The association between area-based deprivation and change in body-mass index over time in primary school children: a population-based cohort study in Hampshire, UK

Running title: Childhood weight gain is linked to home area deprivation

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Abstract

Background/objectives:

Childhood obesity is a serious public health challenge. Cross-sectional evidence indicates that childhood obesity is strongly linked to area deprivation level, yet longitudinal research is scarce. We assessed the association of home-based and school-based deprivation indices with change in childhood body-mass index (BMI) z-score and BMI status over 6 years in Hampshire, England.

Subjects/Methods:

This longitudinal study linked the National Child Measurement Programme data for children aged 4-5 years (2007–08 to 2009–10) to 10–11 years. The dataset was stratified into two groups: 18 733 children for whom home deprivation quintiles, according to the Index of Multiple Deprivation (IMD), remained constant, and 6 153 children who moved home deprivation quintiles between the two time points. The associations between IMD quintiles and change in BMI z-score and status were analysed.

Results:

63.7% of children remained a healthy weight, 3.1% remained overweight, 5.3% remained with obesity, 8.3% became overweight, and 10.3% developed obesity. Children living in the most deprived quintile increased their BMI z-score by 0.13 units more than those in the least deprived quintile (95% CI:0·08–0·19). Home-based deprivation displayed associations with change in BMI status (Relative risk for the most deprived quintile: become overweight 1.47, 1.21-1.78, remain obese 1.82, 1.34–2.40, become obese 2.07, 1.73–2.48). School-based deprivation was not associated with change in BMI z-score or BMI status. Moving home to a more deprived quintile was associated with developing obesity (1.22, 1.04–1.43).

Conclusions More children living in deprived areas developed obesity over time. Home-based deprivation level is more strongly associated with adverse change in childhood weight than school-based deprivation. Scholarly settings can provide opportunities for interventions however obesity prevention interventions should tackle the obesogenic environment combining family and area-based measures.

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Introduction

Childhood obesity is a serious global health challenge.[1] Overweight and obesity can be defined as the accumulation of excessive fat, caused by an imbalance the intake and output of calories.[2] Obesity carries many health risks including cardiovascular disease, musculoskeletal disorders[3], depression[4], obstructive sleep apnoea[5], reduced self-esteem and social exclusion.[6] At least 2.8 million people die each year, globally, as a result of excess weight.[7] Yet, obesity is preventable.

In 2015/16, 22.1% of 4-5 year old and 34.2% of 10-11 year old children were reported to be of excess weight in England. In Hampshire, in the South of England, these figures equate to 22.8% and 29.6%, respectively.[8] Children with obesity are more likely to become adults with obesity.[5] By understanding the drivers of obesity, prevention at a young age could significantly reduce the health and economic burdens of obesity.

The social determinants of health shape an individual's lifestyle and influence their ability to perform daily requirements. In relation to obesity, this concept translates to the obesogenic environment, which is the influence of an individual's surroundings on promoting obesity.[9] For instance, unhealthy food outlets are more widely available in more deprived areas.[10] A plethora of cross-sectional studies, since 1982, show that the burden of obesity falls hardest on children from lower socioeconomic backgrounds.[11] Public Health England states that childhood obesity and the Index of Multiple Deprivation (IMD),[12] a measure of area-level deprivation in England, has an almost linear relationship.[13]

Research is only beginning to establish the association between deprivation and the development of obesity longitudinally. When based on the socioeconomic status (SES) of the family, a study from 5 European countries showed that low parental SES was a risk factor for the development of excess weight after 2 years in children aged 2-9 at baseline.[14] The prevalence of children who were overweight in the lowest socioeconomic group increased from 37.2% at baseline to 67.4% at follow-up, whereas there was no increase in the higher socioeconomic group. A Canadian study of children aged 5 months to 10 years, found that those living with lower SES gained weight at a faster rate.[15] An Australian study of children aged 4-10, found that the relative risk of remaining overweight or obese compared to remaining a normal weight doubled for those in the more disadvantaged households than in more advantaged.[16] When analysing the relationship between neighbourhood-based deprivation and body mass index (BMI) longitudinally, one Australian study found an increased risk for those living in the more deprived areas for being, or becoming, overweight or obese.[17] A German study of children aged 6-10 found those in more deprived neighbourhoods had a BMI z-score of 0.31 units higher than children from less deprived neighbourhoods (P<0.001). This effect was only partially explained by social characteristics of the family.[18]

Environmental factors can be important to health outcomes. Changes in environment can also impact on health. Research over a 20-year period suggests that individuals who migrate from more to less deprived locations are healthier than people who move from less to more deprived locations[19]. Research on the relative magnitude of influence[20] shows environments are dynamic and the distribution of these influences on health differs with age. It can be considered that between the ages of 5 and 18, the magnitude of influence of schools is similar to the community. Therefore, it is important to gain further insight into the relationship between the school environment and children's BMI status.

This analysis of a population-based cohort aimed to characterise the change in BMI z-score and BMI status (healthy weight/overweight/obese) over a 6-year period in children aged 4-5 years at baseline in Hampshire, South of England. We also aimed to investigate if childhood BMI change over time is more strongly associated with area-deprivation when based on the child's home or child's school, and to examine if moving home to a more or less deprived area is associated with change in childhood BMI z-score/status over time.

Methodology

Study design

A population-based observational cohort study analysing data collected through the National Child Measurement Programme (NCMP) which measures the height and weight of children in Reception (aged 4/5 years) and Year 6 (aged 10/11 years) in English primary schools, to assess overweight and obesity levels. [21]

The sampling frame included all children in state-maintained schools under the Hampshire Local Authority with Reception and Year 6 measurements between 2007/08 and 2015/16. 85% of records had a measurement in Reception and Year 6. The Year 6 participation rate of the NCMP in this time period was 95%.

Individual BMI measurements at Reception and Year 6 were linked. The dataset was split into two parts. Dataset one only includes children who have a consistent home deprivation index and school deprivation index quintiles between Reception and Year 6, to ensure that the measure of exposure remained relatively stable between the two time periods. Dataset two comprises of children who moved home deprivation index quintile between Reception and Year 6 to assess how a change in exposure is associated with change in BMI.

Measurement of Outcome

Height and Weight

Height and weight were measured according to the NCMP operational guidance.[22] Children are measured by school nurses using calibrated equipment. To ensure reliability of the NCMP data, measurements were sent to NHS Digital for validation. Data quality indicators highlight warnings for local authorities to check extreme measurements and to make amendments. Any data that is not labelled as correct is removed. A ‘cleaned’ dataset was used for this study.

BMI z-score

BMI z-score can be considered a sound measure to calculate change over time as it is a measure of weight, adjusted for height, age and sex.[23,24,25] BMI is not an age and sex standardised measure and is expected to naturally increase through childhood growth. Therefore, an increase in BMI over time does not indicate an increase in adiposity. Change in BMI z-score between the two measurements was calculated:

Change in BMI z-score = Year 6 BMI z-score – Year R BMI z-score

BMI Status

Analysis of BMI z-score is useful to predict change over time, however, change in BMI status was also analysed to understand the level of morbidity in the population. Children were allocated a BMI status in line with the population monitoring centiles used in the British 1990 growth reference chart (UK90).[26] The thresholds are displayed below, with comparator centiles for the World Health Organisation (WHO) reference where this differs.

Underweight: $<2^{nd}$ Centile (WHO: 3^{rd} Centile),

Healthy Weight: $\geq 2^{nd}$ Centile to $<85^{th}$ Centile, Overweight: ≥85th Centile to <95th Centile,

Obese: ≥95th Centile (WHO: 97th Centile).

Children were allocated one of the six following categories based on the outcome of their measurement: Remained a Healthy Weight, Remained Overweight, Remained Obese, Became Overweight, Became Obese and Became a Healthier Weight (children who decreased their BMI status towards or to a healthy weight).

Measurement of exposure

Area deprivation level is based on the Index of Multiple Deprivation (IMD) 2015, an overall measurement of deprivation made of seven domains: income, employment, health & disability, crime, barriers to housing & services, living environment and education, skills & training.[27] Overall IMD was used in this analysis as research suggests that overall IMD is more strongly associated with childhood obesity than the individual domains within it.[28] IMD is the English official measure of deprivation for small neighbourhoods, known as Lower Super Output Areas (LSOAs). LSOAs were placed into deprivation quintiles using the published dataset.[29]

Hampshire LSOAs primarily fall within the least deprived national quintile. IMD ranked from 932 to 32,329 in Reception, and 932 to 32,841 in Year 6; 1 is the most deprived area and 32,844 is the least deprived area[30]. Therefore, LSOAs were converted to local quintiles by grouping only Hampshire LSOAs by 20%. This creates a more even distribution across the quintiles and allows a better understanding of the level of deprivation within Hampshire.

Measurement of covariates

The following covariates are recorded through the NCMP: age, sex and ethnicity. Office for Standards in Education, Children's Services and Skills (Ofsted) status and rural/urban classification were added using the methods below, and comparisons were made to determine whether home and school deprivation quintiles were different. Urban/rural setting has been shown to be associated with childhood obesity but there is conflicting evidence to the extent[15,18,36].

Ofsted inspect and regulate schools to evaluate how well it is performing and what it is like to be a pupil in the school. As children spend significant time in this environment, it was a novel concept to assess whether the performance of a school is associated with obesity. This could support a targeted approach to intervention.

The school is awarded one of the following Ofsted status': Outstanding, Good, Requires improvement or Inadequate.[31] An Ofsted status was allocated to each child's record based on the most recent Ofsted inspection prior to leaving Year 6 of school, using the published reports.[32] Therefore, children in different year groups at the same school may have different Ofsted status' depending on when they were present. Some schools had become academy schools, which are not inspected by Ofsted, so are listed as 'Academy'.

Urban and rural classifications are nationally assigned to LSOAs. Children were assigned a classification for their home and school, using the 2011 Rural-Urban Classification.[33]

Statistical analysis

In dataset one, univariable linear regression was carried out to identify associations between change in BMI z-score and BMI status between Reception and Year 6 with the co-variables (age, sex and ethnicity, School Ofsted status, rural/urban classification and whether home and school deprivation quintiles were same or different). Significant factors were included as confounders in the multivariable models. Standard errors were adjusted for clustering of pupils within schools.

A multivariable linear regression analysis was conducted to assess if there was a linear relationship between deprivation and change in BMI z-score, adjusting for significant covariates. The data was tested for normality and variability.

Multinomial logistic regression was conducted to examine the associations between deprivation quintiles and BMI status, adjusting for significant covariates. The relative risk of being in each category by deprivation quintiles was calculated.

This analysis was then repeated in database two, with the main exposure variable being whether the child had moved home to a more, or less, deprived quintile.

Data was analysed using Stata I/C 14.0 for Windows.[34]

Ethical considerations

Ethical approval has been granted for this study by the Faculty of Medicine Ethics Committee at the University of Southampton (Ethics ID:23008). Data was collected for the NCMP provided consent was obtained, through an opt-out basis.[35] This research project is a secondary analysis of an anonymised dataset.

Results: Dataset One (children who remained in the same home-based deprivation quintile between Reception and Year 6)

Dataset one consisted of 18,733 children, and dataset two consisted of 6,153 children. Table 1 presents the descriptive statistics by exposure for dataset one. The majority of children are of a White ethnic background, however ethnic status was unknown for one third of children. Most children lived and went to school in urban settings. BMI z-score was lower in Year 6 than Reception for children living in the least deprived areas, however it was higher in Year 6 than in Reception for children living in the most deprived areas.

The univariable linear regression analyses to assess which variables predict change in BMI z-score are presented in Table 2. All variables were significantly associated with change in childhood BMI z-score, excluding urban/rural setting of home and school, and whether home and school were in the same or different quintile. All examined variables showed a significant univariable association with change in BMI status between baseline and follow-up (data not shown).

Being female was protective of an increase in BMI z-score. Children from an Asian background had a change in z-score of 0.26 units higher than children from a White background. There was a significant increase in z-score for children attending a school requiring improvement compared to ‘outstanding’. There were no significant differences in other ethnic or school rating categories. In Reception, change in BMI z-score increased for each month increase in age. Whereas in Year 6, change in BMI z-score reduced for each month increase in age.

Table 3 displays the proportion of children in each ‘change in BMI status’ category. The majority of children were a healthy weight and remained so throughout the study period.

Multivariable linear regression analysis of change in BMI z-score from Reception to Year 6, adjusted for age, sex, ethnicity and school Ofsted status.

Multivariable linear regression analysis indicated home-based deprivation was a significant predictor of change in BMI z-score (table 4). Those in quintile 5 (most deprived) increased their BMI z-score by 0.13 units more than those in quintile 1 (least deprived). Quintiles 4 and 3 also increased their BMI z-score significantly more than those in quintile 1 (least deprived).

There was no evidence of association between school-based deprivation and change in BMI z-score in the adjusted multivariable analysis.

Multinomial logistic regression analysis for change in BMI status between Reception and Year 6, adjusted for age, sex, ethnicity, school Ofsted status, urban/rural status and whether home and school quintile were different.

Figure 1 displays the relative risk for the most deprived quintile compared to the least deprived, with 95% confidence interval. Data shows children living in the most deprived quintile had significantly higher relative risk of remaining obese, and of becoming overweight or obese, than children in the least deprived quintile (P<0.001). In contrast, children living in the most deprived quintile were 47% more likely than those living in the least deprived areas to change their BMI status towards a healthier weight (P<0.001).

When deprivation was based on school, there were no significant differences in the relative risk or change in BMI status between children going to school in the least deprived quintile compared to the most deprived quintile in any category.

Results Dataset Two (children who moved home-based deprivation quintile between Reception and Year 6)

Table 5 presents the characteristics of dataset two, based on home-deprivation quintiles when children were in Reception (as children moved home deprivation quintiles between measurements). As found in dataset one, ethnicity was underreported. The sample characteristics of both datasets are similar, except a higher proportion of children living in the most deprived quintile in dataset one are in urban areas.

Multivariable linear regression analysis for moving home to a more or to a less deprived quintile and change in BMI z-score, adjusted for age, sex, ethnicity and school Ofsted status.

Overall, there was not a statistically significant difference in the change in BMI z-score between those moving to a more deprived quintile compared to those moving to a less deprived quintile (P=0.09).

Multinomial logistic regression analysis for moving home to a more/ less deprived home IMD quintile and change in BMI status category, adjusted for age, sex, ethnicity, school Ofsted status, urban/rural status and whether home and school quintile were different.

There was no evidence of a clear trend for change in BMI status and moving home deprivation quintile except that children who moved to a more deprived area were 21.8% more likely to become obese than children who moved to a less deprived area (P=0.014, 95%CI 1.04-1.43).

Discussion

In this study, we found that the level of area deprivation of where children live was associated with change in BMI status over a 6 year period, where the deprivation quintile remained constant. There was also a linear relationship between home area deprivation and change in BMI z-score, reflecting a social gradient: as deprivation increases, adverse change in BMI z-score increases. School-based area deprivation level was not associated with change in BMI z-score or BMI status. Therefore, the deprivation status of where a child lives is more strongly linked with their change in BMI z-score and BMI status than where they go to school.

These findings are consistent with studies in the literature review, based on high income countries, that analysed change in BMI z-score and deprivation. Two studies[36,17] found that mean BMI z-score decreased in the least deprived and increased in the most deprived. An additional study[16] found the mean BMI z-score decreased in the least deprived and a further four[15,37,18,38] just found BMI z-score increased in the most deprived.

BMI z-score was higher in Year 6 than it was in Reception, and excess weight was more prevalent in more deprived areas. These results are consistent with one study analysing the same aged population.[35] Two studies of children aged 7+ at baseline found a significant association at both time points.[39,40] Therefore, it could be considered that early influences manifest later in life, or, the effect of deprivation grows stronger with age. The latter theory has been highlighted in other research.[41,42,14,43] This information could aide interventions to be age appropriate.

This study did not find a significant association between school-based deprivation and change in BMI z-score or BMI status, which matches the findings of two other studies. The same cohort was used, 939 children living in Australia aged 8 years, but the studies differed in length. Both found, cross-sectionally, a higher proportion of children of a lower SES were categorised as overweight or obese at baseline and follow-up.[41] However, the percentage of children from more deprived schools that were overweight or obese did not increase significantly over time.[38]

Strengths and limitations

To our knowledge, our study is the first to analyse the association of moving home between areas with different levels of deprivation, with change in childhood BMI z-score and BMI status over time. This research provides a novel insight into the relationship between deprivation and obesity. Furthermore, to our knowledge, a robust analysis, using validated measures of deprivation, on the relationship between area deprivation level and change in BMI status and BMI z-score over time has not been previously carried out in England. This expands on what is already known by including the association of the school environment on the development of obesity. The research undertaken provides additional insight into whether moving home to more deprived area increases the risk of negative change in childhood adiposity.

This is a population-based cohort study using a representative sample of children from all Hampshire state-maintained schools. The NCMP is an internationally recognised data source, which improves the objectivity of the data collection. The data collectors were unaware of this study so it was not possible for them to bias the measurements. The exposure measures were collected from nationally validated sources providing the most consistent methods of measurement.

Part two of this study, analysing how moving across different levels of area deprivation over time is linked to childhood BMI change, is a novel concept and to our knowledge, this had not been studied previously. This part of the research also adds to the age-based theory, suggesting the effect of deprivation grows stronger between Reception and Year 6. However, a limitation to this section is that it is unknown when, or how many times, the children moved between the two data collection points, therefore this variable may have been too crude to reveal the true association.

Although there were significant differences in change in BMI z-score and BMI status by area deprivation levels, there should be consideration for unmeasured confounders such as parental BMI, birth weight and parental education. Although ethnicity was included, data was missing for a third of children and therefore this may skew the results, as a result of potential selection bias.

Furthermore, this research used the 2015 IMD scores to enable LSOAs which have changed boundaries over time to be allocated a consistent score. This study is an example of the practical difficulties in creating temporal consistencies when there are changes in geographical measures, highlighted in previous research[44].

Lastly, although the NCMP is a surveillance programme, it can be considered to have some behaviour changing properties. Children are measured in Reception and their results are communicated with their parents. Therefore, parents of children who have a high BMI may make necessary changes to lifestyle and diet. Sensitivity analysis showed that children who were not followed up were more likely to be obese than children who were followed-up. Therefore, the trajectory of these children is unknown.

This study addressed a gap in knowledge of how BMI z-score and BMI status changes between Reception and Year 6 in Hampshire children, and its association to home and school based deprivation. Childhood obesity has severe public health implications. Not only are children living in more deprived areas more likely to be overweight, they are also more likely to increase their BMI z-score over time. Whereas children from the least deprived areas are more likely to reduce their BMI z-score closer to the recommended range, thus widening the health inequalities gap.

In our analysis, school-based area deprivation level was not associated with change in childhood BMI z-score or BMI status over time. Therefore, although schools provide ample opportunities for behaviour change interventions, it is important to target the schools that have the more deprived catchment areas to support children who are living in deprivation. Better understanding of the factors in the home environment that influence unhealthy weights, both external and internal to the home is required. A family-based approach to preventing childhood obesity is key and must consider the socioeconomic circumstances and challenges the family faces. It is recommended that further research is carried to understand whether moving quintile is an associated element in change in adiposity.

This initial study focused on change in BMI status using categories similar to other published literature[17] rather than the 16 possible variations of change in BMI status. Further research can also be undertaken to assess whether children who develop obesity at Year 6 were more likely to be a healthy weight or overweight in Reception, as this can help with a targeted approach to prevention.

Societal and environmental change is essential in more deprived areas within Hampshire in order to combat the development of obesity and its associated health and economic implications. This can include improving the food environment and changing the default choice that is unhealthy fast-foods, in support of the Health Matters campaign.[10] Now that Public Health is embedded in the Local Authority, it is recommended that a whole system approach is taken to target the obesogenic environment. This can include: planning and licensing of establishments, active travel, open spaces and community-based interventions.

In conclusion, our study provides evidence of the longitudinal link of area-level deprivation of where children reside with the development and prevalence of childhood obesity. Obesity prevention initiatives must begin in early life, before the health inequalities gap widens, and must factor in addressing socioeconomic and environmental circumstances as well individual lifestyle risk factors.

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Competing Interests

The authors declare no competing interests.

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Figure Legend

Figure 1: Multinomial logistic regression analysis of the association of home and school based deprivation quintiles with change in BMI status between Reception and Year 6, in Hampshire school children (n=18,733).

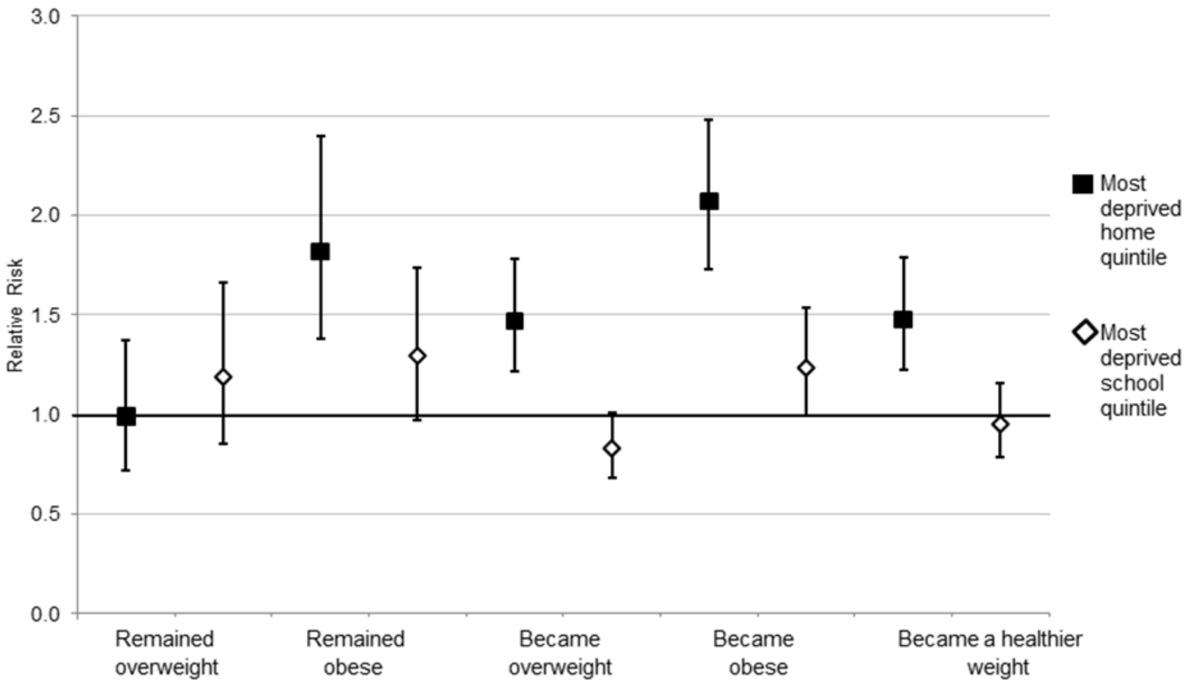

Table 1: Characteristics of dataset one by home-based deprivation quintiles in Hampshire school children (n 18,733)

			Hampshire home-based deprivation quintiles					
			1 (least deprived)		2,3 and 4		5 (most deprived)	
			n= 4290		n=10194		n= 4249	
Categorical Variables			**Number**	**%**	**Number**	**%**	**number**	**%**
Ethnicity								
	White		2429	56.62	6079	59.63	2978	70.09
	Black		~	~	17	0.17	13	0.31
	Asian		~	~	85	0.83	40	0.94
	Any mixed background		134	3.12	422	4.14	186	4.38
	Unknown		1688	39.35	3591	35.23	1032	24.29
Home Rural/Urban status								
	Urban		3424	79.81	7587	74.43	4049	95.29
School Rural/Urban status								
	Urban		3277	76.39	7215	70.78	3956	93.1
School OFSTED Status								
	Outstanding		1274	29.7	1906	18.7	408	9.6
	Good		2449	57.09	6668	65.41	2769	65.17
	Requires Improvement		526	12.26	1444	14.17	937	22.05
	Inadequate		23	0.54	100	0.98	90	2.12
	Academy		18	0.42	76	0.75	45	1.06
Sex								
	Male		2210	51.52	5295	51.94	2148	50.55
Continuous variables			**Mean**	**S.D**	**Mean**	**S.D**	**Mean**	**S.D**
Baseline		Age in months	60.11	2.29	60.04	2.22	60.23	2.26
		BMI	15.99	1.35	16.11	1.42	16.31	1.54
		BMI z-score	0.26	0.91	0.33	0.94	0.46	0.95
Follow-up		Age in months	129.14	3.96	128.94	3.96	129	3.93
		BMI	18.02	2.77	18.37	3.02	19.12	3.56
		BMI z-score	0.24	1.08	0.37	1.12	0.6	1.2

S.D Standard Deviation ~ Data suppressed to prevent disclosure

Table 2: Univariable linear regression analysis of the association between change in BMI z-score between Reception and Year 6 in Hampshire school children and children's characteristics (n=18,733).

	Change in BMI Z-score	P Value	95% Confidence interval	
Reception Age In Months	0.01	0.04	0	0.01
Year 6 Age In Months	-0.01	<0.001	-0.01	-0.01
Sex Male (Reference)				
Female	-0.09	<0.001	-0.12	-0.07
Ethnicity				
White (Reference)				
Black	0.08	0.62	-0.23	0.39
Asian	0.26	<0.001	0.12	0.39
Mixed	-0.01	0.89	-0.07	0.06
Unknown	-0.01	0.48	-0.04	0.02
Home Deprivation Quintile				
1 Least Deprived (Reference)				
2	0.01	0.72	-0.03	0.05
3	0.07	0.001	0.03	0.12
4	0.11	<0.001	0.07	0.15
5 Most Deprived	0.16	<0.001	0.12	0.2
School Deprivation Quintile				
1 Least Deprived (Reference)				
2	0.03	0.116	-0.01	0.07
3	0.02	0.443	-0.02	0.05
4	0.12	<0.001	0.08	0.16
5 Most Deprived	0.1	<0.001	0.07	0.14
School OFSTED Status				
Outstanding (Reference)				
Good	0.09	<0.001	0.05	0.12
Requires Improvement	0.14	<0.001	0.09	0.18
Inadequate	0.09	0.14	-0.03	0.21
Academy	0.07	0.35	-0.08	0.22
Home Urban/Rural Setting				
Rural (Reference)				
Urban	0.02	0.31	-0.02	0.05
School Urban/Rural Setting				
Rural (Reference)				
Urban	-0.01	0.6	-0.04	0.02
Home and School IMD*				
Same (Reference)				
Different	0.02	0.08	0	0.05

*51% of children had the same home and school IMD Quintile

Table 3: Proportion of children in each 'change in BMI status' category between Reception and Year 6 in Hampshire school children (n=18,733)

Change in BMI Status	Proportio	% Confidence interv	
Maintained a healthy weight	63.7	62.96	64.34
Remained overweight	3.1	2.88	3.38
Remained obese	5.3	4.97	5.61
Became overweight	8.3	7.94	8.73
Became obese	10.3	9.83	10.7
Became a healthier weight	9.4	8.95	9.78

Table 4: Multivariable linear regression analysis of the association between home and school based deprivation quintiles with change in BMI z-score between Reception and Year 6 in Hampshire school children (n=18,733).

		Home IMD Quintile				School IMD Quintile			
		Change in BMI z-score	95% Confidence interval		P. Value	Change in BMI z-score	95% Confidence interval		P. Value
Model 1*	Quintile 1 (Least Deprived)- Reference								
	Quintile 2	0.01	-0.03	0.05		0.03	-0.01	0.07	
	Quintile 3	0.07	0.03	0.11		0.02	-0.02	0.05	
	Quintile 4	0.11	0.07	0.15		0.12	0.08	0.16	
	Quintile 5 (Most Deprived)	0.16	0.12	0.20		0.10	0.07	0.14	
					<0.001				<0.001
Model 2**	Quintile 1 (Least Deprived)- Reference								
	Quintile 2	0.00	-0.04	0.03		0.01	-0.04	0.06	
	Quintile 3	0.06	0.01	0.11		-0.02	-0.06	0.03	
	Quintile 4	0.08	0.02	0.13		0.06	-0.01	0.13	
	Quintile 5 (Most Deprived)	0.13	0.08	0.19		0.00	-0.07	0.06	
					<0.001				0.54

* Unadjusted

** Adjusted for child age, sex, ethnicity, school Ofsted status, school/home IMD quintile

Standard errors were adjusted for clustering of children within schools

Table 5: Characteristics of dataset two by home-based deprivation quintiles in Reception year of Hampshire school children (n=6,153)

		Hampshire home-based deprivation quintiles (reception)					
		1 (least deprived)		2,3 and 4		5 (most deprived)	
		n= 972		n=3,786		n= 1,395	
Categorical Variables		**number**	**%**	**number**	**%**	**number**	**%**
Ethnicity							
	White	549	56.48	2135	56.39	876	62.8
	Black	~	~	5	0.13	~	~
	Asian	~	~	37	0.98	~	~
	Any mixed background	54	5.56	140	3.7	64	4.19
	Unknown	357	36.73	1469	38.8	440	31.54
Home Rural/Urban status							
	Urban	713	73.35	3039	80.27	1216	87.17
School Rural/Urban status							
	Urban	735	75.62	2970	78.45	1279	91.68
School OFSTED Status							
	Outstanding	200	20.58	623	16.46	160	11.47
	Good	636	65.43	2429	64.16	904	64.8
	Requires Improvement	124	12.76	663	17.51	296	21.22
	Inadequate	~	~	52	1.37	27	1.94
	Academy	~	~	19	0.5	8	0.57
Sex							
	Male	532	54.73	1951	51.53	692	49.61
Continuous variables		**Mean**	**S.D**	**Mean**	**S.D**	**Mean**	**S.D**
Baseline (Reception)							
	Age in months	60.19	2.35	60.17	2.36	60.19	2.34
	BMI	16.12	1.31	16.13	1.45	16.23	1.47
	BMI z-score	0.35	0.86	0.34	0.93	0.41	0.95
Follow-up (Year 6)							
	Age in months	128.89	3.93	129.17	3.93	129.2	4.02
	BMI	18.34	2.83	18.49	3.11	18.75	3.3
	BMI z-score	0.39	1.09	0.41	1.13	0.48	1.15

S.D Standard Deviation ~ Data suppressed to prevent disclosure