National Obesity Observatory

NHS

National Child Measurement Programme:

Detailed Analysis of the 2007/08 National Dataset

April 2009

HM Government

Authors

Caroline Ridler

Nick Townsend

Hywell Dinsdale

Cathy Mulhall

Harry Rutter

Acknowledgements

We are grateful to the following colleagues who have contributed to this report:

Bryony Butland, Department of Health

Peter Dick, Department of Health

Sian Evans, Eastern Region Public Health Observatory

Justine Fitzpatrick, London Health Observatory

Andrew Hughes, South East Public Health Observatory

Shireen Mathrani, National Obesity Observatory

Bronwyn Petrie, Department of Health

Di Swanston, National Obesity Observatory

Rosie Taylor, Department of Health

Jo Watson, South East Public Health Observatory

Alyson Whitmarsh, NHS Information Centre for Health and Social Care

Supported by

ASSOCIATION OF PUBLIC HEALTH OBSERVATORIES APHO

NHS The Information Centre for health and social care

The National Obesity Observatory is part of Supporting Public Health

Contents

Figures and tables

Figures

Tables

Abbreviations

BMI	Body Mass Index
CI	Confidence Interval
HSE	Health Survey for England
IDACI	Income Deprivation Affecting Children Index
IMD	Index of Multiple Deprivation
LCI	Lower Confidence Interval
LSOA	Lower Super Output Area
NCMP	National Child Measurement Programme
NHS IC	NHS Information Centre for Health and Social Care
NOO	National Obesity Observatory
PCT	Primary Care Trust
PHO	Public Health Observatory
PSA	Public Service Agreement
SDS	Standard Deviation Score
UCI	Upper Confidence Interval
UK90	British 1990 Growth Reference

Key findings

PCT participation and data quality

- The rate of participation in the NCMP increased or stayed the same in over 80% of PCTs between 2006/07 to 2007/08. The collection of child postcode and opt-out information also improved, along with a decrease in the rounding of height and weight measurements to the nearest whole or half number.
- At PCT level, as the opt-out rates for Year 6 pupils decrease, the measured prevalence of both obesity and overweight & obesity increase significantly.
- A significant association was found between the rounding of weight measures and the PCT prevalence of overweight & obesity in Reception. The greater the proportion of weight measurements that were either whole numbers or half numbers the lower the prevalence of overweight & obesity.

Prevalence figures

- The NCMP prevalence figures show that substantial changes have occurred in children's BMI over the past two decades – with the proportion of children classified as obese nearly doubling for children in Reception and increasing more than threefold for children in Year 6.
- The greatest increase in prevalence of obesity in Year 6 children occurred within more deprived areas from 2006/07 to 2007/08. This may be related to an increase in response rate rather than a true change.
- Year 6 children in White and Asian ethnic groups have seen an increase in reported obesity prevalence since 2006/07. This may be a consequence of differential changes in participation across different ethnic groups rather than a true increase in prevalence.

Distribution of BMI

- In younger children the population shift in BMI is spread relatively evenly across the whole population, while for older children in the Year 6 age group the biggest increases in BMI have occurred amongst those children who were already likely to be classified as overweight or obese.
- The only group to show any decrease in mean BMI from the 1990 baseline are the 5% of Year 6 girls with the lowest BMI. With the exception of these girls, mean BMI has increased for all children in Reception and Year 6.
- The 2007/08 mean BMI for boys in Year 6 equates to the 69th centile of the UK90 BMI distribution, whilst the 2007/08 mean for girls equates to the 66th centile. For boys and girls in the UK90 reference population mean BMI was at the 50th centile.

Regression analysis – multivariable models

- Multivariable models indicate that deprivation is a confounding variable for ethnicity and that there are differential degrees of deprivation between different ethnic groups, influencing the odds of being classified as overweight & obese.
- Controlling for height suggests that earlier findings in which children from Black African and Black Caribbean ethnic groups had the highest odds of being obese, were most likely to be due to physical characteristics related to ethnicity, in particular height.
- The higher the mean deprivation score the greater the participation rate, suggesting that individuals from higher socio-economic groups are the most likely to opt out.
- Data collection inaccuracies occur at both Reception and Year 6 within PCTs. These could be reduced through standardised approaches and a better understanding of non-participation.

1 Introduction

The National Child Measurement Programme (NCMP) weighs and measures the height of children in Reception (typically aged 4–5 years) and Year 6 (aged 10–11 years). The findings are used to inform local planning and delivery of services for children and gather population-level surveillance data to allow analysis of trends in excess weight. The programme also seeks to raise awareness of the importance of healthy weight in children. The NCMP is part of the government's strategy to tackle the continuing rise in excess weight across the population.

This report analyses the NCMP 2007/08 national dataset provided by the NHS Information Centre for Health and Social Care (NHS IC). The NHS IC collates and analyses NCMP data centrally after they have been collected at a local level and submitted by Primary Care Trusts (PCTs), with the support and cooperation of schools, children and parents.

This report follows on from the report *National Child Measurement Programme: 2007/08 school year, headline results* (NHS IC 2007/08 NCMP report) published by the NHS IC in December 2008. It presents detailed secondary analysis to further our understanding of the epidemiology of child height, weight and Body Mass Index (BMI) across the country, and attempts to explain some of the findings presented in the NHS IC 2007/08 NCMP report. The National Obesity Observatory (NOO) will conduct further analyses following this report.

The existence of different approaches to defining obesity means that the interpretation and comparison of prevalence data is more complex than it might initially appear. Health Survey for England (HSE) findings, in agreement with other data, show that over the last twenty years the proportion of the child population classified as overweight or obese has increased. In addition, HSE data also show an increase in mean BMI over the past decade for children.

The NCMP dataset contains anonymised information on individual children who have been measured. This, combined with the size of the dataset, means the NCMP data provide a powerful tool to examine changes in child weight status. This can provide much more detail than simply the prevalence of overweight and obesity.

This report presents analysis of PCT participation levels and investigates data quality issues in the collection of the 2007/08 NCMP dataset. Data on prevalence of underweight, healthy weight, overweight and obesity are analysed, comparing the 2007/08 data to 2006/07 and the 1990 baseline. Analyses by deprivation and ethnic group are also included.

The report goes on to examine how the distribution of BMI differs by age and sex of the child sample population and investigates changes since the 1990 baseline. It also looks at the association between obesity prevalence and characteristics of both the individual children and the PCTs in which they were measured, using regression analysis.

2 Methods and data sources

The NHS IC 2007/08 NCMP report presents a summary of the method of central collection of NCMP data and further information on data quality and methodology.

The analysis presented here, unless specified otherwise, uses data from the national dataset provided to Public Health Observatories (PHOs) by the NHS IC. Records which are coded as being from children who attend independent or special schools have been excluded from this analysis. This is consistent with the method used by the NHS IC. No further cleaning of the dataset was done.

The 2007/08 NCMP dataset provides information on all children, including those who are underweight or a healthy weight. This allows for detailed analysis of the trends in BMI within the child population and fits with the government's policy focus on a healthy weight across the population.

It is important to note that the NCMP 2007/08 dataset uses the UK 1990 growth reference (UK90) for BMI and the 85th and 95th percentiles to define children as overweight or obese according to age and sex. This definition is commonly used in the UK for population monitoring, e.g. in recent HSE reports.

To be consistent with data published by the NHS IC, the method for calculating prevalence data in this report is the same as used by the NHS IC. The UK90 BMI percentiles are used to determine weight status, with children in the 2nd percentile or below classed as underweight, 2nd to 84.9th as healthy weight, 85th to 94.5th as overweight and ≥95th as obese. This report also uses the UK90 percentiles to provide a baseline for comparison.

Throughout this report the terms underweight, healthy weight, overweight and obese are used and refer to children classified into these categories using the UK90 BMI percentiles. The terms 'overweight & obesity' and 'overweight & obese' are also used to refer to the total number of children classified as either overweight or obese. Technical statistical terms such as weighted regression, odds ratios and coefficient of determination are defined in the glossary at the end of this report.

Regression analysis in this report investigates both individual level and PCT level variables. The individual level analysis utilises all individual cases within the regression, providing a more in-depth analysis of child obesity and its determinants than the PCT level analysis which aggregates the dataset to 152 PCTs.

PCT level analysis uses weighted regression of aggregated data to investigate associations between the proportion of individuals classified as obese or overweight & obese in the PCT against the PCT characteristics. The weighting takes into account the participation rate of the PCTs, placing more emphasis on those PCTs that have measured a larger proportion of their population.

3 PCT participation and data quality

3.1 Headline figures

PCT participation is a measure of the number of pupils measured by the PCT against the reported number of pupils eligible to be measured.

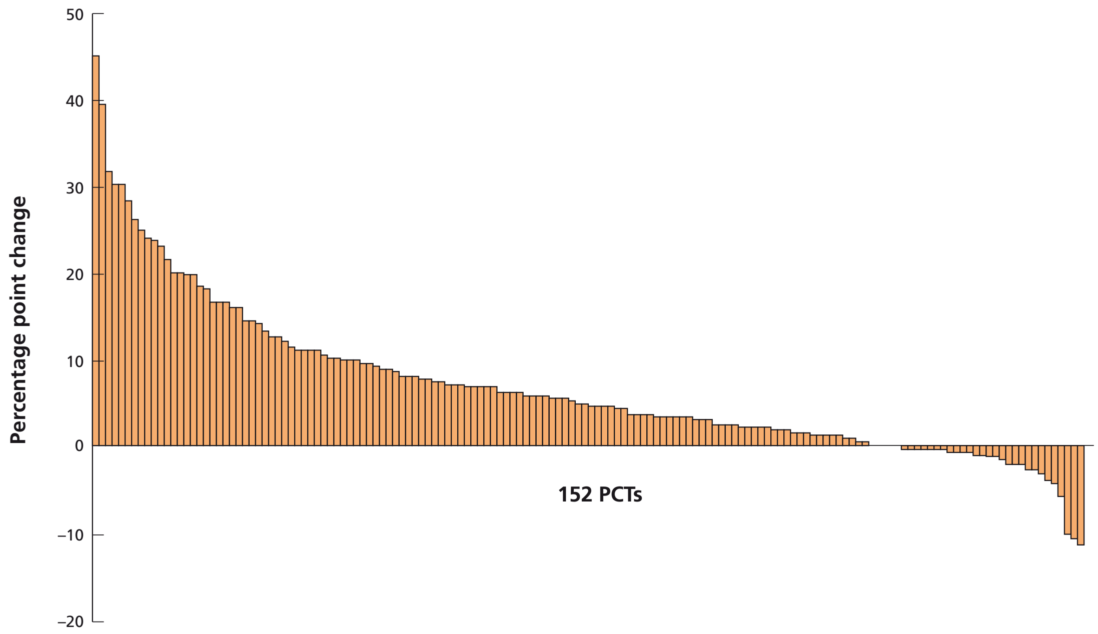
The NHS IC 2007/08 NCMP report showed that the level of participation in the NCMP was 89% for Reception and 87% for Year 6, increasing from 83% and 78% respectively from the 2006/07 NCMP. Individual PCTs' participation rates vary. PCTs were set a target participation rate of 85% of children from Reception and Year 6 combined; over 80% (123 from 152) of PCTs achieved the target.

The collection of child postcode (used to derive lower super output area [LSOA]) greatly improved in the 2007/08 NCMP. 42.3% of child LSOA data were not recorded in 2006/07, reducing to just 4.9% in 2007/08 due to missing or invalid child postcodes.

3.2 Change in PCT participation rates

Figure 1 shows the absolute percentage point change across both school years in participation across PCTs between the 2006/07 and 2007/08 NCMP. Twenty-nine PCTs had a fall in participation; over 80% of PCTs (123) had an increase or no change in the level of participation.

Figure 1: Absolute change in the rate of PCT participation, 2006/07 to 2007/08



The NHS IC 2007/08 NCMP report found a significant association between increased participation rate and increased reported prevalence of obesity and overweight & obesity.

3.3 PCT level variation in opt-out

The data-capture tool for the NCMP provides an opportunity for PCTs to enter information on the number of pupils who opted out of the NCMP. This provides further information such as whether data are missing due to parental choice to opt-out, the child choosing to opt-out or if the child was absent on the day measurements took place. Analysis of data on opt-out of the NCMP enables investigation of the relationship between choice to opt out and prevalence of obesity.

As reported in the NOO *NCMP: Detailed Analysis of the 2006/07 National Dataset* report (NOO 2006/07 NCMP report), in 2006/07 43 PCTs (28.3%) returned opt-out information for Reception whilst 54 PCTs (35.5%) did so for Year 6; for the 2007/08 data collection 91 (59.9%) PCTs provided this information for Reception and 101 (66.4%) PCTs provided opt-out information for Year 6.

Within this analysis opt-out includes the numbers of children who have not been measured due to personal or parental choice, children reported as unable to stand on the scales, absent on the day of measurement or for 'other reasons'. Opt-out rates have been calculated using this number divided by the total number eligible for measurement in each PCT minus the number of children not measured due to the whole school opting out.

Results from weighted regression analysis of opt-out rates agree with the findings from the 2006/07 report that there is a significant association, at the 5% level, between opt-out rates and obesity and overweight & obesity prevalence with Year 6 pupils. No significant association was found with Reception pupils (Table 1).

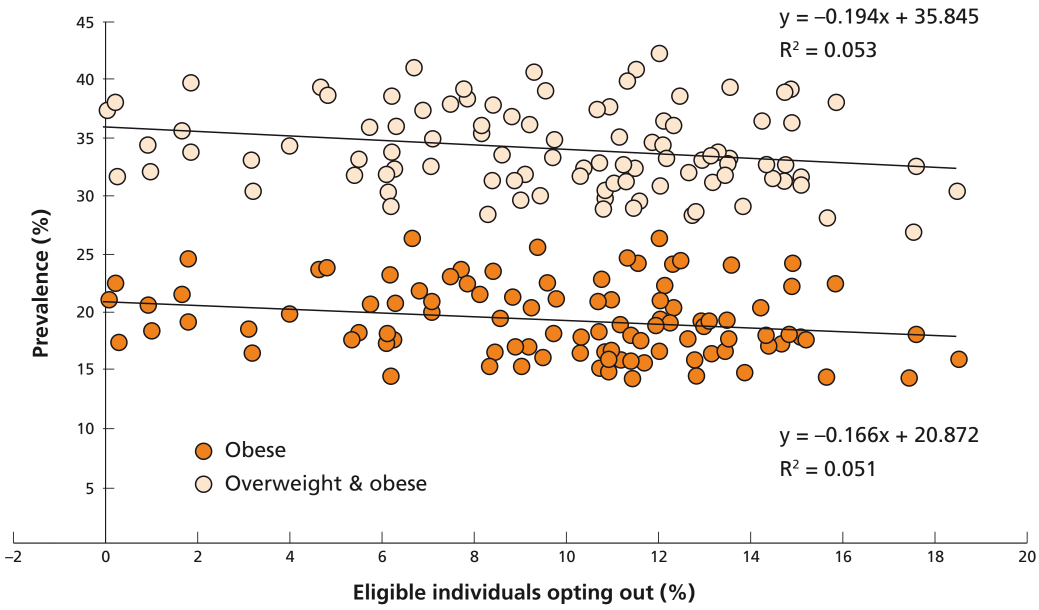
Table 1: Results of weighted linear regression between opt-out rate and reported prevalence of obesity and overweight & obesity for Reception and Year 6

Dependent variable	Number of PCTs	Slope (Beta coefficient)	Standard error of Beta	Significance (p value)	Odds Ratios	Coefficient of determination (R^2)
Reception obese	91	0.04	0.04	0.306	1.04	0.012
Reception overweight & obese	91	0.06	0.06	0.341	1.01	0.010
Year 6 obese	101	-0.17	0.07	0.023*	0.85	0.051
Year 6 overweight & obese	101	-0.19	0.08	0.021*	0.82	0.053

* significant at the 5% level

As the opt-out rates for Year 6 pupils decreased the measured prevalence of both obesity and overweight & obesity increased (Figure 2). This further supports the hypothesis that pupils opting out in Year 6 are more likely to be overweight or obese.

Figure 2: Prevalence of obesity and overweight & obesity against opt-out rate for Year 6 pupils, with trends from weighted regression



3.4 Accuracy of measures

Data quality has improved considerably since the 2005/06 NCMP. However, some issues remain which may affect the accuracy of the reported prevalence of overweight and obesity. In the NOO 2006/07 NCMP report the issue of digit preference was highlighted as an important factor and is revisited here.

PCTs were requested in the NCMP guidance to collect height in centimetres and weight in kilograms to the first decimal place (i.e. the nearest millimetre for height and nearest 100 grams for weight). However, many PCTs appear to be routinely rounding a large proportion of their measurements to the nearest whole or half number (i.e. 23kg or 23.5kg rather than, for example, 23.1kg or 23.2kg for weight and 100.0cm or 100.5cm rather than, for example, 100.1cm or 100.2cm for height). There is a range of possible explanations for this, including: limitations in the measuring equipment used; insufficient staff training; and technical issues related to rounding of figures within child health systems.

For a random distribution of heights and weights, it would be expected that PCTs would record about 10% of height and weight measures to the nearest whole number, and 10% to the nearest half number. A further 10% of measures would be recorded for each of the other decimal places. The distribution of height measures in the 2007/08 NCMP dataset shows very strong digit preference to whole and half numbers, and that of weight measures to whole numbers.

Figures 3 and 4 show the changes in digit preference between 2006/07 and 2007/08. There has been an improvement, with a decrease in rounding to the nearest whole or half number, for both height and weight measures. However, there is still a considerable problem with rounding of measures. Rounding of measures is more common for height than weight.

Figure 3: Comparison of digit preference for recorded height measures, all children measured, 2006/07 and 2007/08

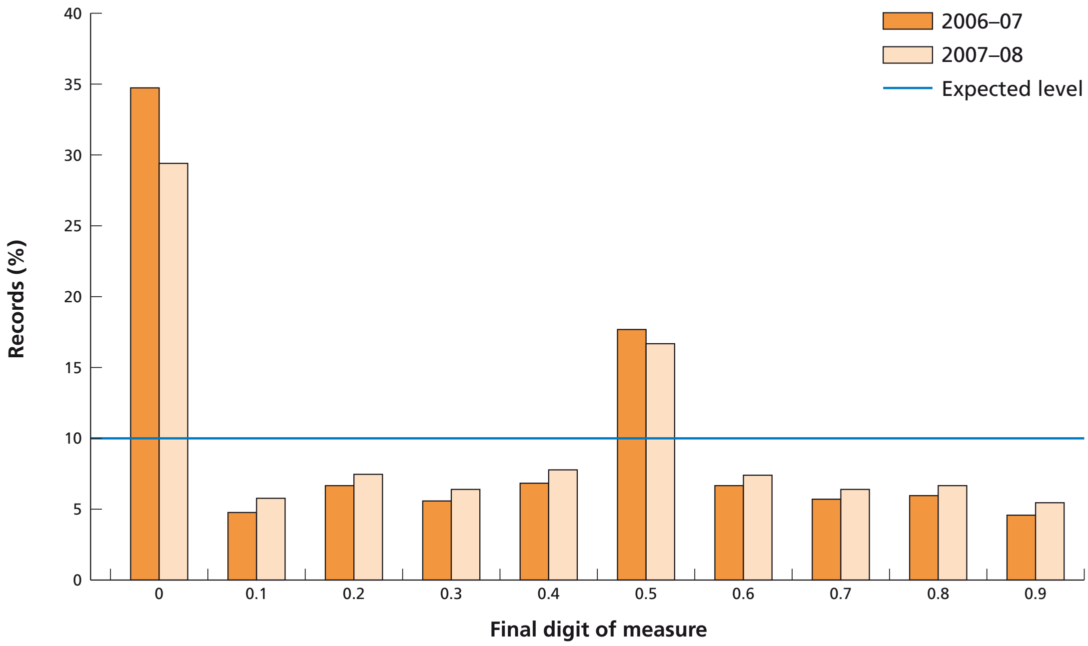
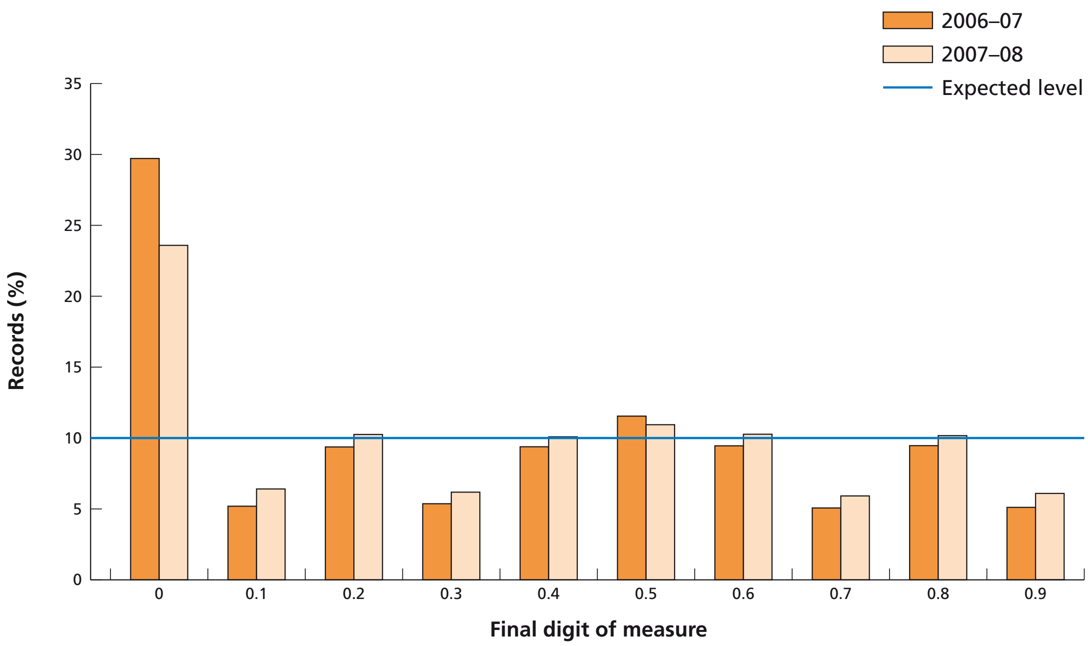


Figure 4: Comparison of digit preference for recorded weight measures, all children measured, 2006/07 and 2007/08



When testing the effect of digit preference on prevalence a significant association was found between the rounding of weight measures and the PCT prevalence of overweight & obesity in Reception. No significant association was found for Year 6.

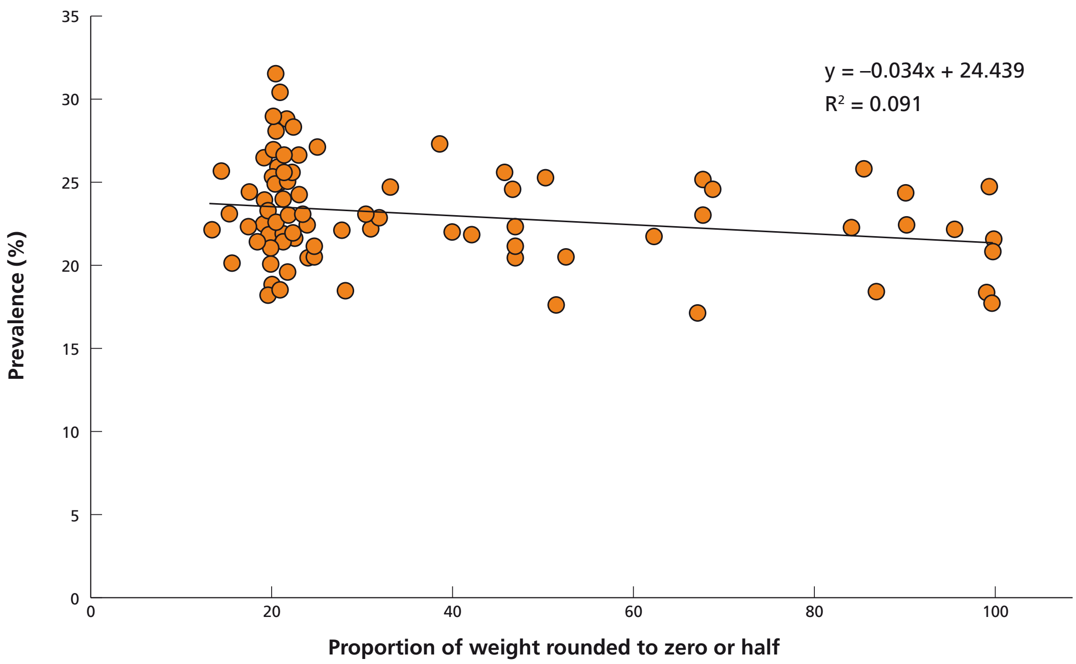
Table 2: Results of weighted linear regression between percentage of weight measurements rounded to whole number and half number against reported prevalence of obesity and overweight & obesity for Reception and Year 6

Dependent variable	Number of PCTs	Slope (Beta coefficient)	Standard error of Beta	Significance (p value)	Odds Ratios	Coefficient of determination (R^2)
Reception obese	152	-0.01	0.01	0.069	0.99	0.022
Reception overweight & obese	152	-0.03	0.01	<0.001**	0.97	0.091
Year 6 obese	152	-0.01	0.01	0.232	0.99	0.010
Year 6 overweight & obese	152	-0.01	0.01	0.278	0.99	0.008

** significant at the 1% level

The beta coefficient indicates that the greater the proportion of weight measurements that were either whole numbers or half numbers the lower the prevalence of overweight & obesity. This relationship is demonstrated in Figure 5.

Figure 5: Prevalence of overweight & obesity against proportion of rounded weight measures for children in Reception



As weight is measured to one decimal place, where these weight measurements are being correctly rounded it would be expected that 20% of weight measures would be rounded to zero or half numbers within each PCT. This explains the grouping of PCTs around the 20% value in Figure 5; however, a sizeable number of PCTs have a higher than expected proportion of rounded figures.

Further analysis found that the direction of the relationship for rounding of height measurements was opposite to that for the rounding of weight measurements, although no significant associations were found for height (Table 3). Due to the way BMI is calculated (weight/height^2), rounding down of weight measures will decrease BMI, whilst rounding down of height measures will increase BMI. Rounding up of both measures would have the opposite effect. Because they have effects in opposite directions, if both height and weight are rounded in the same direction this will to some extent reduce the impact on obesity prevalence.

Table 3: Results of weighted linear regression between percentage of height measurements rounded to whole number and half number against reported prevalence of obesity and overweight & obesity for Reception and Year 6

Dependent variable	Number of PCTs	Slope (Beta coefficient)	Standard error of Beta	Significance (p value)	Odds Ratios	Coefficient of determination (R^2)
Reception obese	152	0.01	0.01	0.243	1.01	0.009
Reception overweight & obese	152	0.02	0.01	0.259	1.01	0.008
Year 6 obese	152	0.00	0.01	0.758	1.00	0.001
Year 6 overweight & obese	152	0.01	0.02	0.646	1.00	0.001

In order to control for the influence of rounding for both weight and height on each other, weighted regression analysis was repeated with both variables (Table 4)

Table 4: Results of weighted linear regression between percentage of weight measurements and percentage of height measurements rounded to whole number and half number against reported prevalence of obesity and overweight & obesity for Reception

Dependent variable	Weight Height	Slope (Beta coefficient)	Standard error of Beta	Significance (p value)	Odds Ratios	Coefficient of determination (R^2)
Reception obese	Weight	-0.01	0.01	0.031*	0.99	0.040
	Height	0.01	0.01	0.098	1.01	
Reception overweight & obese	Weight	-0.04	0.01	<0.001**	0.96	0.119
	Height	0.03	0.01	0.031*	1.03	

** significant at the 1% level * significant at the 5% level

In the weighted regression model with both height and weight rounding, significant associations were found in Reception between the rounding of weight measures and obesity prevalence, and between the rounding of both weight and height measures and overweight & obesity prevalence. No significant associations were found with Year 6 prevalence.

These results suggest that weight rounding has a more significant association with prevalence figures than height, indicating that weight rounding has a greater influence on reported prevalence. Height measurements are taken in centimetres to one decimal place. As these figures are converted into metres to be used in the calculation of BMI they are divided by 100, thereby reducing the rounding error to the third decimal place. Weight, however, is measured in kilograms, with no conversion required to calculate BMI, hence any inaccuracies in rounding remain at the first decimal place, explaining the greater influence of the inaccurate rounding of weight on prevalence in comparison to height. Height still has an association, however, and it would appear that where PCTs round both weight and height incorrectly there is some equalising effect.

The rounding of figures has less impact with Year 6 results. This is likely to be because changes in decimal measures have less impact on taller and heavier children, as the proportional change to their recorded height and weight will be less.

From these data it is not possible to derive accurate estimates of the influence of rounding at PCT level, but this is an important factor to include within further analysis so that the effect of digit preference can be adjusted for. This highlights a need to continue to emphasise the importance of accurate recording of weight and height within the NCMP guidance.

3.5 Age at time of measurement

The NOO 2006/07 NCMP report found a significant association between the mean age of children measured in Reception and the prevalence of overweight & obesity, with a greater prevalence found with a lower mean age. This is consistent with the expected growth curves for children of Reception year age. No significant association was found for Year 6 pupils.

Logistic regression using the 2007/08 data found a significant association between age in months of the individual and the likelihood of being classified as overweight & obese for both boys and girls in Reception, although no significant association was found for pupils in Year 6 (Table 5).

Table 5: Results of a logistic regression analysis between overweight & obesity prevalence and age of individual

Year Group	Sex	Number of pupils	Slope (Beta coefficient)	Standard error of Beta	Significance (p value)	Odds Ratios	Coefficient of determination (R^2)
Reception	Male	241337	-0.01	0.00	<0.001**	0.99	<0.001
	Female	231039	-0.01	0.00	<0.001**	1.00	<0.001
Year 6	Male	252736	<0.00	0.00	0.950	1.00	<0.001
	Female	236553	<0.00	0.00	0.848	1.00	<0.001

** significant at the 1% level

These findings agree with those from the NOO 2006/07 NCMP report but use the individual cases rather than data aggregated by PCT. These results again indicate that as the age of the Reception pupil increases the likelihood of him or her being classified as overweight & obese decreases.

3.6 Key points on PCT participation and data quality

- The collection of child postcode greatly improved in the 2007/08 NCMP: 42.3% of child LSOA data were missing in 2006/07, reducing to just 4.9% missing in 2007/08.
- There has been an improvement in PCTs returning information on child opt-out since 2006/07, however further improvement is needed.
- The rate of participation in the NCMP increased or stayed the same in over 80% of PCTs between 2006/07 to 2007/08.
- There is a significant association, at the 5% level, between opt-out rates and prevalence of both obesity and overweight & obesity with Year 6 pupils. No significant association was found with Reception pupils.

- As the opt-out rates for Year 6 pupils decreased the measured prevalence of both obesity and overweight & obesity increased.
- Analysis shows a decrease in rounding of height and weight measurements to the nearest whole or half number since 2006/07. However, there is still a considerable problem with rounding of measures.
- A significant association was found between the rounding of weight measures and the PCT prevalence of overweight & obesity in Reception. The greater the proportion of weight measurements that were either whole numbers or half numbers the lower the prevalence of overweight & obesity.
- Results suggest that weight rounding has a more significant association with prevalence figures than height, indicating that weight rounding has a greater influence on reported prevalence.

4 Prevalence Figures

4.1 Reported national prevalence

As described in the NHS IC 2007/08 NCMP report, the reported prevalence of obesity was 9.6% in Reception and 18.3% in Year 6. The proportion of children classified as overweight was 13% for Reception and 14.3% for Year 6. Data from the 2006/07 NCMP show prevalence of obesity was 9.9% in Reception and 17.5% in Year 6 and overweight prevalence 13% in Reception and 14.2% in Year 6. It is important to see these prevalence figures within the context of the participation rates, which were for 2007/08 89% for Reception and 87% for Year 6; and for 2006/07 83% for Reception and 78% for Year 6.

In the 1990 baseline population, 5% of children would have been classified as obese using this definition, with a further 10% classified as overweight. The 2007/08 NCMP prevalence figures show the substantial changes that have occurred in children's BMI over the past two decades – with the proportion of children classified as obese nearly doubling for children in Reception and increasing more than threefold for children in Year 6 since the baseline. The rise in the proportion of children classified as overweight has been less marked, but has still shown a relative increase of 30% for Reception and 40% for Year 6.

Figure 6: Comparison of boys' BMI categorisation against 1990 baseline and NCMP 2006/07 and 2007/08 populations

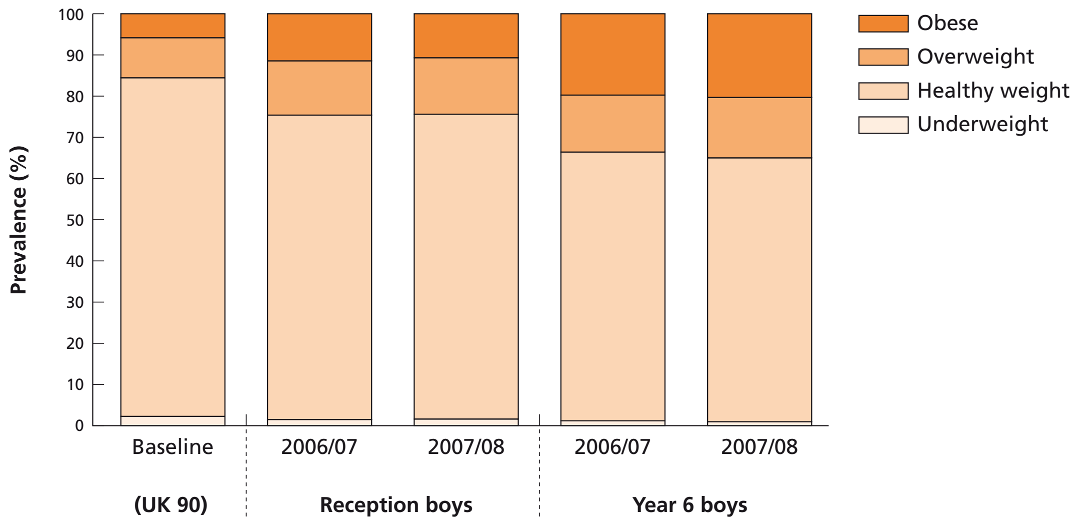
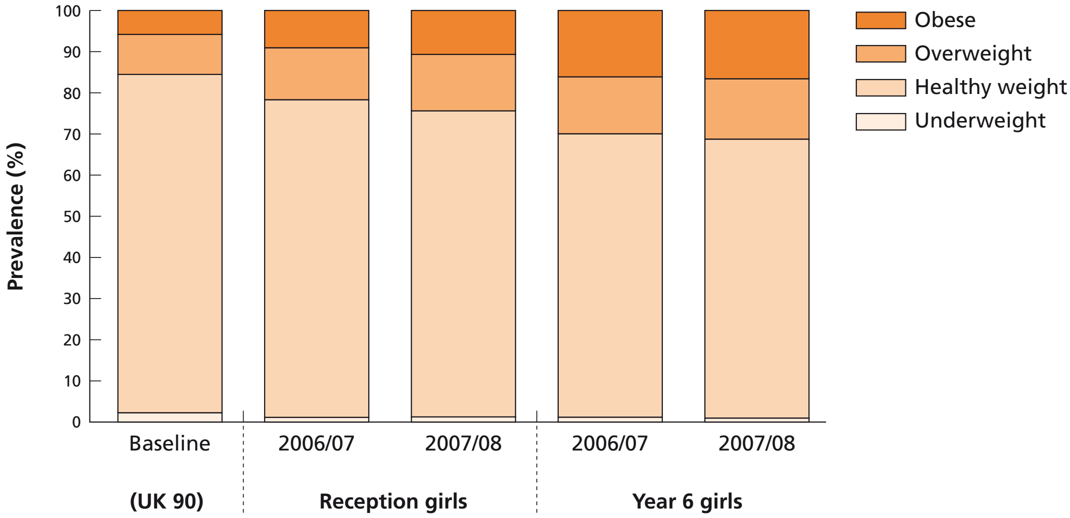


Figure 7: Comparison of girls' BMI categorisation against 1990 baseline and NCMP 2006/07 and 2007/08 populations



Due to the large sample size the confidence intervals (CIs) are extremely narrow and are not shown on Figures 6 and 7; they are presented in Tables 6 and 7.

Table 6: Prevalence of obesity, overweight, healthy weight and underweight, all children measured, with 95% confidence intervals, 2007/08

School year:	Reception						Year 6					
Sex:	Boys			Girls			Boys			Girls		
Prevalence with 95% CIs	%	LCI	UCI	%	LCI	UCI	%	LCI	UCI	%	LCI	UCI
Obese	10.4	10.28	10.52	8.8	8.72	8.95	20.0	19.82	20.13	16.6	16.40	16.70
Overweight	13.6	13.50	13.77	12.3	12.13	12.39	14.4	14.23	14.50	14.2	14.05	14.33
Healthy weight	74.5	74.32	74.66	77.9	77.72	78.06	64.5	64.29	64.66	67.6	67.43	67.80
Underweight	1.5	1.43	1.53	1.0	0.97	1.06	1.2	1.15	1.23	1.6	1.59	1.70

Table 7: Prevalence of obesity, overweight, healthy weight and underweight, all children measured, with 95% confidence intervals, 2006/07

School year:	Reception						Year 6					
Sex:	Boys			Girls			Boys			Girls		
Prevalence with 95% CIs	%	LCI	UCI	%	LCI	UCI	%	LCI	UCI	%	LCI	UCI
Obese	10.7	10.53	10.78	9.0	8.93	9.17	19.0	18.86	19.18	15.8	15.69	16.00
Overweight	13.6	13.46	13.74	12.4	12.31	12.59	14.2	14.03	14.31	14.1	14.00	14.30
Healthy weight	74.2	74.06	74.42	77.5	77.30	77.65	65.5	65.28	65.67	68.3	68.13	68.53
Underweight	1.5	1.45	1.55	1.0	0.99	1.08	1.3	1.29	1.39	1.7	1.63	1.74

As described above, an increase in NCMP participation rate is associated with an increase in the reported prevalence of obesity, possibly because this reflects a reduction in selective opt-out by heavier children. This association may explain some of the increase in reported prevalence of obesity.

4.2 PCT prevalence of obesity

Statistical process control charts enable the use of objective criteria for distinguishing background or natural variation ('common cause variation') from events of significance identified by statistical techniques ('special cause variation'). Control charts are plots of the underlying data with lines indicating the mean, median or target value and control limits superimposed. The common types are based on simple statistical distributions. Funnel plots are a type of commonly used chart in public health methods where the indicator of interest is plotted against the denominator (usually sample size). This provides a characteristic funnel shape which gives the chart its name. The control limits on funnel plots are two and three standard deviations from the mean. The analysis carried out in the current report uses the *APHO Funnel Plot for Proportions and Percentages* template.

Figures 8 and 9 below show the funnel plots of obesity prevalence for Reception and Year 6 respectively. They both show a high proportion of PCTs with a prevalence of obesity outside the funnel control limits, represented by the dashed lines; this is more pronounced in Year 6. The PCTs outside the funnel control limits indicate special cause variation, where these areas are significantly different from the mean England value. A large proportion of points outside control limits is often referred to as overdispersion.

Detailed investigation of the particular characteristics of PCTs lying outside control limits may provide a source of useful information about the determinants of obesity within these PCTs.

Figure 8: Funnel plot of variation in obesity prevalence in Reception children 2007/08 across PCTs in England

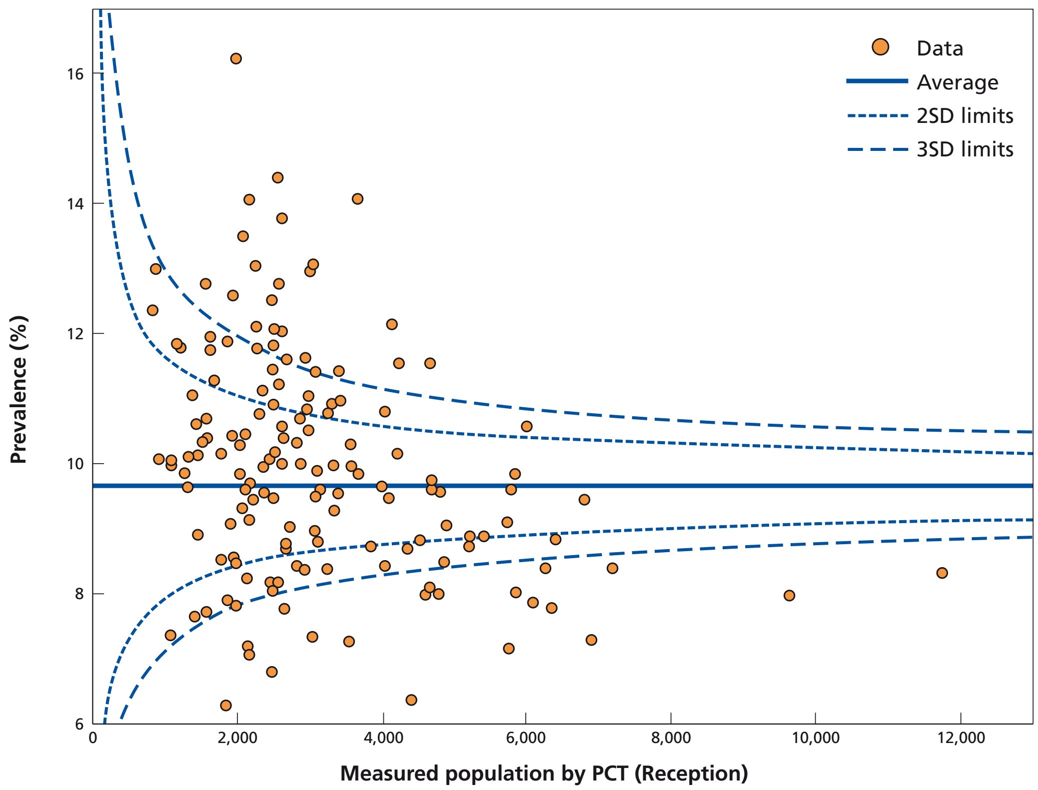
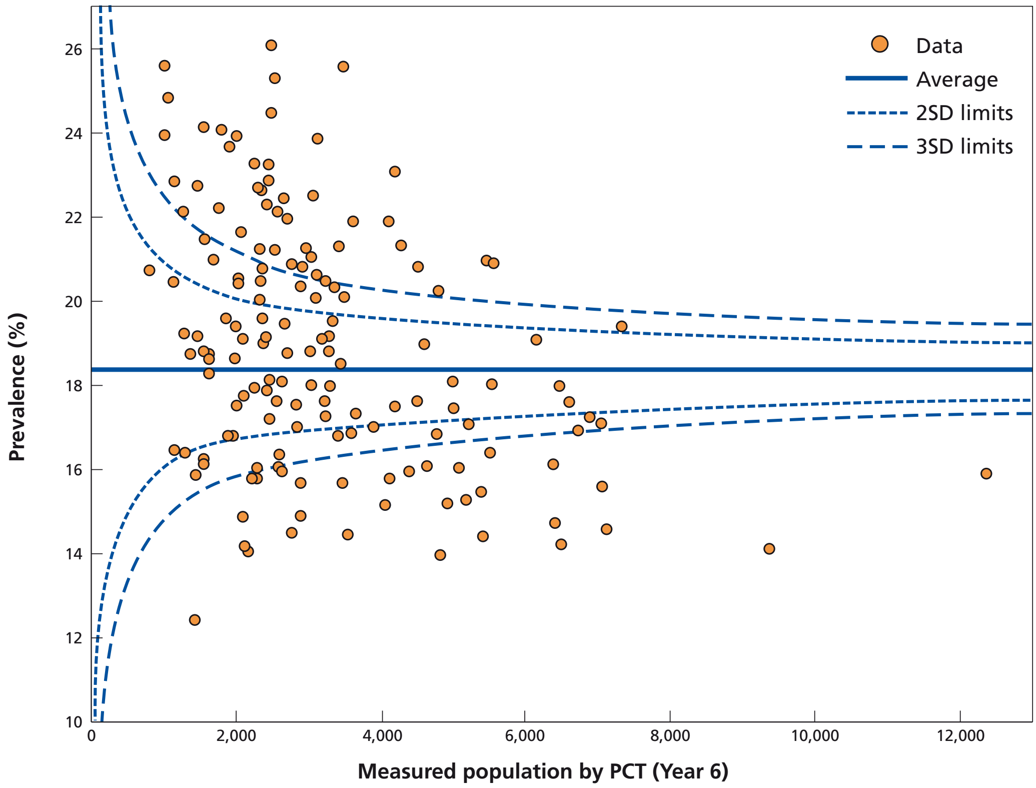


Figure 9: Funnel plot of variation in obesity prevalence in Year 6 children 2007/08 across PCTs in England



4.3 Deprivation

The wider literature on obesity, the NHS IC 2007/08 NCMP report and the NOO 2006/07 NCMP report all describe a strong relationship between obesity prevalence and deprivation. This is investigated further here.

Prevalence of obesity has been calculated for each Index of Multiple Deprivation (IMD) 2007 decile using LSOA of school rather than LSOA of child. This has been done to allow comparison with 2006/07 data, as the recording of child postcode in 2006/07 was insufficient to allow comprehensive analysis of LSOA of child.

A statistically significant decreasing trend in obesity prevalence is observed, with the highest in the most deprived decile and the lowest in the least deprived. There is no evidence showing any statistically significant changes in the prevalence of obesity between deprivation deciles in Reception children between 2006/07 and 2007/08, shown in Figure 10.

Figure 10: Prevalence of obesity in Reception children 2006/07 and 2007/08 by 2007 Index of Multiple Deprivation decile

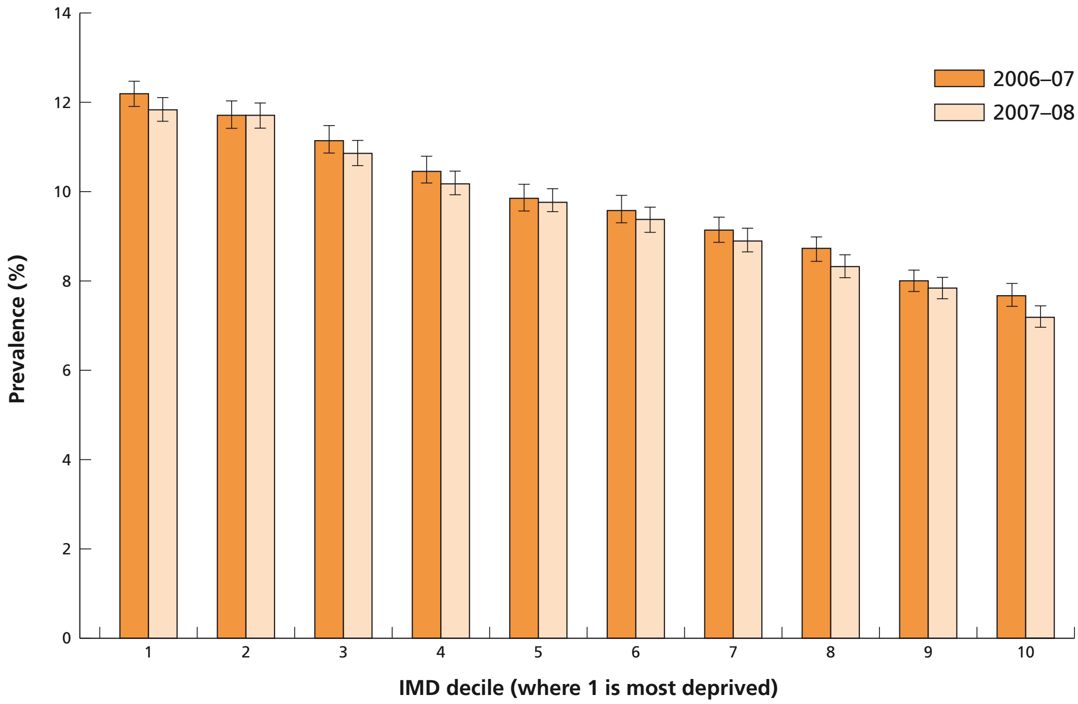


Figure 11: Prevalence of obesity in Year 6 children 2006/07 and 2007/08 by 2007 Index of Multiple Deprivation decile

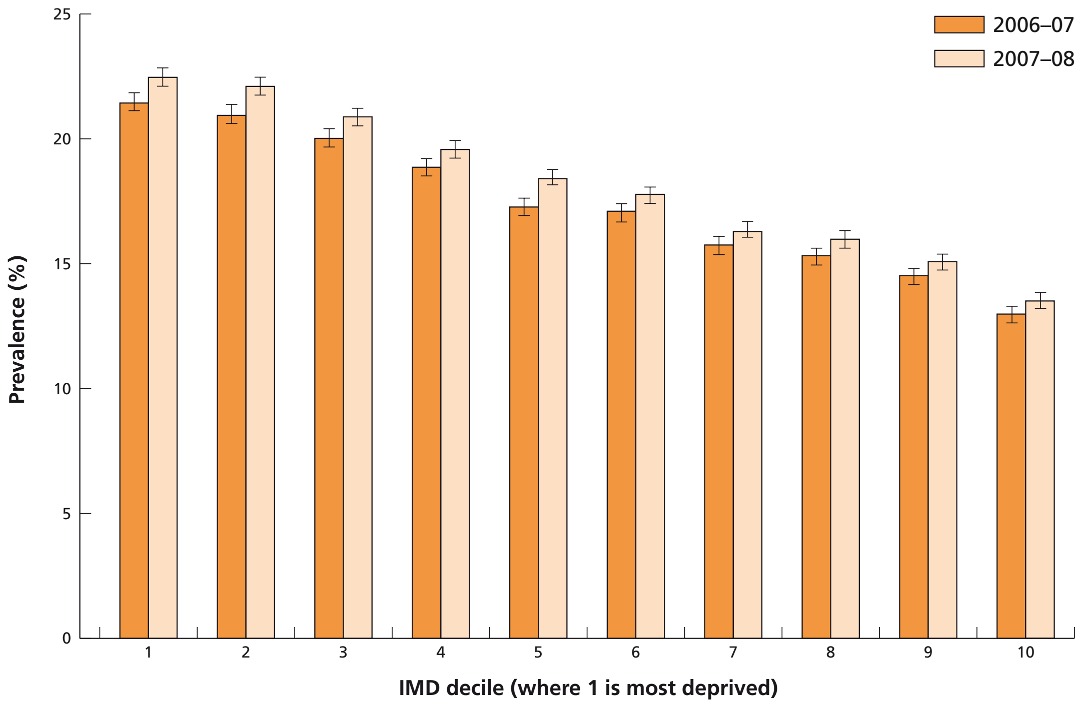


Figure 11 illustrates that the prevalence of obesity in Year 6 children has significantly increased within more deprived areas from 2006/07 to 2007/08. The 1st, 2nd, 3rd and 5th deciles show the largest observable increase in prevalence. However, this may be related to an increase in response rate rather than a true change.

Further analysis on the influence of deprivation was also conducted using the Income Deprivation Affecting Children Index (IDACI) score for individual child LSOAs. The IDACI shows the percentage of children in each LSOA that live in families that are income deprived (i.e. in receipt of Income Support, Income-based Jobseeker's Allowance, Working Families' Tax Credit or Disabled Person's Tax Credit below a given threshold); this is a less complex measure of deprivation than the IMD.

Logistic regression between IDACI scores and obesity classification indicates a significant relationship between deprivation and the likelihood of being classified as obese (Table 8).

Table 8: Results of a logistic regression analysis between obesity and IDACI scores for LSOA of child measured

Year Group	Sex	Number of pupils	Slope (Beta coefficient)	Standard error of Beta	Significance (p value)	Odds Ratios	Coefficient of determination (R^2)
Reception	Male	230065	0.01	<0.00	<0.001**	1.01	0.006
	Female	220167	0.01	<0.00	<0.001**	1.01	0.007
Year 6	Male	239888	0.01	<0.00	<0.001**	1.01	0.009
	Female	224533	0.01	<0.00	<0.001**	1.01	0.012

** significant at the 1% level

As the level of deprivation increases, the likelihood of an individual being classified as obese also increases. The relatively low coefficient of determination (R^2) scores in comparison to those obtained in the NOO 2006/07 NCMP report (which used IMD rather than IDACI) are an indication of the relatively less complex nature of the IDACI compared to the IMD, and the relative increase in variance by using all individual cases. Using the aggregated measure may lead to ecological inference fallacy whereby one assumes that individuals within the PCT have the average characteristics of the PCT as a whole. Also, as the IMD is a more complex measure of deprivation, using 38 indicators based in 7 domains, it will explain a great amount of the variation through confounding for many factors.

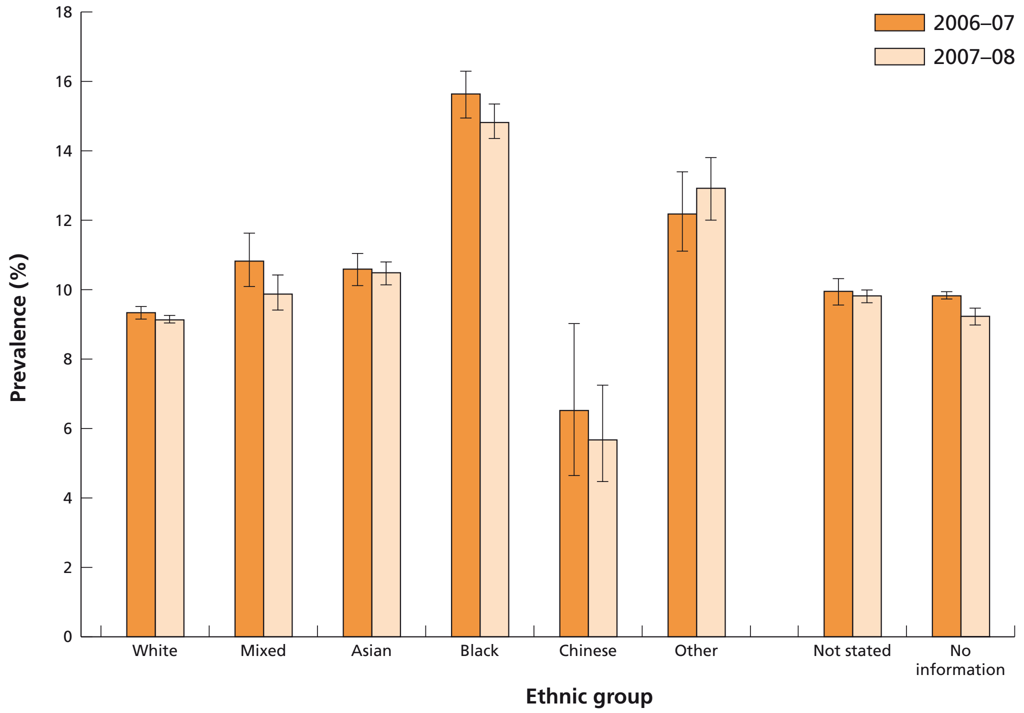
4.4 Ethnicity

The 2006/07 NOO NCMP report identified differences between ethnic groups in the prevalence of obesity when aggregated to the PCT level.

The collection of child ethnic group data by the NCMP has improved considerably; the 2006/07 dataset did not collect ethnicity for 62.7% of children, whereas ethnic group was not provided for 11.6% of children in the 2007/08 NCMP. This allowed for a more in-depth investigation into ethnicity as a determinant of obesity.

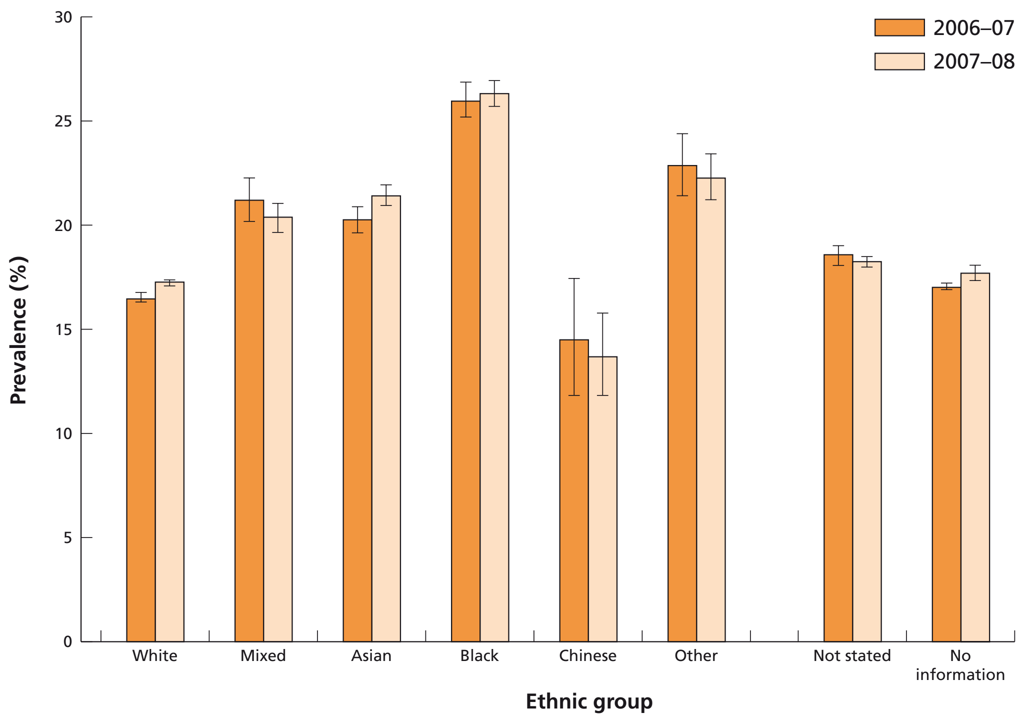
Analysis between ethnic groups was carried out using all the individual level data and a comparison between 2006/07 and 2007/08 data was performed. This found that there has been no significant change in the prevalence of obesity between ethnic groups amongst children in Reception (Figure 12).

Figure 12: Prevalence of obesity in Reception children 2006/07 and 2007/08 by ethnic group



However, Year 6 children in White and Asian ethnic groups have seen significant increases in reported obesity prevalence (Figure 13). These increases may be a consequence of the differential changes in participation across different ethnic groups.

Figure 13: Prevalence of obesity in Year 6 children 2006/07 and 2007/08 by ethnic group



To investigate the differences between ethnic groups and prevalence of obesity further, odds ratios were calculated for each of the main ethnic groups against White British as a reference (Table 9).

Table 9: Odds ratios for the relative likelihood of the main ethnic groups being obese in comparison to the White British ethnic group, with 95% confidence intervals

	Boys		Girls	
	Reception	**Year 6**	**Reception**	**Year 6**
Bangladeshi	1.588* 1.387, 1.819	1.799* 1.612, 2.007	1.382* 1.188, 1.605	1.180* 1.041, 1.337
Black African	1.811* 1.609, 2.039	1.498* 1.360, 1.651	2.146* 1.894, 2.431	1.973* 1.786, 2.181
Black Caribbean	1.400* 1.213, 1.616	1.569* 1.407, 1.750	1.642* 1.414, 1.909	2.104* 1.879, 2.356
Chinese	0.868 0.636, 1.183	1.001 0.804, 1.357	0.323* 0.191, 0.546	0.530* 0.390, 0.720
Indian	0.948 0.827, 1.087	1.368* 1.237, 1.513	0.882 0.758, 1.028	1.028 0.917, 1.150
Pakistani	1.309* 1.163, 1.473	1.564* 1.422, 1.721	1.328* 1.168, 1.508	1.336 0.921, 1.084
White British	1	1	1	1

* significant at the 5% level

White British was chosen as the reference category as this is the largest ethnic group measured in the NCMP. In order to act as a reference the odds of a White British individual being classified as obese were set as one. The odds ratios for other ethnic groups show the relative likelihood of individuals from an ethnic group being classified as obese, in comparison to those within the White British ethnic group. Any figure above 1 means that they are more likely to be classified as obese than the White British population, whilst any figure below 1 means that they are less likely. Significance was calculated at the 5% level ($p = 0.05$) by examining 95% confidence intervals. Where the confidence intervals go through 1 there was no significance at the 5% level.

Many of the ethnic groups were significantly more likely to be classified as obese than individuals from the White British ethnic group, with only girls from the Chinese ethnic group found to be significantly less likely to be classified as obese.

Figure 14: Odds of being classified as obese for ethnic groups in reference to the White British ethnic group

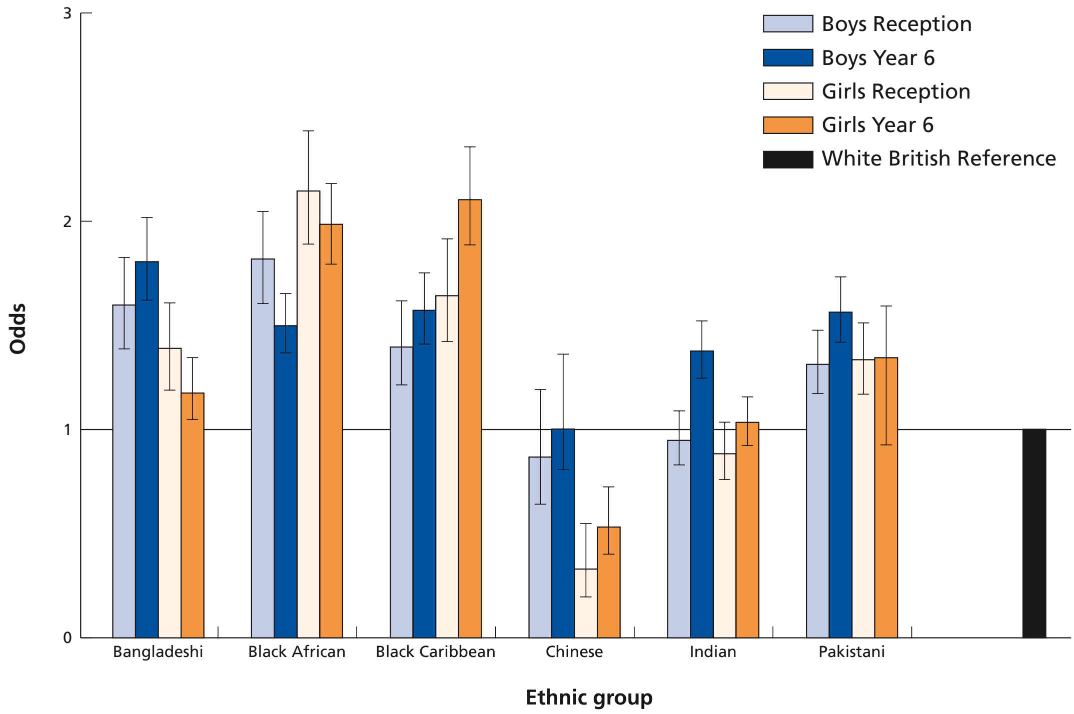


Figure 14 demonstrates the odds of being classified as obese for each of the ethnic groups; the black line shows the White British reference score of 1. This demonstrates the significant differences found between ethnic groups in the likelihood of being obese. The reasons for any difference between ethnic groups is unclear from this analysis and may be due to biological differences, or other confounding factors. This is further investigated in the multivariable models section (Section 6).

4.5 Key points on prevalence figures

- The 2006/07 and 2007/08 NCMP prevalence figures show substantial changes have occurred in children's BMI over the past two decades – with the proportion of children classified as obese nearly doubling for children in Reception and increasing more than threefold for children in Year 6.
- A statistically significant decreasing trend in obesity prevalence by deprivation is observed, with the highest prevalence in the most deprived decile and the lowest in the least deprived.
- The prevalence of obesity in Year 6 children has increased within more deprived areas from 2006/07 to 2007/08. This may be related to an increase in response rate rather than a true change.
- Logistic regression between IDACI scores and obesity classification indicates a significant relationship between deprivation and the likelihood of being classified as obese.
- Year 6 children in White and Asian ethnic groups have seen an increase in reported obesity prevalence. This may be a consequence of differential changes in participation across different ethnic groups.

5 Distribution of BMI

There has been an increase in both obesity prevalence and mean BMI from the 1990 baseline population to the present. Studying any change in trends will identify whether this change in mean BMI is due to increases in BMI across the whole population or if the rise in mean BMI has been driven by the obese population becoming more obese.

5.1 Comparison of 2007/08 NCMP BMI distribution with UK90 baseline

The following figures show the distribution of BMI compared to the expected distribution of BMI for children of the same age from the 1990 baseline population for Reception (Figure 15) and Year 6 (Figure 16). The mean ages of boys and girls measured in Reception and Year 6 (60.9 months and 132.9 months respectively, for both sexes) were used to calculate the baseline distribution for children of that age, based on the UK90 dataset.

Figure 15: Distribution of BMI for all children in Reception 2007/08, compared to the 1990 baseline population

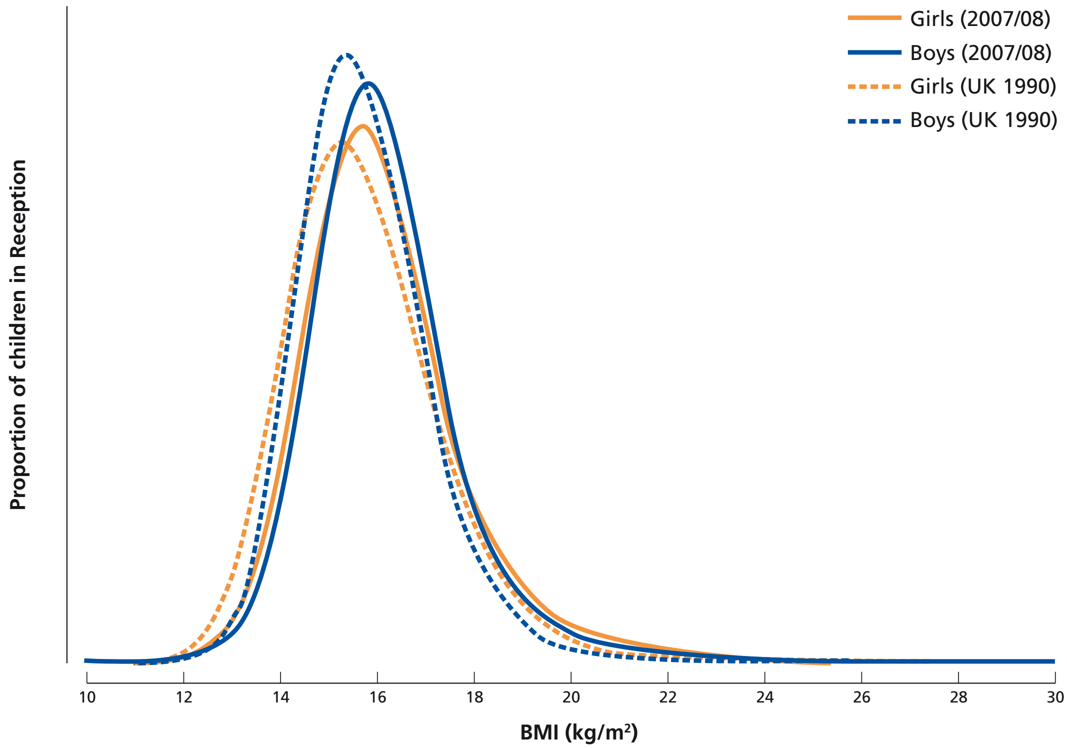
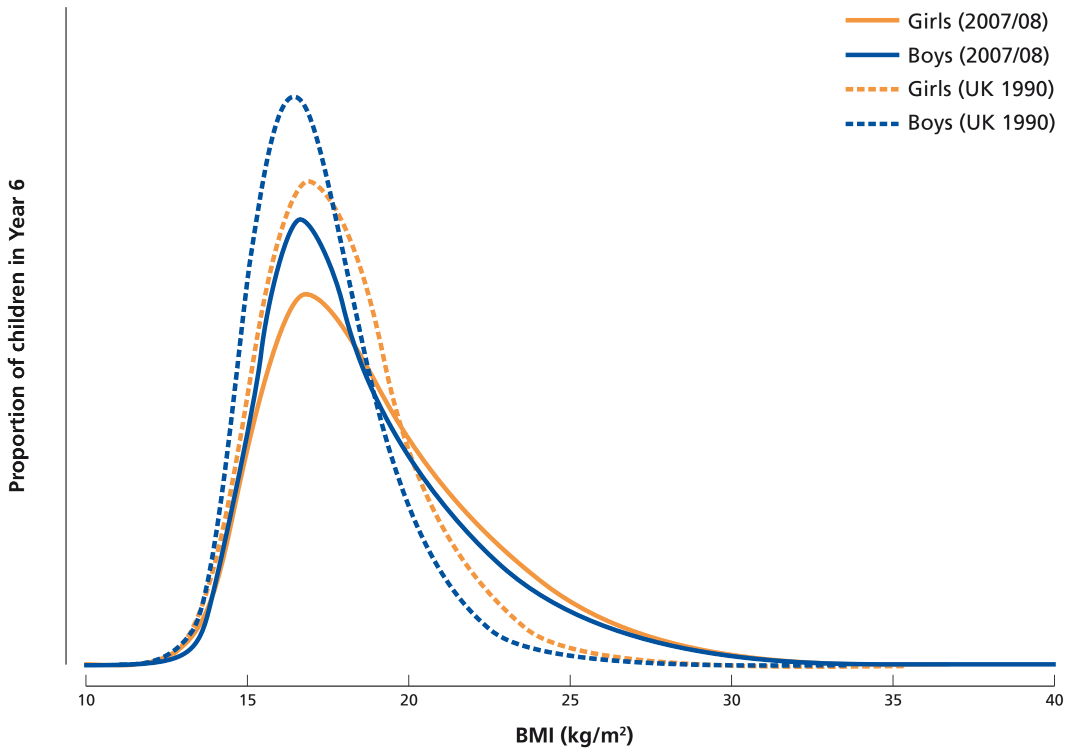


Figure 16: Distribution of BMI for all children in Year 6 2007/08, compared to the 1990 baseline population



Figures 15 and 16 show very different patterns of change in the BMI distribution over time for younger and older children.

For all children in Reception, the whole distribution has shifted slightly to the right (centred around a higher BMI value), but the trend of the distribution remains largely the same. In both baseline and current population there is an indication of some positive skew.

For children measured in Year 6, there has been a noticeable change in the shape of the distribution, with the current distribution showing far greater positive skew than the baseline. A similar pattern emerges for both boys and girls, although the BMI distribution of girls appears to have slightly more positive skew. The baseline population for girls was also more skewed.

These findings suggest that while obesity prevalence has increased in both Reception and Year 6 since the 1990 baseline, the pattern of change across the whole population differs. In younger children the population shift in BMI is spread relatively evenly across the whole population, while for older children in the Year 6 age group the biggest increases in BMI have occurred amongst those children who are already likely to be classified as overweight or obese.

In order to investigate these findings further one can divide the BMI distribution into segments, based on the BMI values, and use z scores to examine the relative change of each group in comparison to the baseline population.

5.2 Analysis using BMI z score

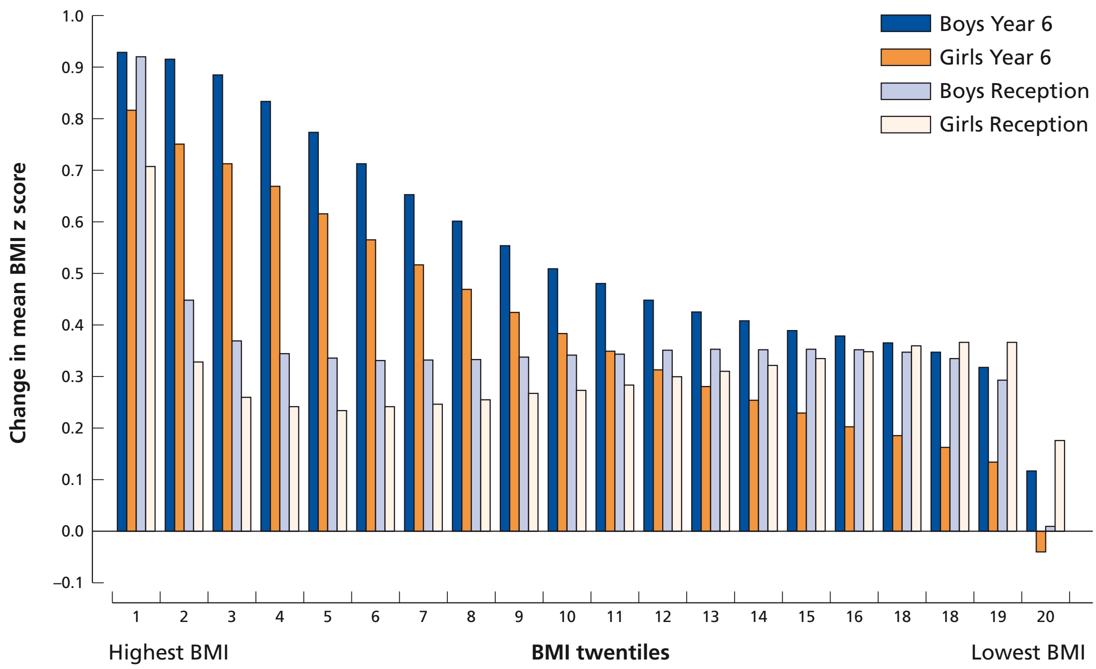
The use of z scores enables standardisation of data for age and sex, and thus allows comparability across such groups. A z score (or standard deviation score (SDS)) is a measure of the number of standard deviations from the expected mean BMI for an individual. In children this takes account of their age and sex, by relating current BMI to that expected using the UK90 Growth Reference.

For example, a boy aged 10, with a BMI of 21.7kg/m^2, would be assigned a z score of +2.0, indicating that his BMI is two standard deviations above the expected BMI for a boy of that age. This equates to the 97.7th centile of the distribution, so such a child would be likely to be classified as obese using both the population monitoring cut-off (95th centile) and the clinical cut-off (97.7th [98th] centile).

Z scores relating to the UK90 growth reference were calculated for BMI measures within the NCMP dataset. For this analysis individuals have been divided by sex and school year and ranked according to their BMI z score. Each group was then subdivided into 20 evenly sized groups (twentiles), each of which contained 5% of that population subgroup with mean BMI z scores calculated for each twentile.

Figure 17 shows the change in mean BMI z score since the baseline for girls and boys in both Reception and Year 6 for the NCMP 2007/08.

Figure 17: Change in mean BMI z score for twentiles of the BMI distribution from the 1990 baseline to 2007/08



This chart further demonstrates that the pattern of change since the baseline differs between the different year groups measured for the NCMP. Although the patterns are broadly similar between males and females, the average changes for males are generally higher, which might be expected given the greater increase in child obesity prevalence since the 1990 baseline for boys.

For both girls and boys in Year 6, the increase in mean z score is smallest in the 5% of the population with the lowest BMI and greatest in the 5% of the population with the highest BMI, with a gradual increase between these groups.

For both sexes the 5% of the Year 6 population with the lowest BMI appears to have substantially smaller increases in mean BMI z score than the next 5% of the population. Indeed the 5% of girls in Year 6 with the lowest BMI appear to have marginally lower BMI than the equivalent 5% in the baseline population. This is the only group to show any decrease.

With the exception of the girls in the 'thinnest' 5% of the Year 6 population, all mean BMI has increased across the whole population. Although the largest increases (0.8 SDS for girls, 0.9 SDS for boys) have occurred in the 5% of the population with the highest BMI, children in the middle of the BMI distribution now have a BMI score higher than their equivalents in the UK90 distribution by around 0.5 SDS for boys and 0.4 SDS for girls. The 2007/08 mean BMI for boys in Year 6 equates to the 69th centile of the UK90 BMI distribution, whilst the 2007/08 mean for girls equates to the 66th centile, in comparison to the means for both boys and girls in the UK90 population being in the 50th centile.

Similar increases have also been found for children in the lower BMI scores for the population. The lowest 5–10% of the BMI distribution now have a mean BMI z score around 0.3 SDS higher than the equivalent proportion of the 1990 baseline population.

For children in Reception the pattern is somewhat different. Although there have been very large increases in mean BMI z score in the top 5% of the population (0.9 SDS for boys and 0.7 SDS for girls), the rest of the population has all increased a similar amount, around 0.3 SDS.

5.3 Key points on distribution of BMI

- In younger children the population shift in BMI is spread relatively evenly across the whole population, while for older children in the Year 6 age group the biggest increases in BMI have occurred amongst those children who are already likely to be classified as overweight or obese.
- The 5% of girls in Year 6 with the lowest BMI appear to have marginally lower BMI than the equivalent 5% in the baseline population. This is the only group to show any decrease.
- With the exception of the girls in the 'thinnest' 5% of the Year 6 population, all mean BMI has increased for all children in Reception and Year 6.
- The 2007/08 mean BMI for boys in Year 6 equates to the 69th centile of the UK90 BMI distribution, whilst the 2007/08 mean for girls equates to the 66th centile, in comparison to the means for both boys and girls in the UK90 population being in the 50th centile.

6 Regression analysis – multivariable models

6.1 Multivariable models – individual characteristics

Multivariable models allow a more in-depth investigation into the data by including all the independent variables in the analysis. This allows any confounding between these variables to be accounted for. These multivariable models were calculated for both PCT (Section 6.2) and individual level variables (Table 10).

Table 10: Results of a logistic regression analysis between overweight & obesity and all the individual characteristic variables

Dependent variable	Slope (Beta coefficient)	Standard error of Beta	Significance (p value)	Odds Ratios
Sex	-0.17	0.01	<0.001**	0.85
Ethnicity			<0.001**	
Age	-0.00	<0.01	<0.001**	1.00
Year Group	0.13	0.01	<0.001**	1.14
IDACI	0.01	<0.01	<0.001**	1.01

Coefficient of determination (R^2) = 0.027 ** significant at the 1% level Number of pupils = 914,653

In the multivariable model for overweight & obesity, significant associations were found with all the individual characteristic variables. These findings agreed with those from the univariable models, with the same direction of relationship found for each characteristic.

The low coefficient of determination score indicates the low amount of variation explained by the multivariable model. This is representative of the large amount of variation found through using all the individual cases of the NCMP dataset and also indicates the complexity behind the determination of an individual's weight.

As the ethnicity variable is a categorical variable the result in Table 10 is only a measure of the significance of the variables as a whole, calculated through using a Wald test. This indicates that there are significant differences between ethnic groups. Odds ratios were calculated, as before, to compare each ethnic group against White British (Table 11).

Table 11: Odds ratios for the relative likelihood of individuals from the main ethnic groups being overweight & obese in reference to White British from the multivariable model

Ethnic Group	Odds Ratios	95% Confidence Intervals
Bangladeshi	0.99	0.94, 1.04
Black African	1.36*	1.30, 1.42
Black Caribbean	1.21*	1.15, 1.27
Chinese	0.68*	0.61, 0.76
Indian	0.85*	0.83, 0.91
Pakistani	0.95	0.91, 1.00
White British	1	1

* significant at the 5% level

The odds of being classified as obese, in comparison to White British, change for ethnic groups between univariable and multivariable models, with some changes of significance. The univariable models were calculated using data split by sex and year group. These changes are likely to be a representation of the relationship between deprivation and ethnicity, highlighting differential degrees of deprivation between different ethnic groups.

These are interesting findings and highlight the need for further investigation of ethnicity as a factor in the determination of obesity. This should take into account confounding factors such as deprivation, and differences in build and growth patterns. By including height as an independent variable in the multivariable model it is possible partially to adjust for some of these biological differences. Although this has some expected influence on the beta coefficients and odds ratios for the other independent variables it does not change the direction of the relationships nor the significance for any of them (Table 12).

Table 12: Results of a logistic regression analysis between overweight & obesity and all the individual characteristic variables, including height

Dependent variable	Slope (Beta coefficient)	Standard error of Beta	Significance (p value)	Odds Ratios
Sex	-0.25	0.01	<0.001**	0.78
Ethnicity			<0.001**	
Age	-0.05	<0.01	<0.001**	0.95
Year Group	0.15	0.01	<0.001**	1.16
IDACI	0.01	<0.01	<0.001**	1.01
Height	0.10	<0.01	<0.001**	1.10

Coefficient of determination (R^2) = 0.115 ** significant at the 1% level Number of pupils = 914,653

As height is a value used within the measurement of BMI there may be some concern that there is a possibility of multicolinearity between height and both dependent and independent variables. Using prevalence as a dichotomous variable, rather than BMI, will reduce this. The large dataset and the lack of change in direction of relationship or significance for any of the other variables provides some reassurance that any colinearity that may be present is not affecting the statistical tests. Including height causes a large increase in R^2, indicating the impact of height on BMI and overweight & obesity classification.

Whilst controlling for height, ethnicity remains significant. Calculating odds ratios for each of the ethnic groups provides a measure of the differences in the likelihood of being overweight & obese between ethnic groups, once relative height has been accounted for (Table 13).

Table 13: Odds ratios for the relative likelihood of individuals from the main ethnic groups being overweight & obese in comparison to the White British ethnic group from multivariable models, including height

Ethnic Group	Odds Ratios	95% Confidence Intervals
Bangladeshi	1.17*	1.10, 1.25
Black African	0.96	0.91, 1.02
Black Caribbean	0.97	0.91, 1.04
Chinese	0.76*	0.66, 0.89
Indian	0.97	0.91, 1.03
Pakistani	1.08*	1.02, 1.14
White British	1	1

* significant at the 5% level

From these odds ratios children from Black African and Black Caribbean ethnic groups were found to have no significant differences in the likelihood of being classified as overweight & obese from the White British group. This suggests that earlier findings in which they had the highest odds of being obese were most likely to be due to body composition, in particular height, even when deprivation is controlled for.

Figure 18: Odds of being classified as overweight & obese for ethnic groups in reference to the White British ethnic group from multivariable models, with and without controlling for height

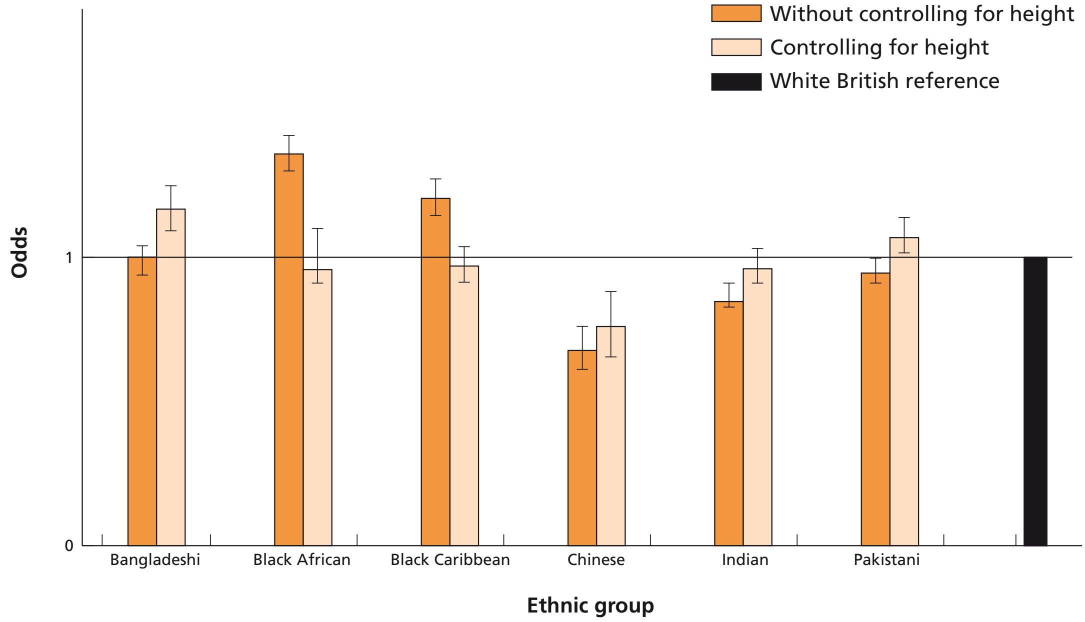


Figure 18 demonstrates the changes in odds of being obese when controlling for height. Changes in significance and direction of the odds ratios for ethnic groups other than Black African and Black Caribbean, in particular Pakistani, further strengthen the argument for more in-depth analysis and research into differential obesity prevalence and determination for different ethnic groups. These odds ratios were calculated from multivariable models controlling for the influence of sex and age, and therefore present an overall indication of the impact of ethnicity. Further research split by age and sex will investigate the differential influence of ethnic group for different ages and sexes.

6.2 Multivariable models – PCT characteristics

Multivariable models were also calculated for the PCT level characteristics, although as individual level characteristics such as sex, ethnicity and age were included in the individual level models these were not added here.

In the initial regression model for obesity prevalence in Reception the only variable that was found to be significantly associated was IMD (Table 14).

Table 14: Results of a weighted regression analysis between obesity prevalence and all the PCT characteristic variables for Reception

Dependent variable	Slope (Beta coefficient)	Standard error of Beta	Significance (p value)	Odds Ratios
Participation rate of measured schools	-0.02	0.03	0.459	0.98
Opt-out rates	0.00	0.03	0.917	1.00
Height rounding both	0.01	0.01	0.231	1.01
Weight rounding both	-0.01	0.01	0.263	0.99
IMD	0.12	0.02	<0.001**	1.13

Coefficient of determination (R^2) = 0.433 ** significant at the 1% level
Number of PCTs = 91

As opt-out rate had been included in this model, the number of PCTs that could be included in the analysis was reduced from 152 to 91 (which is the number of PCTs that provided data on opt-out). Multivariable models were then run without opt-out measures using all the PCTs and a multivariable model with all the significant PCT characteristic variables calculated (Table 15).

Table 15: Results of a weighted regression analysis between obesity prevalence and the significant PCT characteristic variables for Reception

Dependent variable	Slope (Beta coefficient)	Standard error of Beta	Significance (p value)	Odds Ratios
Height rounding both	0.02	0.01	0.031*	1.02
Weight rounding both	-0.01	0.01	0.013*	0.99
IMD	0.12	0.01	<0.001**	1.13

Coefficient of determination (R^2) = 0.413 ** significant at the 1% level * significant at the 5% level
Number of PCTs = 152

This multivariable model indicates that 41% of the variation in prevalence between PCTs can be explained by these three variables, highlighting the need to improve the accuracy and standardisation between PCTs in the collection of data, in particular with regard to digit preference, and supporting further research into the association between deprivation and weight determination.

Repeating these multivariable models for Year 6 found that, as with Reception, in the initial model with all the PCT level variables only IMD was found to have a significant association with the prevalence of obesity (Table 16).

Table 16: Results of a weighted regression analysis between obesity prevalence and all the PCT characteristic variables for Year 6

Dependent variable	Slope (Beta coefficient)	Standard error of Beta	Significance (p value)	Odds Ratios
Participation rate of measured schools	0.00	0.05	0.960	1.00
Opt-out rates	-0.08	0.06	0.142	0.92
Height rounding both	0.01	0.02	0.460	1.01
Weight rounding both	-0.01	0.01	0.269	0.99
IMD	0.23	0.02	<0.001**	1.26

Coefficient of determination (R^2) = 0.551 ** significant at the 1% level
Number of PCTs = 101

Repeated models found no other significant associations between any of the PCT level variables and the prevalence of obesity at Year 6 except for IMD. Height and weight rounding, as previously discussed, would have less impact on Year 6 BMI measures due to their relatively lower influence in larger children. Participation rate and opt-out rates, that were both found to be significantly associated with prevalence at the 5% level in univariable models, are not found to be significant in the multivariable model.

This suggests that once controlling for deprivation, as measured by the IMD, the significant association between participation and opt-out is lost. It is possible that pupils of different socio-economic status have varying likelihood of non-participation and there may be correlation between these variables. It must also be recognised that opt-out and participation rates may be highly correlated as they measure similar things. In order to counter this, models were calculated including only one measure of either at a time, but no significant association was found for either opt-out or participation.

In order to investigate this proposed colinearity and correlation between variables further correlation matrices for the independent variables were calculated.

6.3 Correlations between independent variables

As expected there is a strong, significant, negative correlation between participation rate and opt-out rate for both Reception (Table 17) and Year 6 (Table 18). Other significant correlations that are found with both Reception data and Year 6 data include participation rate and IMD. The higher the mean deprivation the greater the participation rate, suggesting that higher socio-economic status individuals are more likely to opt out. Although no significant associations were found for opt-out rates, the correlation coefficient indicates that pupils in more deprived PCTs are more likely to opt out in Reception and less likely to opt-out in Year 6. Neither of these correlations are significant, however, and although not all PCTs provided opt-out rates, these results suggest further research should be undertaken on the opting out and participation of pupils.

Table 17: Results of a correlation matrix for the PCT independent variables for Reception

	Opt-out	Height both	Weight both	IMD	Coefficients
Participation	-0.338 <0.001** 91	-0.103 0.205 152	-0.146 0.072 152	0.186 0.022* 152	Correlation Significance Number of PCTs
Opt-out		0.073 0.489 91	-0.122 0.248 91	0.067 0.528 91	Correlation Significance Number of PCTs
Height both			0.231 0.004** 152	-0.038 0.642 152	Correlation Significance Number of PCTs
Weight both				-0.036 0.658 152	Correlation Significance Number of PCTs

** significant at the 1% level * significant at the 5% level

Table 18: Results of a correlation matrix for the PCT independent variables for Year 6

	Opt-out	Height both	Weight both	IMD	Coefficients
Participation	-0.360 <0.001** 101	-0.177 0.029* 152	-0.082 0.316 152	0.217 0.007** 152	Correlation Significance Number of PCTs
Opt-out		0.004 0.971 101	-0.117 0.244 101	-0.163 0.103 101	Correlation Significance Number of PCTs
Height both			0.277 <0.001** 152	-0.021 0.795 152	Correlation Significance Number of PCTs
Weight both				-0.044 0.589 152	Correlation Significance Number of PCTs

** significant at the 1% level * significant at the 5% level

For both Reception and Year 6 a significant positive correlation was found between PCTs rounding weight measurements and rounding height measurements. This suggests that PCTs which round one measure tend also to round the other. Comparing the rounding of height and weight to participation rate found that PCTs with higher participation rates were less likely to round these measures. Although this was only found to be significant for height rounding with Year 6, it may indicate overall inaccuracies in data collection within PCTs. To investigate this further a correlation matrix for these measures was calculated to compare between Reception and Year 6 data collection (Table 19).

Table 19: Results of a correlation matrix for the PCT independent variables for comparing Reception to Year 6

Participation	Opt-out	Height both	Weight both	Coefficients
0.564 <0.001** 152	0.460 <0.001** 91	0.880 <0.001** 152	0.863 <0.001** 152	Correlation Significance Number of PCTs

** significant at the 1% level

All the correlations were significant at the 1% level, and all suggest that data collection inaccuracies occur at both Reception and Year 6 within PCTs, highlighting varying standards between PCTs in data collection. This further promotes the need for a standardised approach to data collection by PCTs alongside research into non-participation.

6.4 Key points on regression analysis – multivariable models

- Multivariable models indicate that deprivation is a confounding variable for ethnicity and that there are differential degrees of deprivation between different ethnic groups, influencing the odds of being classified as overweight & obese.
- Controlling for height suggests that earlier findings in which children from Black African and Black Caribbean ethnic groups had the highest odds of being obese were most likely to be due to body composition, in particular height.
- The higher the mean deprivation the greater the participation rate, suggesting that individuals from higher socio-economic groups are more likely to opt-out.
- Further research is recommended to provide a better understanding of influences on opting out and participation of pupils.
- Data collection inaccuracies occur at both Reception and Year 6 within PCTs, highlighting varying standards between PCTs in data collection and further promoting the need for a standardised approach and research into non-participation.

7 Conclusions

- Data quality for the NCMP is improving, although this should still be a focus in future programmes. Findings from this report indicate that inaccuracies in measurement as well as when in the school year individuals are measured may affect prevalence figures.
- Participation rate is also improving, with increased participation throughout PCTs. As analysis suggests that non-participating pupils are more likely to be overweight or obese the NCMP would benefit from improved reporting of opt-outs, especially as non-participation may vary by age, sex and ethnic group. Any investigation into the motivations behind individuals choosing not to be measured would benefit the data collection process.
- There is also an increased recording of child postcode and ethnicity which allows for a more in-depth investigation into factors such as deprivation and ethnicity.
- Analysis into ethnicity suggests there is a difference between ethnic groups in the likelihood of being classified as obese, but that some of these differences may be due to differences in physical characteristics such as height. Further investigation into differences between ethnic groups in body composition, as well as other factors such as deprivation, would be beneficial.
- Deprivation is an important determinant of obesity prevalence. Although changes in obesity prevalence were found to be greater amongst the more deprived, further analysis should be performed on this, as it is possible this may be due to an increase in participation within the more deprived areas.
- A more in-depth analysis into deprivation using the domains of the IMD at LSOA level should provide a greater indication of where the influence of deprivation on obesity prevalence lies.
- In Reception year children there has been a population shift in BMI spread relatively evenly across the whole population. For Year 6 the biggest increases in BMI have occurred amongst those children who are already likely to be classified as overweight or obese.
- For all factors for which future research is recommended, it is important, if one is to focus as closely as possible on understanding the impact these factors have, to take into account the confounding variables and factors which interact with these when conducting the analysis. As these factors work at various levels, and due to the data collection nature of the NCMP, a multilevel approach is recommended for future analyses.

References

APHO. Funnel Plot for Proportions and Percentages template. Available at: http://www.apho.org.uk/resource/view.aspx?RID=47241. Accessed 13/04/09.[Further details about funnel plots for Statistical Process Control are available at: http://www.apho.org.uk/resource/view.aspx?RID=39445. Accessed 13/04/09].

NHS Information Centre for Health and Social Care. National Child Measurement Programme: 2007/08 school year, headline results, December 2008. Available at: http://www.ic.nhs.uk/webfiles/publications/ncmp/ncmp0708/NCMP%202007-08%20Report.pdf. Accessed 13/04/09.

National Obesity Observatory. National Child Measurement Programme: Detailed Analysis of the 2006/07 National Dataset, June 2008. Available at: http://www.noo.org.uk/uploads/doc168_2_NOO_NCMP_report230608.pdf. Accessed 13/04/09.

Glossary

Beta coefficient. Standardised regression coefficient used to predict standardised scores on Y from scores on X. The beta coefficient corresponds to the gradient of a regression equation.

BMI. The Body Mass Index, or Quetelet index, is a key index for relating a person's body weight to their height. It is calculated by dividing an individual's height in kilograms (kg) by their height in metres (m) squared.

Coefficient of determination. This is the squared multiple R and can be interpreted as the proportion of variance in Y that can be predicted from X.

Confidence intervals. A confidence interval gives an estimated range of values which is likely to include an unknown population parameter. Confidence intervals are used to indicate the reliability of an estimate.

Logistic regression. A regression analysis for which the outcome variable is categorical. As categorical variables do not conform to ordinary linear regression assumptions different computational procedures are required. Logistic regression fits these data to a logistic curve which allows the relationship between the outcome variable and the independent variables to be calculated.

Multicolinearity. Occurs where two or more independent variables in a regression model are highly correlated. When this occurs the coefficient estimates may change erratically in response to small changes in the model or the data, thereby affecting significance testing. Multicolinearity does not reduce the reliability of the model as a whole; it only affects calculations regarding individual variables.

Multivariable. Regression models containing more than one independent variable.

Odds ratios. A ratio of odds for members of two different groups, calculated as the exponential of the beta coefficient. The odds ratio is a way of comparing whether the probability of a certain event is the same for two groups. An odds ratio of 1 implies that the event is equally likely in both groups, an odds ratio greater than one implies that the event is more likely in the first group, whilst an odds ratio less than one implies that the event is less likely in the first group.

p value. A measure of significance, the smaller the p value the more strongly the test rejects the null hypothesis, where the null hypothesis represents the hypothesis of no change or no effect.

Regression analysis. A collective name for techniques for the modelling and analysis of numerical data used to find relationships between variables, by modelling the outcome variable as a function of the independent variables. Most commonly the best-fit is evaluated by using the least-squares method, but other criteria have also been used.

Standard error of beta. Standard error of beta estimates how much the value of beta should vary across different samples from the same population. This can be used to form confidence intervals and for significant testing.

Univariable. Regression models containing one independent variable.

Wald test. A statistical test typically used to test whether an effect exists or not, i.e. whether an independent variable has a statistically significant relationship with an outcome variable.

Weighted regression analysis. Weighted least-squares regression can be used when it may not be assumed that every observation should be treated equally. Weighting maximises the efficiency of the parameter estimation by attempting to give each data point its proper degree of influence over the parameter estimates.

z score. The distance of an individual score from the mean of a distribution, expressed in terms of the number of standard deviations from the mean.

National Obesity Observatory

noo.org.uk
info@noo.org.uk
01865 334900