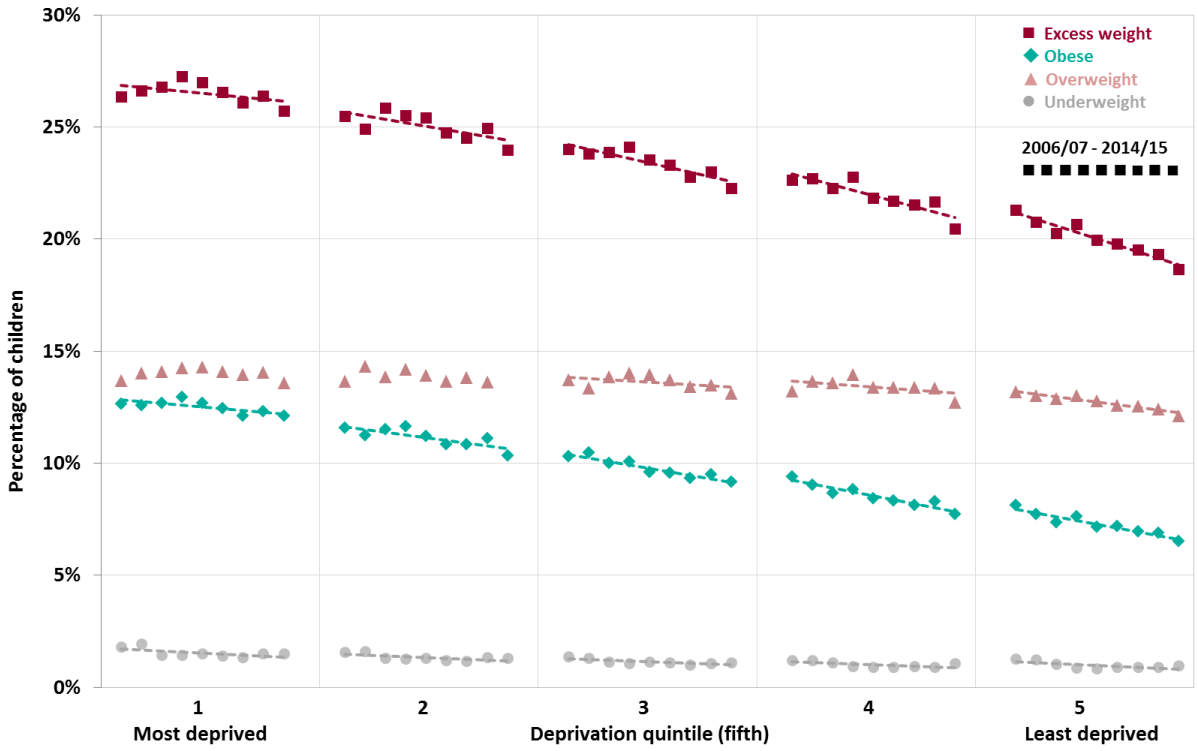


Figure 2b. Prevalence of obesity, excess weight, overweight and underweight by year of measurement and IMD quintile: Reception, girls.
Significant upward or downward linear trends are shown with a dashed line.

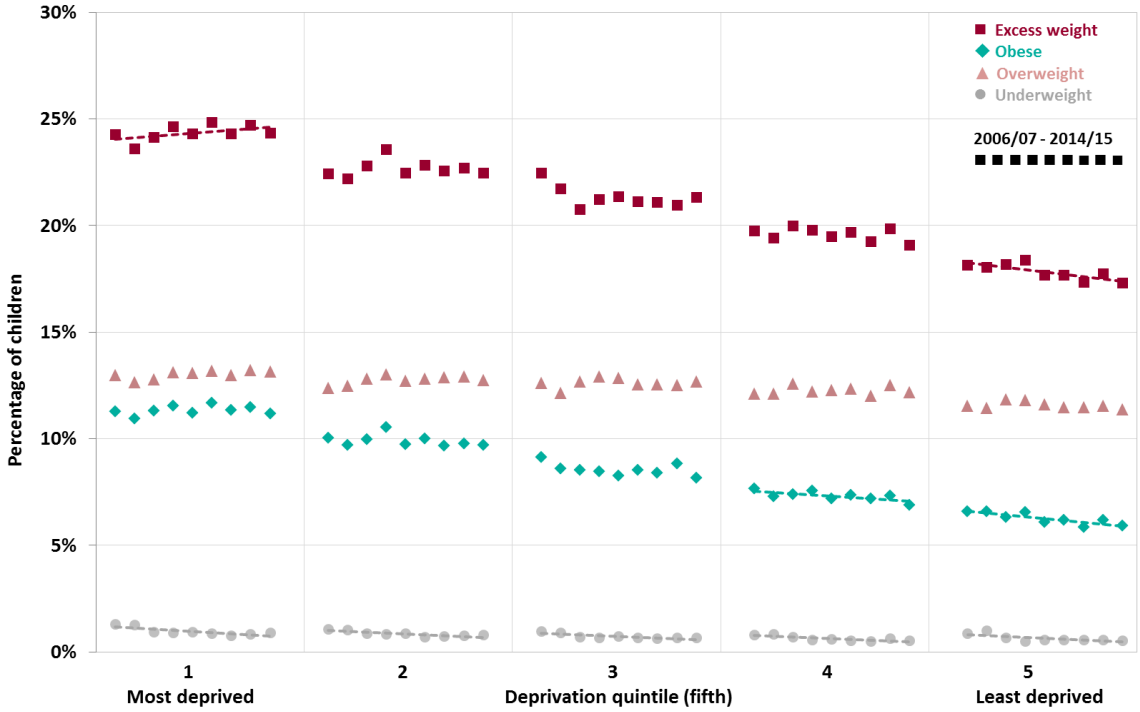


Figure 2c. Prevalence of obesity, excess weight, overweight and underweight by year of measurement and IMD quintile: Year 6, boys.
Significant upward or downward linear trends are shown with a dashed line.

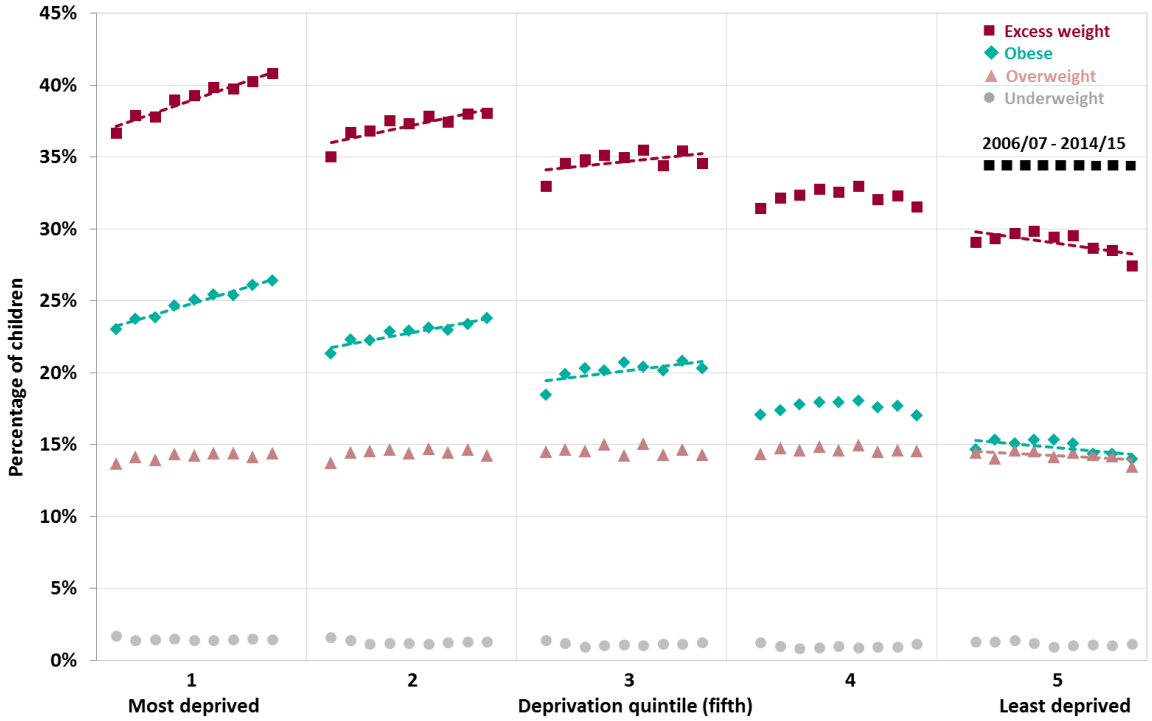
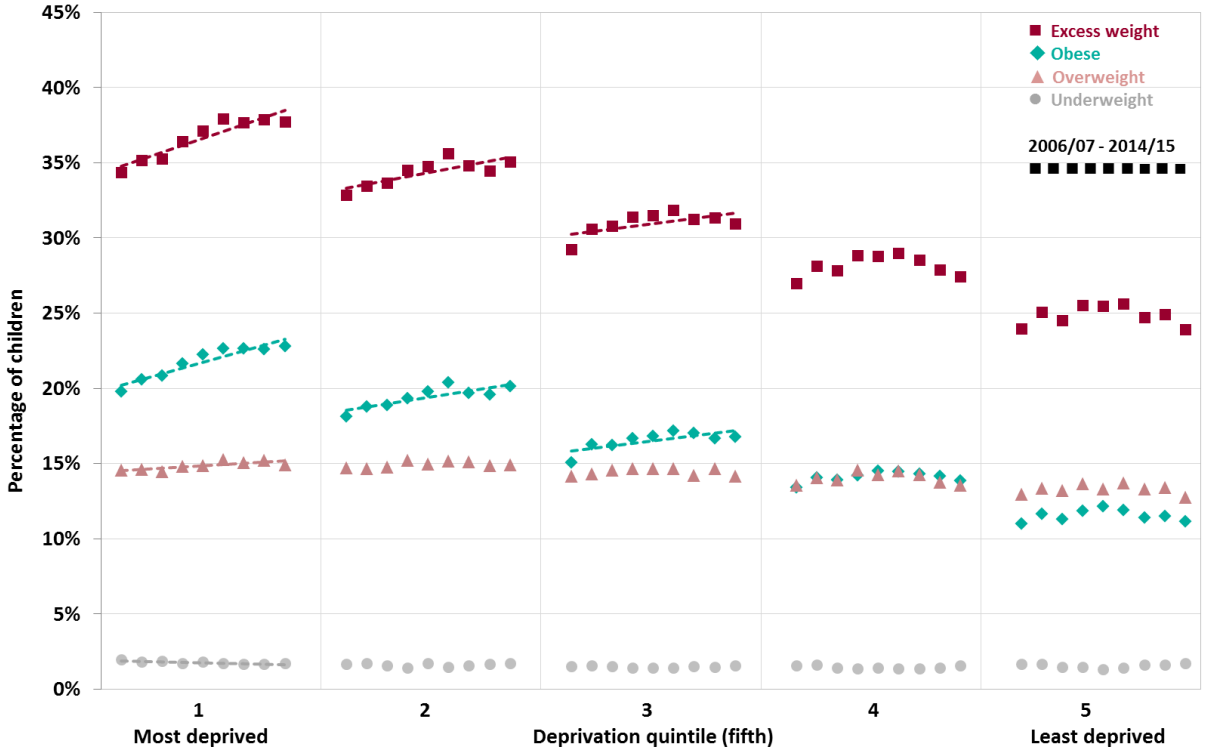


Figure 2d. Prevalence of obesity, excess weight, overweight and underweight by year of measurement and IMD quintile: Year 6, girls.
Significant upward or downward linear trends are shown with a dashed line.



Changes by ethnic group

Previous analyses using both NCMP and HSE data have shown that child obesity prevalence varies substantially between ethnic groups.[13,14] Such analyses show that children classed as White British tend to 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.[15,16] Confounding factors are not adjusted for in the analyses presented here.

The variation in ethnicity coding between NCMP measurement years means that weight category prevalence trends over time by ethnic group must be interpreted with caution as coding percentage might vary with weight status. For example, if ethnic groups with higher obesity prevalence were less likely to have a valid ethnic group coding this would cause some bias in the prevalence estimates, which is hard to detect. Lower rates of ethnicity coding in the earlier years of NCMP also lead to smaller numbers of children in each ethnic group. This can make it difficult to discern trends within ethnic groups as the data is subject to more sampling variation from year to year. NCMP ethnicity coding has been 80% to 85% complete over the past six years.

The ethnicity trend analysis conducted for this report has been based on seven ethnic groups, classified according to NHS ethnicity codes. It was not possible to include all groups because of space constraints and the groups presented are the most diverse with sufficient sample size. Figures 3a to 3d show the association between weight category prevalence and these ethnicities by year of NCMP measurement. Few trends are significant which is likely to be a reflection of the small numbers in some ethnic groups as well as the conservative Bonferroni correction[d] applied to correct for multiple significance testing.

Figure 3a shows newly significant declining trends in excess weight and obesity in Black Caribbean Reception boys and continuing declines in White British boys. These declining trends are steeper than those estimated last year, with the exception of the trend in excess weight among White British boys which is broadly similar. A significant declining trend is now found in White British boys overweight which reflects the overall trend seen in Figure 1 for Reception boys.

Trends in prevalence by ethnic group for Reception girls which are statistically significant in Figure 3b were also significant in last year's report,[1] that is using data up to 2013/14. However the estimated average annual increase in excess weight in Chinese girls is

[d] The Bonferroni correction lowers the p value at which a test is considered significant, to account for the number of comparisons being performed. To perform the Bonferroni correction we divided the critical p value (α, set to 0.05) by the number of comparisons being made in each year and sex group for each type of analysis.

less than that found last year (0.77 percentage points versus 0.93 percentage points), and the past six years show a much flatter trend than earlier data. The estimated annual reductions in underweight prevalence in Black African, Pakistani and White British girls are also smaller than in analysis to 2013/14.

The upward trend in obesity prevalence in Indian Year 6 boys seen to 2013/14 is significant when 2014/15 data is included (Figure 3c). This is likely to be due to a bigger sample size, since the estimated average annual increase in obesity prevalence is less than for 2013/14 (0.29 compared to 0.30 percentage points per year). The downward trend in underweight prevalence in Pakistani Year 6 boys has become slightly steeper compared with the trend to 2013/14 and is now significant. Levelling off is seen in prevalence of underweight in White British Year 6 boys where the downward trend has become non significant.

The significant increases in excess weight and obesity prevalence (Figure 3d) for Year 6 girls were also significant in last year's report. The estimated average annual rates of increase in these groups are all lower than the rates estimated to 2013/14, indicating that the rate of increase is slowing. The significant declining trends reported last year in underweight prevalence in Bangladeshi and White British Year 6 girls are no longer significant. The most recent two years of data show a slight upturn in underweight prevalence in these two ethnic groups.

Figure 3a. Prevalence of obesity, excess weight, overweight and underweight by year of measurement and selected ethnicity: Reception, boys. Significant upward or downward linear trends are shown with a dashed line.

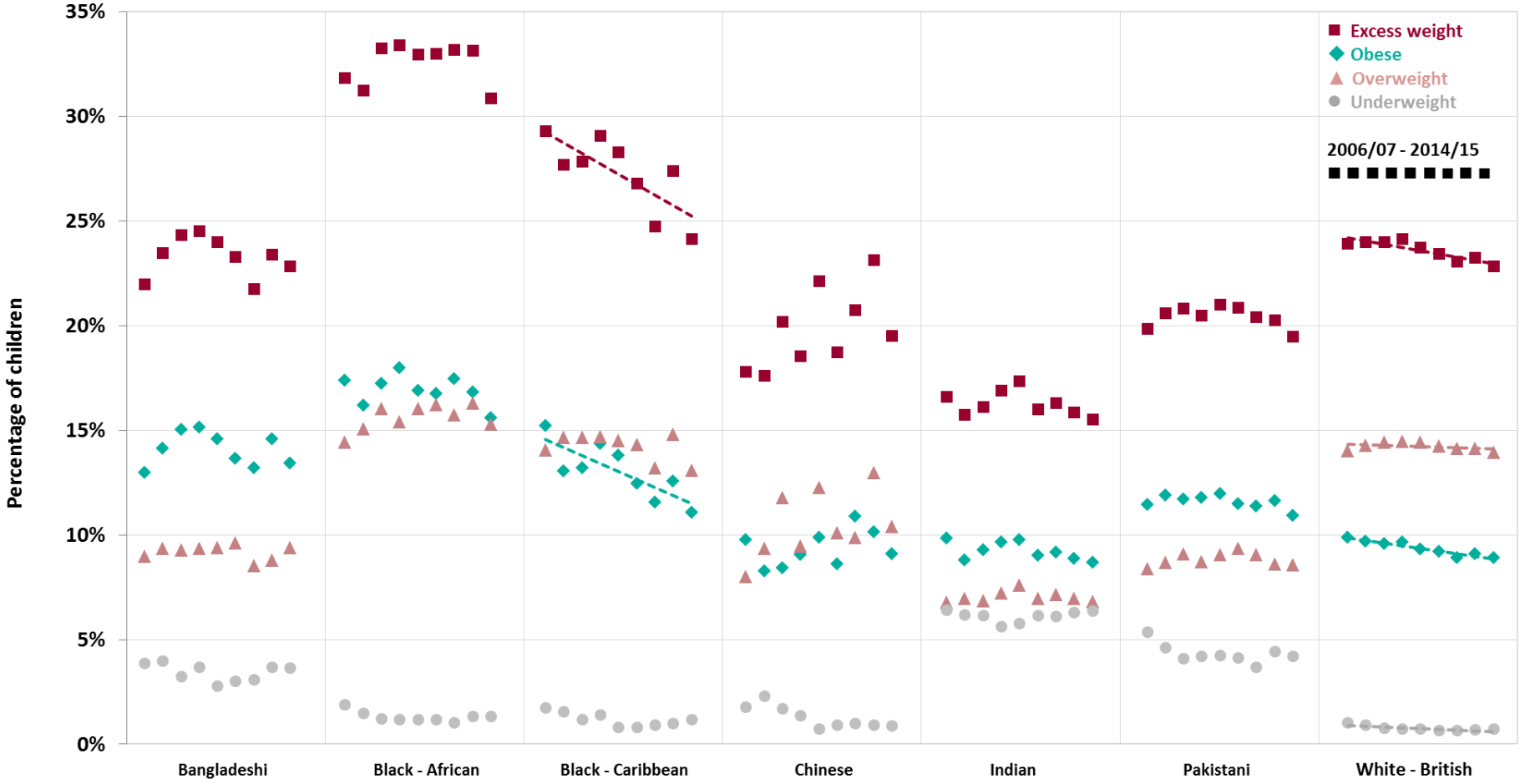


Figure 3b. Prevalence of obesity, excess weight, overweight and underweight by year of measurement and selected ethnicity: Reception, girls. Significant upward or downward linear trends are shown with a dashed line.

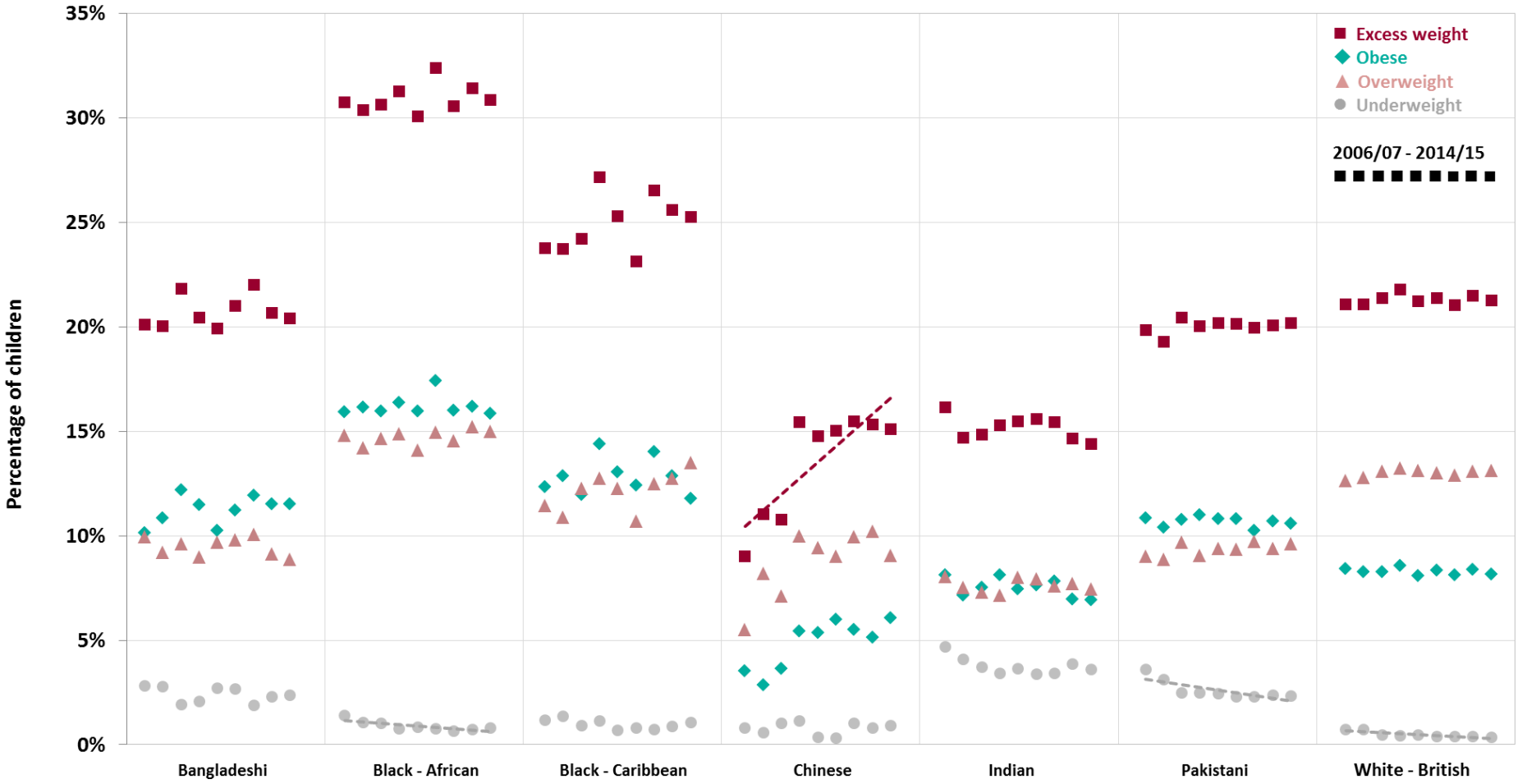


Figure 3c. Prevalence of obesity, excess weight, overweight and underweight by year of measurement and selected ethnicity: Year 6, boys. Significant upward or downward linear trends are shown with a dashed line.

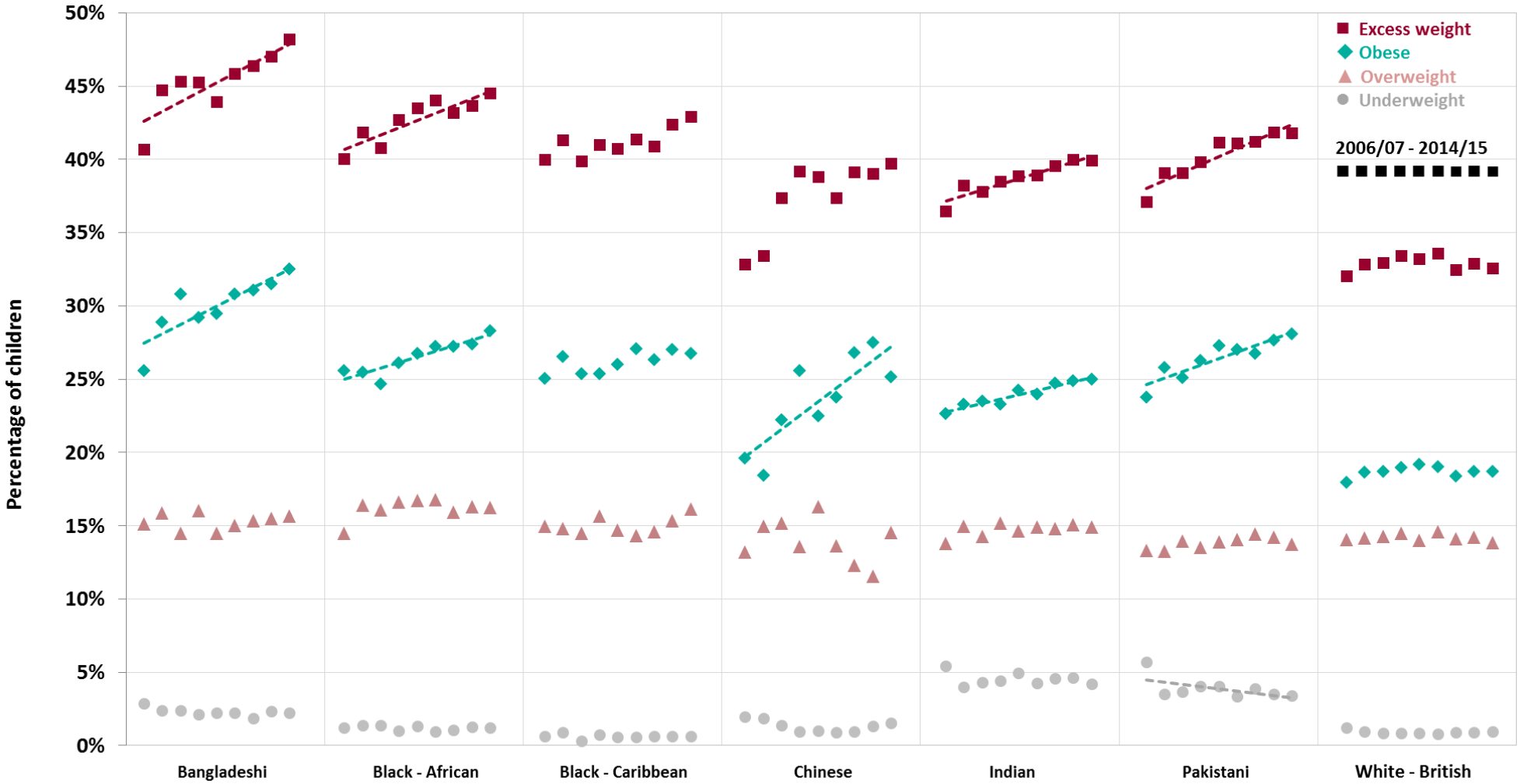
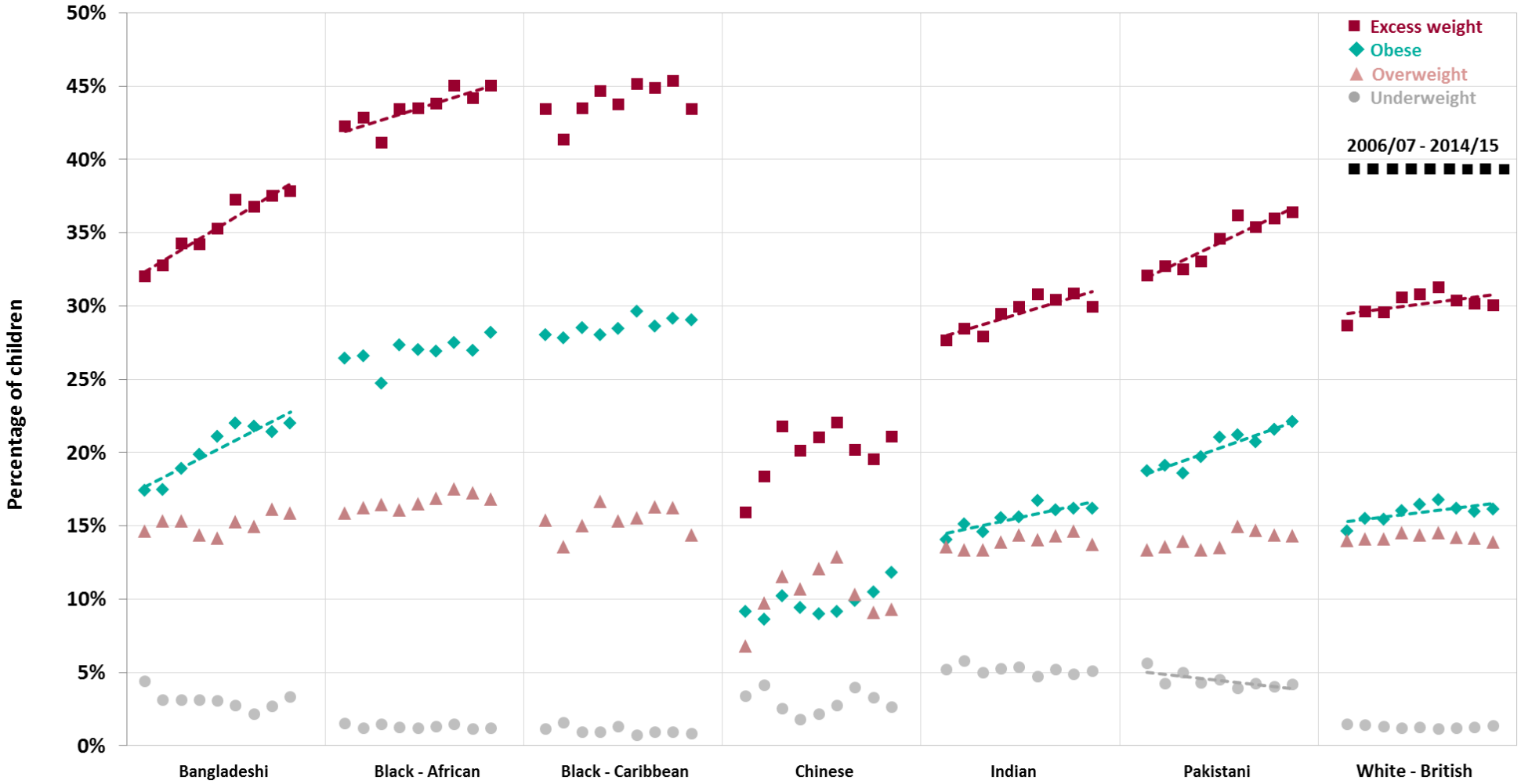


Figure 3d. Prevalence of obesity, excess weight, overweight and underweight by year of measurement and selected ethnicity: Year 6, girls. Significant upward or downward linear trends are shown with a dashed line.



Changes in the distribution of children's BMI

Changes in mean BMI *z*-score by weight category

BMI *z*-scores, rather than actual BMI values, have been used to examine change in mean BMI over time in order to standardise the average age of measurement of children in Reception and Year 6 in different measurement years. 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. Figures 4a and 4b show trends in mean BMI *z*-score by weight category, age and sex for all years of NCMP measurement.

Figure 4a shows that the small significant increases in mean *z*-score over time for obesity and excess weight in Year 6 boys and girls found to 2013/14 continue to be significant. The estimated annual rates of increase also remain much the same. The increase over time in mean BMI *z*-score in Year 6 girls overweight is no longer significant and the estimated annual rate of increase in units of *z*-score has dropped from 0.0004 to 0.0003 per year. This indicates that, although Year 6 overweight girls are still on average getting heavier (given height) over time, the annual rate of increase in weight for height has slowed.

Figure 4b shows that mean BMI *z*-score for underweight Reception girls continues to increase over time and that this trend remains significant. By contrast, increases in mean BMI *z*-score for underweight Reception boys and Year 6 boys and girls have levelled off since around 2012/13 and no significant change in mean *z*-score was seen for these groups. Figure 4b also shows that mean healthy weight BMI *z*-score has remained stable in all groups.

Figures 5 and 6 show trends in mean BMI *z*-score in the obese weight category by IMD quintile and ethnic group respectively, for each school year and sex combination. Sample sizes here become relatively small and so the mean *z*-scores differ greatly from year to year. This is particularly the case with ethnic groups (Figure 6). However it is possible to discern some overall patterns.

Figure 5 shows that mean BMI *z*-score in the obese weight category increases systematically with increasing deprivation. Obese children living in more deprived areas have a higher mean BMI for age than obese children living in less deprived areas. In Reception boys and girls, mean BMI *z*-score in the obese weight category shows a non significant reduction over time which is most pronounced in the least deprived quintiles, though no trend is significant. In Year 6 boys and girls, mean BMI *z*-score in the obese weight category is generally increasing over time. The rate of increase does not appear

to be higher in more deprived quintiles but, as only one trend is significant, it is difficult to draw firm conclusions.

Figure 6 shows that there are systematic variations in mean BMI *z*-score in the obese weight category by ethnic group but that these variations are not consistent across the school year and sex groups. For example, Bangladeshi boys have the highest absolute levels of mean BMI *z*-score in the Reception boys group but Bangladeshi girls have one of the lowest levels of mean BMI *z*-score in the Year 6 girls group. White British children have the lowest levels of mean BMI *z*-score in all year and sex groups except Year 6 girls where the lowest mean BMI *z*-scores are generally seen in Indian girls.

Figure 6 also shows variation in rates of change in mean BMI *z*-score in the obese weight category over time by ethnic group. Trends appear generally downward for White British and Black African Reception boys, White British Reception girls, Black African and Black Caribbean Year 6 girls. Broad upward trends are seen in White British Year 6 boys and girls and Year 6 Bangladeshi boys. However, given the general dispersion of the points only one of these trends is significant - the increase seen in White British Year 6 girls.

Figure 4a. Mean BMI *z*-score by weight category, year of measurement, school year, and sex. NCMP 2006/7 to 2014/15.
Significant upward or downward linear trends are shown with a dashed line

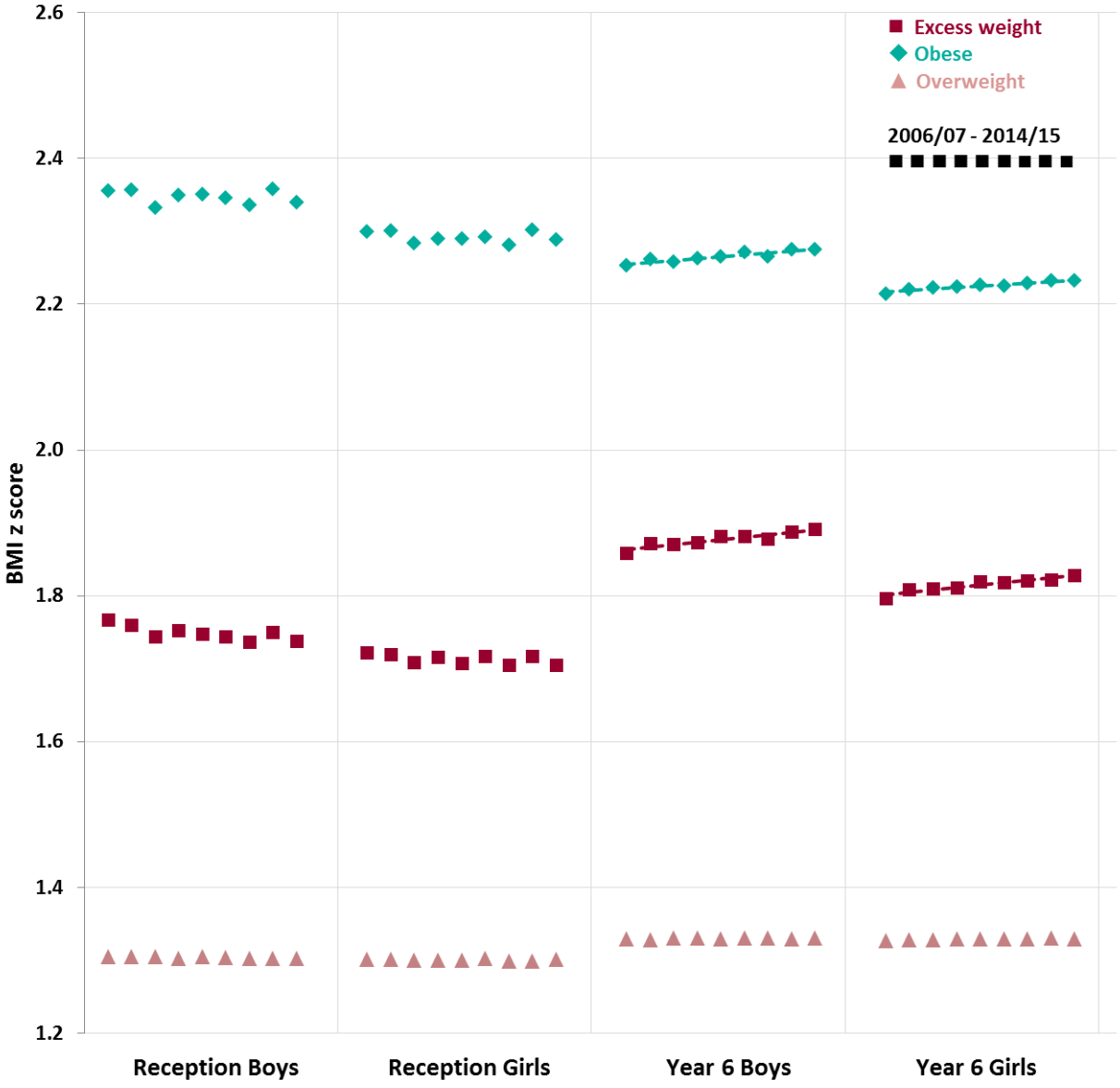


Figure 4b. Mean BMI *z*-score by underweight and healthy weight category, year of measurement, school year, and sex. NCMP 2006/7 to 2014/15.
Significant upward or downward linear trends are shown with a dashed line.

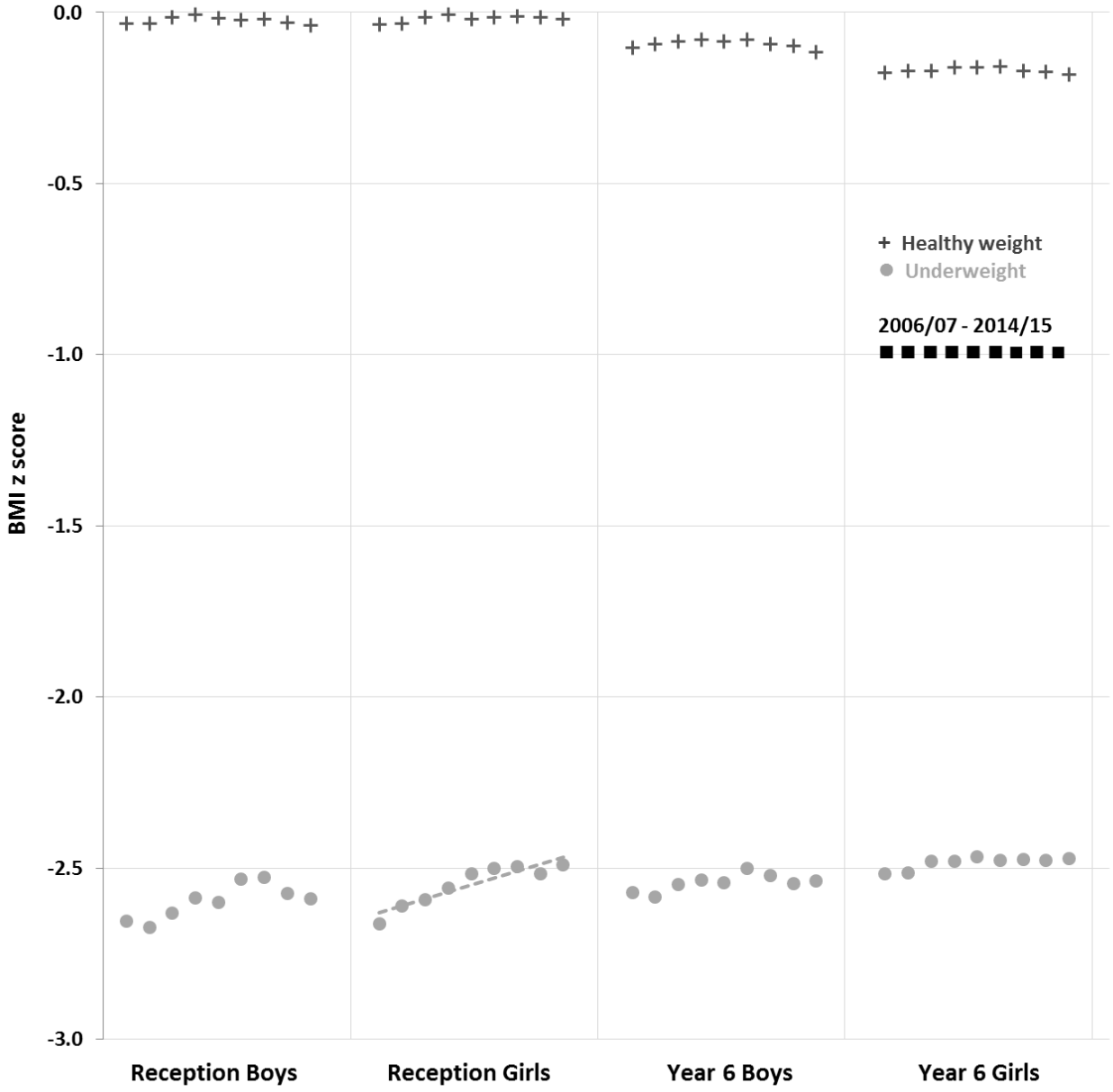


Figure 5. Mean BMI *z*-score in the obese weight category by IMD quintile, year of measurement, school year, and sex. NCMP 2006/7 to 2014/15.
Significant upward or downward linear trends are shown with a dashed line.
Quintile 1 is most deprived.

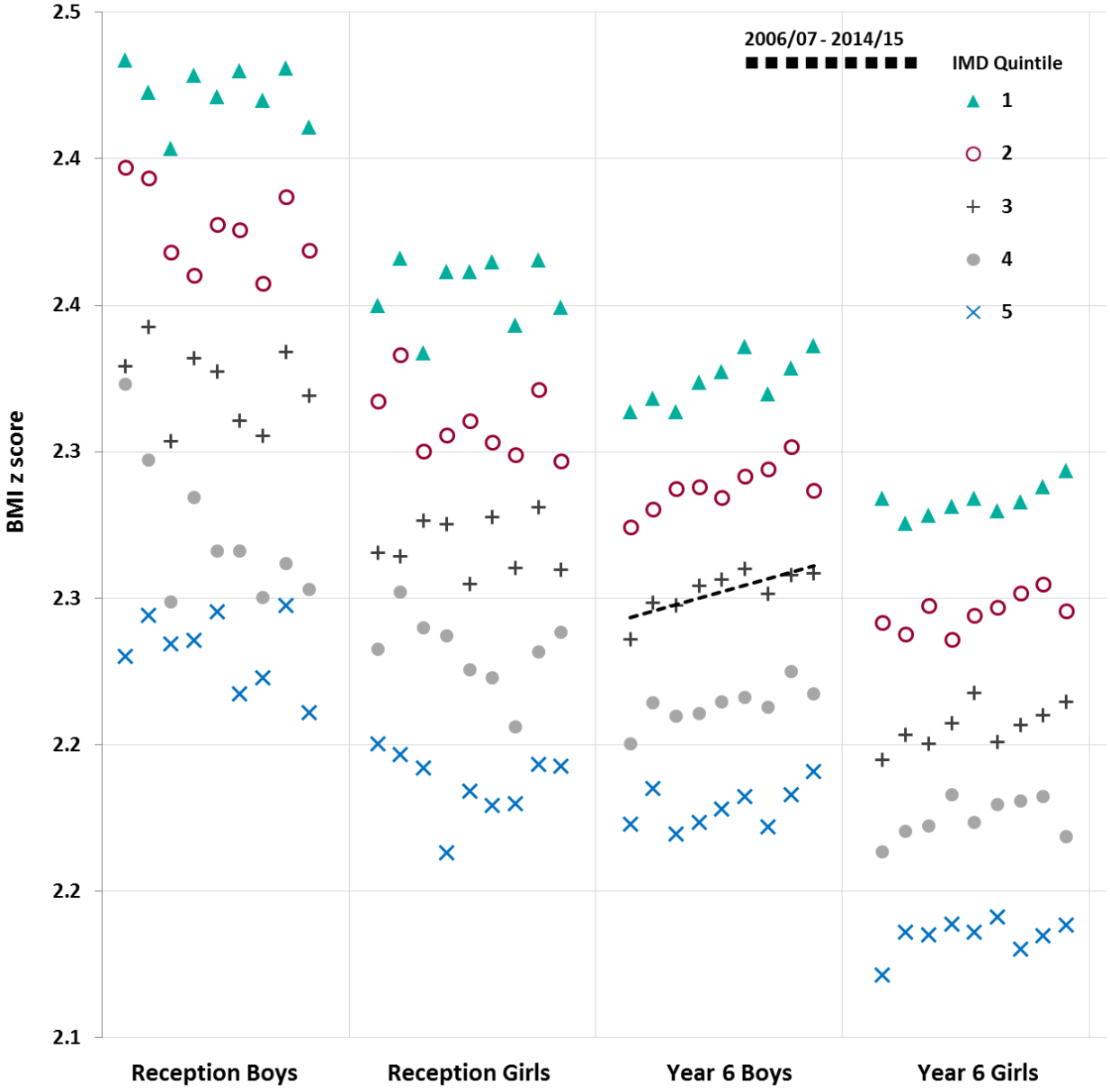
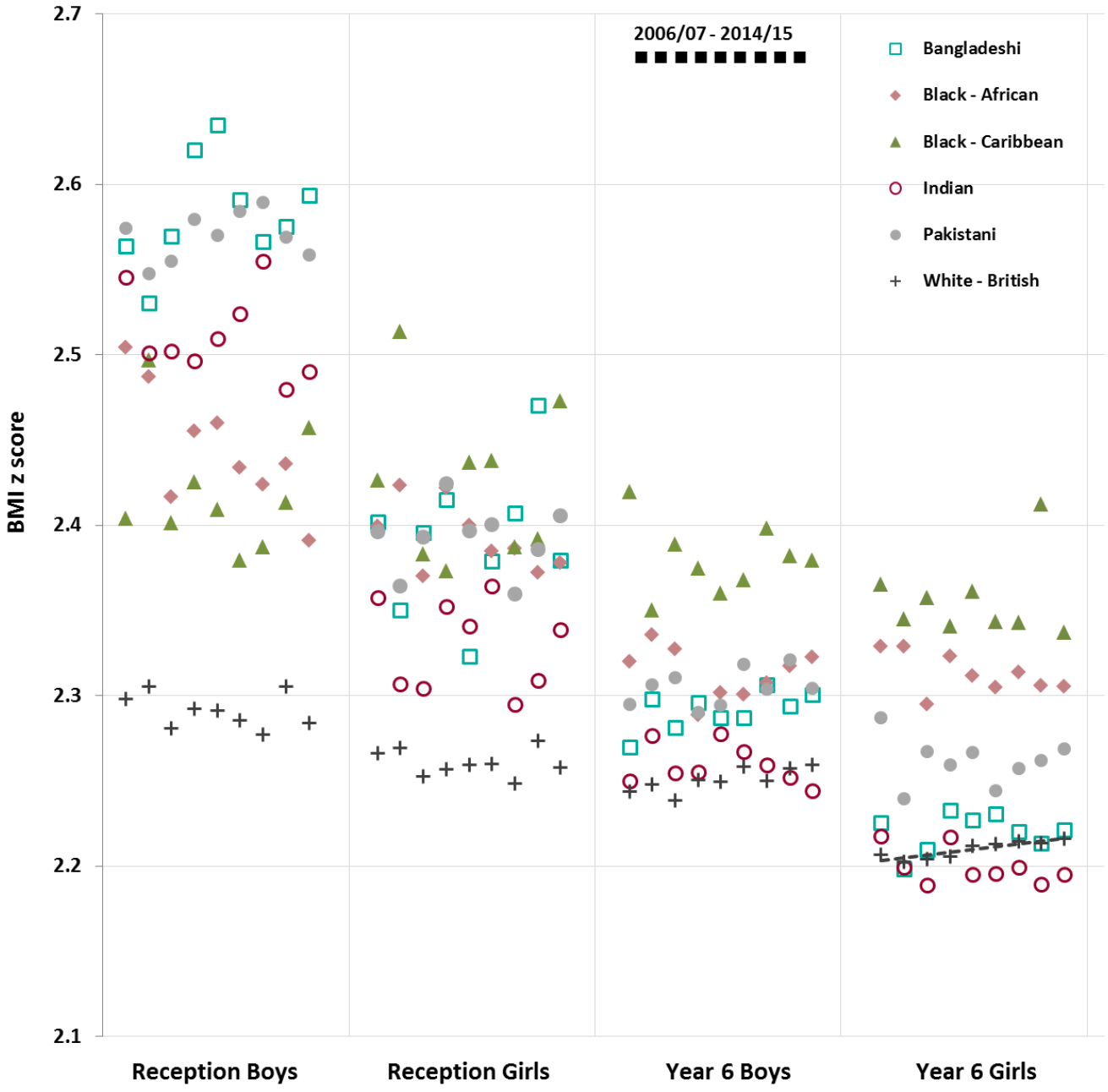


Figure 6. Mean BMI *z*-score in the obese weight category by ethnicity, year of measurement, school year, and sex. NCMP 2006/7 to 2014/15.
Significant upward or downward linear trends are shown with a dashed line.



Obesity prevalence changes in repeat-measured cohorts

NCMP measurement began in 2006/7 and a large proportion of the children who were measured in Reception in the start year will have been remeasured in Year 6 in 2012/13. Similarly, children who were measured in Reception in 2007/8 and 2008/9 will have been remeasured in 2013/14 and 2014/15 respectively. PHE does not hold identifiable NCMP data and, as such, the potential to make detailed comparisons of the measurements within these pairs of years is limited. However, an analysis of changes in weight category prevalence between Reception and Year 6 at national level will be broadly valid as long as the rate of remeasurement is high. In view of the high participation rates in the NCMP (Section 9) it is reasonable to assume that most children are remeasured. The rate of remeasurement will mainly be driven by rate of pupil switching between state and private sectors, pupil immigration and emigration (at national level) and changes in pupil opt out, all of which are very small compared with the overall NCMP population.

Figure 7 shows the relative change in obesity prevalence from Reception to Year 6 for the three cohort years with repeated measurements, by sex and deprivation quintile. A relative change of 0% indicates no change at all in obesity prevalence between Reception and Year 6. A relative change of 50% between Reception and Year 6 means that obesity prevalence has increased by half of its Reception value while a relative increase of 100% means that it has doubled from its Reception value.

Figure 1 shows that in each of the measurement years obesity prevalence approximately doubles between Reception and Year 6. Figure 7 demonstrates that this relationship holds within cohorts too since overall relative obesity prevalence increases by around 100% from Reception to Year 6, for boys and girls. The exact rate of increase depends on the cohort pair and IMD quintile. The 2006/7 to 2012/13 cohort shows a lower relative increase in obesity prevalence from Reception to Year 6 than do the two later cohorts. This indicates that proportionally more children became obese between Reception and Year 6 in the later cohorts than between 2006/7 and 2012/13. Relative rates of increase are higher in the more deprived IMD quintiles and in boys.

Figure 8 shows the relative change in obesity prevalence from Reception to Year 6 by sex and ethnic group, for the three cohorts with repeated measures. As noted previously, the variation in ethnicity coding between NCMP measurement years means that all ethnic group trends must be interpreted with caution. The largest relative increases in Figure 8 are in Chinese boys and girls where obesity prevalence roughly triples from Reception to Year 6 in all three cohorts. However, Chinese children have the lowest rates of obesity prevalence in Reception and, even with this high relative

increase, have among the lowest rates of obesity prevalence in Year 6 (Figures 3a to 3d). The smallest relative increases in obesity prevalence from Reception to Year 6 are in Black African boys and girls. Black African obesity rates in Reception are already the highest of any ethnic group and remain among the highest in Year 6.

Figure 8 shows that the 2006/7 to 2012/13 cohort has a lower relative increase in obesity prevalence from Reception to Year 6 than the two later cohorts in all ethnic groups except Bangladeshi, Black African, Black Caribbean and Pakistani. The rate of relative increase in obesity prevalence by sex also varies by ethnic group. Boys tend to have a higher rate of relative increase than girls in Asian ethnic groups (Bangladeshi, Indian and Pakistani) (Figure 8) although they also have higher rates of obesity prevalence than girls in these ethnic groups in Reception (Figures 3a to 3b). Girls have a higher relative increase than do boys in Black Caribbean and Chinese groups (Figure 8).

Figure 7. Relative change in obesity prevalence from Reception to Year 6 by sex and deprivation quintile for cohorts with repeated measures (2006/7 and 2012/13; 2007/8 and 2013/14; 2008/9 and 2014/15)

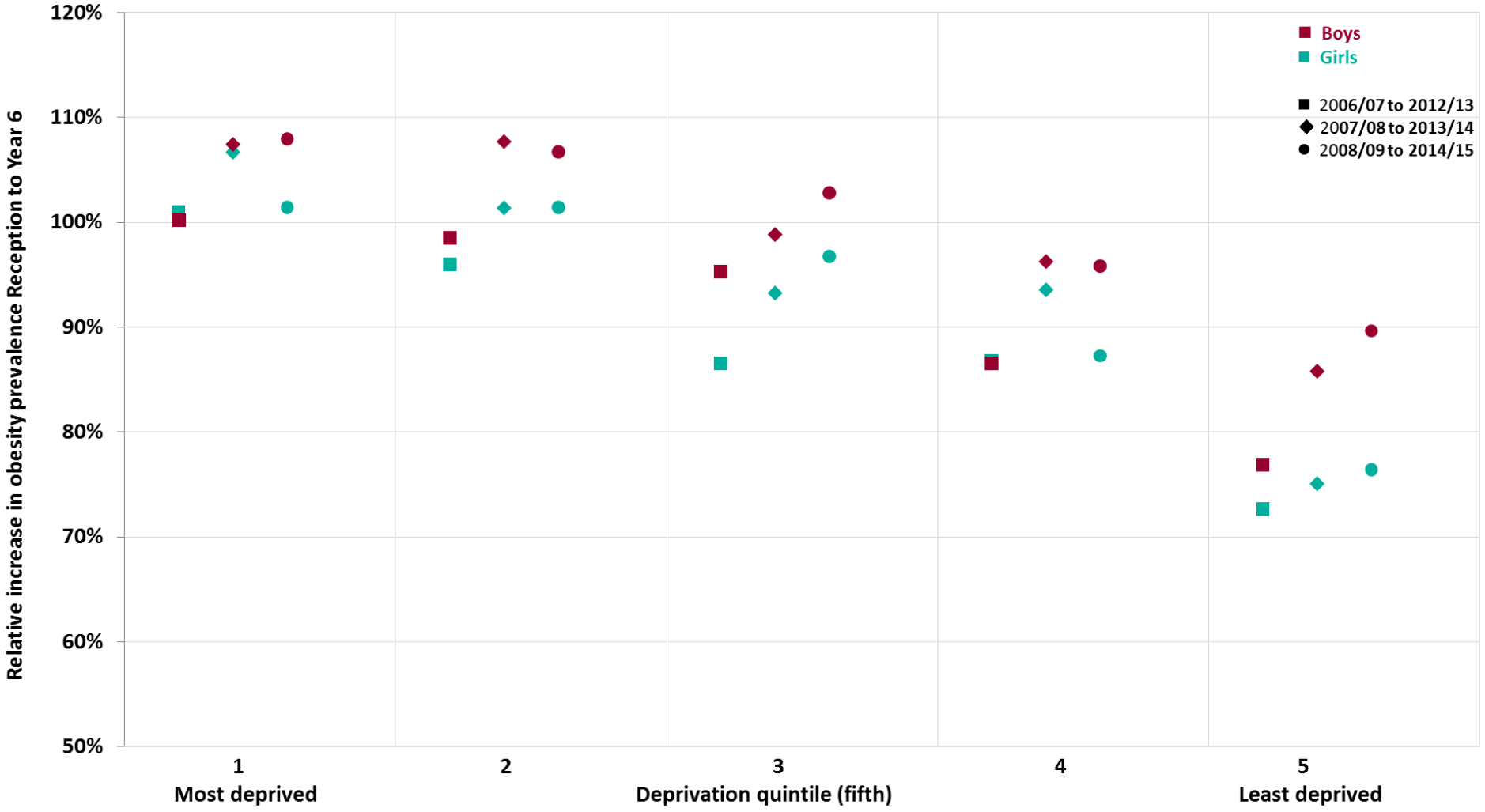
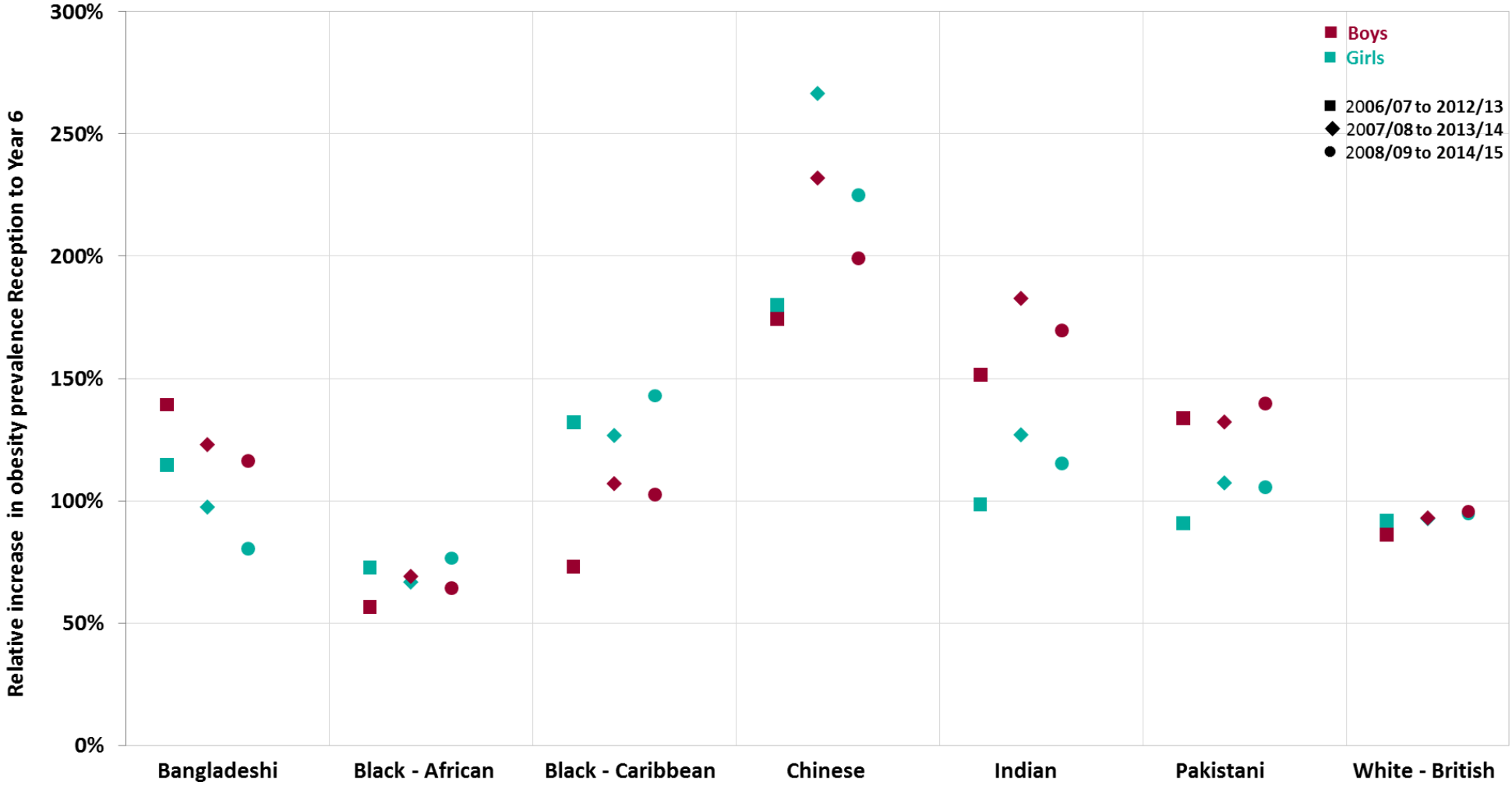


Figure 8. Relative change in obesity prevalence from Reception to Year 6 by sex and ethnicity for cohorts with repeated measures (2006/7 and 2012/13; 2007/8 and 2013/14; 2008/9 and 2014/15)



The National Child Measurement Programme dataset

The 2014/15 NCMP dataset contains the largest number of child measurements collected to date by the programme with 1,141,859 valid measurements of children from state maintained schools in England. Overall participation (the percentage of eligible children that are measured) was 94.8% in 2014/15, the highest it has ever been. Figure 9a shows the number of children measured by year of measurement, school year (Reception and Year 6) and sex. Figure 9b 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 steadily over the years 2006/7 to 2014/15. In 2014/15 a total of 610,636 children were measured compared to 587,336 in 2013/14 (Figure 9a). Participation in the NCMP has also risen over time for this age group although there was a very small fall in 2013/14 to 94.2%. In 2014/15 Reception year participation was 95.5% (Figure 9b).

In Year 6, a year-on-year decrease in the absolute number of boys and girls measured occurred from 2009/10 to 2012/13 because of demographic changes leading to a fall in the number of children of this age 'eligible for measurement'. In 2014/15, the total number of children measured increased compared to 2013/14 with 531,223 child measurements recorded (Figure 9a). However, the number of Year 6 boys measured decreased in 2014/15 compared to 2013/14. The level of participation for children in Year 6 has continued to increase over time, reaching 94.0% in 2014/15 (Figure 9b).

Figure 9a. Number of children measured by year of measurement, school year, and sex

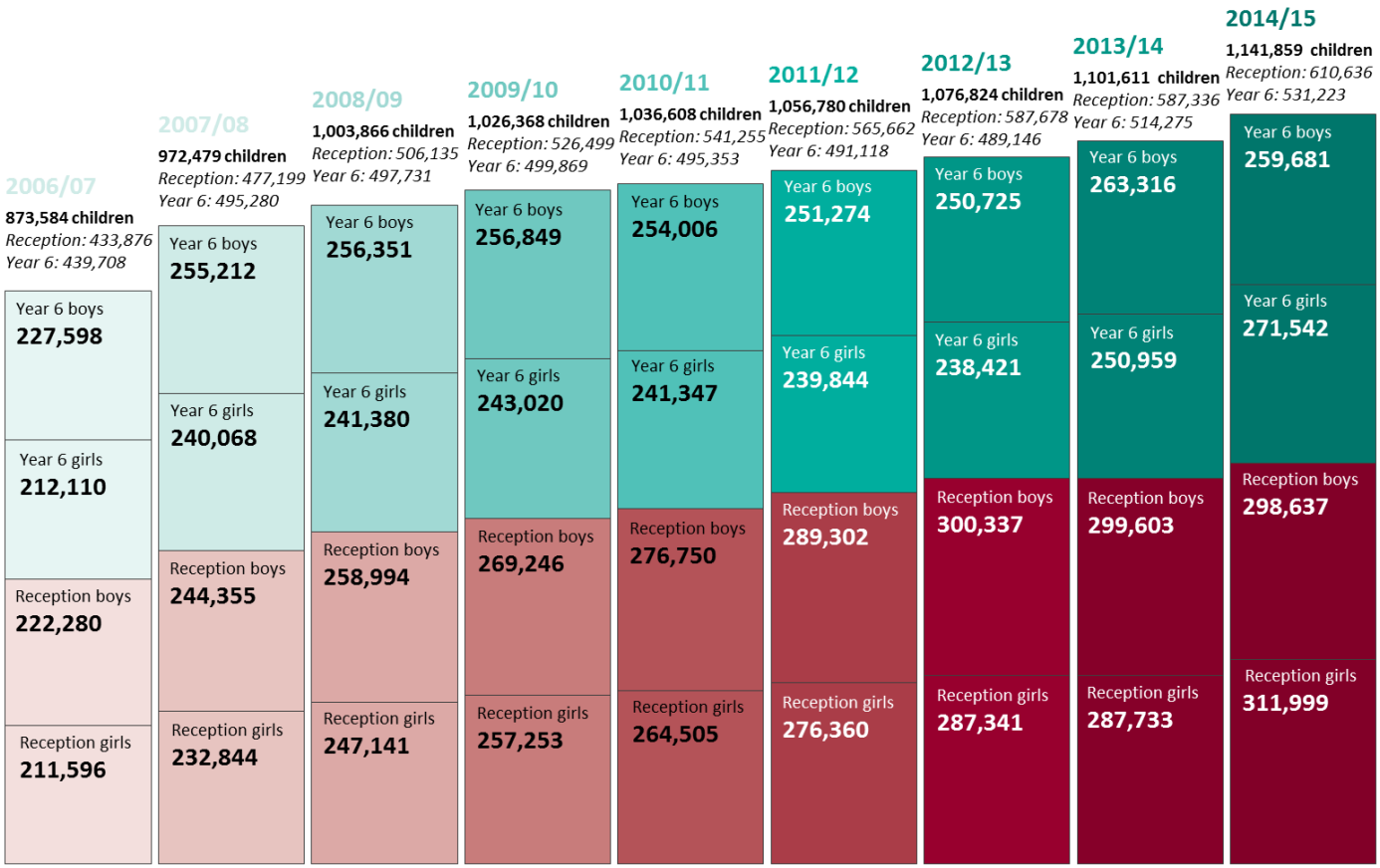
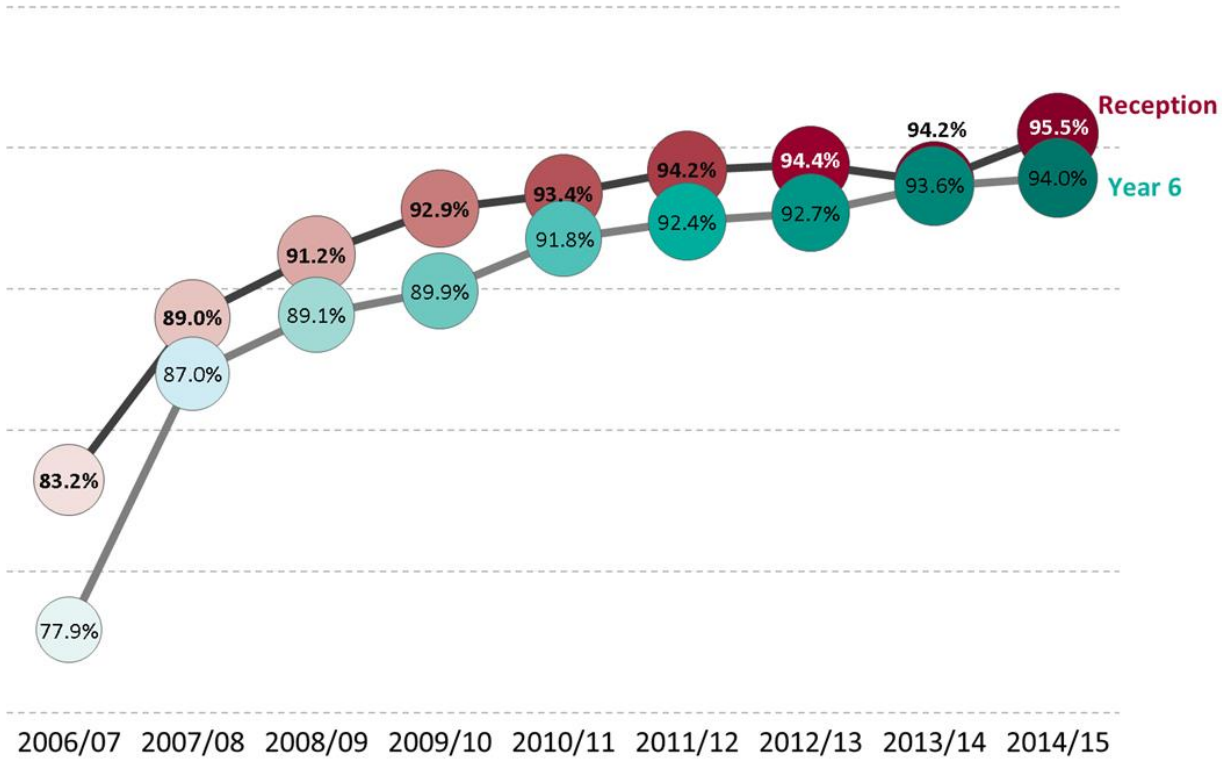


Figure 9b. Percentage participation by year of measurement and school year



Discussion and conclusions

Obesity prevalence shows a significant downward linear trend for Reception boys and girls overall from 2006/7 to 2014/15. This contrasts with the downward trend found in Reception boys only using data up to 2013/14.[1] The trends in obesity prevalence in Year 6 boys and girls continue to show year-on-year increases in prevalence but at lower rates than trends to 2013/14. The annual increase in excess weight prevalence in Year 6 boys and girls is also smaller compared with the trend to 2013/14.[1] Underweight prevalence has stabilised in Year 6 boys and girls and no longer shows a significant downward trend, though there is still a significant small annual reduction among Reception boys and girls.

Analysis by IMD quintile continues to show a widening inequality gap in the overweight, obese and excess weight categories for boys and girls in Reception and Year 6. Where prevalence is declining overall, it is either increasing in the most deprived quintiles compared to the least or is generally declining at a slower rate. Where prevalence is increasing overall it is increasing at a faster rate in the most deprived quintiles. Where prevalence of healthy weight, excess weight, overweight and obesity have increased in individual quintiles, the rate of increase is lower than for last year. By contrast, rates of decrease have tended to become greater, reflecting overall results.

Estimates of trends in weight category prevalence by ethnic group are potentially subject to bias. This is due to the variation in NCMP ethnic category coding over time and because ethnicity coding in the dataset is below 100% (80% to 85% complete over the past six years). Ethnic groups which show significant trends in prevalence over time have larger sample sizes, trends of higher magnitude, or both. As a result, few differences in trend significance exist from last year's report, though obesity and excess weight prevalence in Black Caribbean Reception boys are now showing significant annual declines, as is overweight prevalence in White British Reception boys. A newly significant upward trend is also seen in obesity prevalence in Indian Year 6 boys.

Significant increases in mean BMI *z*-score over time in obesity and excess weight for Year 6 boys and girls indicate that the children in these weight categories are also on average getting heavier (for their height) over time. Detailed analysis of mean BMI *z*-scores within the obese weight category shows a systematic increase with deprivation; that is obese children from more deprived quintiles are on average heavier than obese children from less deprived quintiles. This is consistent with earlier analysis of severe obesity using NCMP data.[17] Trends in mean BMI *z*-score in the obese weight category by IMD quintile reflect the overall trends in obesity prevalence noted above, though few trends in *z*-score are significant. Mean BMI *z*-score in the obese weight category also shows clear patterning by ethnic group, but this varies by school year and sex.

Analysis of repeat measured cohorts shows that the 2006/7 to 2012/13 NCMP cohort tends to exhibit a lower relative increase in obesity prevalence from Reception to Year 6 than the two later cohorts, except in some ethnic groups, possibly as a result of lower rates of ethnicity coding in 2006/7. The relative rates of obesity prevalence increase shown by the cohort year pairs are higher in the more deprived IMD quintiles and in boys.

Our analyses have assumed that trends in weight category prevalence over time are linear. Figures 1 to 4 indicate that this appears to be a reasonable assumption in most cases but this is, nonetheless, a limitation of our approach. We have not assessed changes in estimated trends between last year and this year for statistical significance and they should be interpreted with caution. However, nine years of NCMP data representing over nine million child measurements have been summarised in this report and it provides a comprehensive picture of weight trends in the year groups which it monitors.

Appendix 1: methods

This report is based on the NCMP datasets for the nine years 2006/7, 2007/8, 2008/9, 2009/10, 2010/11, 2011/12, 2012/13, 2013/14 and 2014/15.

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, for consistency over time and between areas, these records have been excluded. The number of valid records for the nine years of measurement is shown in Figure 9a, broken down by school year and sex.

Only children with valid geographical coding (postcode of residence) have been included in the analysis by 2011 IMD quintile. The proportion of records with this coding has increased over the nine years of the NCMP. In 2006/7, the first year of the NCMP, around 57% of child records included valid coding for place of residence. This increased to 95% in 2007/8, and to over 99% in 2008/9 and subsequent years. The variation in coding has the potential to bias the estimates of prevalence by IMD quintile and findings for 2006/7 in particular must be interpreted with caution.

Linear regression models have been used to describe prevalence trends throughout this report. Logistic models were used to assess the significance of the trends (using a Bonferroni correction for multiple hypothesis testing[e]), while least squares models were used to obtain the average increase or decrease in prevalence per year over time for descriptive purposes. These models assume that the trends are linear, both because there are too few data points to accurately capture a non-linear trend and to facilitate more straightforward comparison between the weight, sex and year categories. Logistic model trend estimates obtained with NCMP data from 2006/7 to 2014/15 were compared with trend estimates obtained for last year's report,[1] using data from 2006/7 to 2013/14, but were not assessed for statistical significance. All analysis was performed in R.[18]

Trend estimates described in this report may differ from those reported in the Public Health Outcomes Framework[7] (PHOF) and other PHE online data tools[19] including the NCMP LA Profile[20] because of differences in methodology and data used. The online tools currently use a chi-squared statistical test for trend[21] with the most recent five data points but, if this trend is not significant, go back further in time and test for a significant trend again. NCMP data published in the PHOF and the NCMP LA Profile also combines annual measurements for boys and girls, in contrast to the analyses presented here which consider boys and girls separately.

[e] The Bonferroni correction lowers the p value at which a test is considered significant, to account for the number of comparisons being performed. To perform the Bonferroni correction we divided the critical p value (α, set to 0.05) by the number of comparisons being made in each year and sex group for each type of analysis.

References

1. Copley V. R. & Bray C. Changes in children's body mass index between 2006/07 and 2013/14: National Child Measurement Programme. London: Public Heath England, October 2015. www.noo.org.uk/NCMP/National_report
2. Dinsdale H., Hancock C. and Rutter H. National Child Measurement Programme: Changes in children's body mass index between 2006/07 and 2012/13. London: Public Heath England, 2014. www.noo.org.uk/NCMP/National_report
3. Ridler C, Dinsdale H, Rutter H. National Child Measurement Programme: Changes in children's body mass index between 2006/07 and 2011/12. Oxford: National Obesity Observatory, 2013. www.noo.org.uk/NCMP/National_report
4. Dinsdale H, Ridler C, Rutter H. National Child Measurement Programme: Changes in children's body mass index between 2006/07 and 2010/11. Oxford: National Obesity Observatory, 2012. www.noo.org.uk/NCMP/National_report
5. Dinsdale H, Ridler C, Rutter H. National Child Measurement Programme: Changes in children's body mass index between 2006/07 and 2009/10. Oxford: National Obesity Observatory, 2011. www.noo.org.uk/NCMP/National_report
6. Dinsdale H, Ridler C. National Child Measurement Programme: Changes in children's body mass index between 2006/07 and 2008/09. Oxford: National Obesity Observatory, 2010. www.noo.org.uk/NCMP/National_report
7. Public Health England. 2016. Public Health Outcomes Framework. Online Data Tool. www.phoutcomes.info/
8. Health and Social Care Information Centre. 2015. National Child Measurement Programme England, 2014–15: Tables [.xlsx]. http://digital.nhs.uk/catalogue/PUB19109
9. Public Health England, 2016. NCMP Local Authority Profile. Data Tool. http://fingertips.phe.org.uk/profile/national-child-measurement-programme
10. Health and Social Care Information Centre. 2015. National Child Measurement Programme England, 2014–15. http://digital.nhs.uk/catalogue/PUB19109
11. Cole TJ, Freeman JV, Preece MA. Body mass index reference curves for the UK. 1990. Archives of Disease in Childhood 1995 73:25–9.
12. Public Health England. 2016. Patterns and trends in child obesity. Slideset. www.noo.org.uk/slide_sets
13. Health and Social Care Information Centre. Health Survey for England 2004: The Health of Minority Ethnic Groups–headline tables. Leeds: Health and Social Care Information Centre, 2006. http://digital.nhs.uk/pubs/hse04ethnic

14. Health and Social Care Information Centre. National Child Measurement Programme: England, 2013/14 school year. Leeds: Health and Social Care Information Centre, 2014. http://digital.nhs.uk/catalogue/PUB16070/nati-chil-meas-prog-eng-2013-2014-rep.pdf

15. Cronberg A, Munro Wild H, Fitzpatrick J. Jacobson B. Causes of childhood obesity in London: diversity or poverty? The effect of deprivation on childhood obesity levels among ethnic groups in London. London: London Health Observatory, 2010. www.lho.org.uk/Download/Public/16724/1/NCMP%202008-09%20Ethnicity%20and%20deprivation%20FINAL.pdf

16. Dinsdale H, Rutter H. National Child Measurement Programme: Detailed Analysis of the 2006/07 National Dataset. Oxford: National Obesity Observatory, 2008. www.noo.org.uk/uploads/doc/vid_5265_NOO%200607%20NCMP%20report_150210.pdf

17. Ells, L. J., Hancock, C., Copley, V. R., Mead, E., Dinsdale, H., Kinra, S., Viner, R. M. & Rutter, H. (2015). Prevalence of severe childhood obesity in England: 2006–2013. Arch Dis Child 100: 631–6.

18. R Core Team. 2014. R: A language and environment for statistical computing. Vienna, Austria: R Foundation for Statistical Computing. www.R-project.org/

19. Public Health England. 2016. Public Health Profiles. Online Data Tools. http://fingertips.phe.org.uk/

20. Public Health England. 2016. NCMP Local Authority Profile. Online Data Tool. http://fingertips.phe.org.uk/profile/national-child-measurement-programme

21. Armitage P & Berry G. Statistical Methods in Medical Research (3rd edition). Oxford: Blackwell 1994.

(Web links accessed 26/08/2016)

Reader information

Title	Changes in children's body mass index between 2006/7 and 2014/15: National Child Measurement Programme
Authors	Vicky Copley and Catherine Bray, Public Health England
Acknowledgements	Caroline Hancock, Public Health England Paul Niblett, NHS Digital Rosie Taylor, Public Health England Loretta Sollars, Public Health England Kate Sweeney, Public Health England Shireen Mathrani, Public Health England
Publication date	October 2016
Description	Examination of changes in child weight category prevalence and mean BMI in England between 2006/7 and 2014/15, based on analysis of National Child Measurement Programme data
How to cite	Copley V. R. & Bray C. Changes in children's body mass index in England between 2006/7 and 2014/15: National Child Measurement Programme. London: Public Health England, October 2016
Contact	Obesity Risk Factors Intelligence, Public Health England www.noo.org.uk ncmp@phe.gov.uk
Electronic location	www.noo.org.uk
Copyright	