Healthy school meals and Educational Outcomes

Michèle Belot

Nuffield College

University of Oxford

Jonathan James

Department of Economics

University of Essex

April 2010

This paper provides field evidence on the effects of a diet on educational outcomes, exploiting a campaign lead in the UK in 2004, which introduced drastic changes in the meals offered in the schools of one Borough – Greenwich - shifting from low-budget processed meals towards healthier options. We evaluate the effect of the campaign on educational outcomes in primary schools using a difference in differences approach; comparing educational outcomes in primary schools (key stage 2 outcomes more specifically) before and after the reform, using the neighbouring Local Education Authorities as a control group. We find evidence that educational outcomes did improve significantly in English and Science. We also find that authorised absences – which are most likely linked to illness and health - fell by 14%.

Keywords: Child nutrition, Child health, School meals, Education, Natural Experiment

JEL-codes: J13, I18, I28, H51, H52

"Mens Sana in Corpore Sano"

(A Sound Mind in a Sound Body)

Juvenal (Satire 10.356)

1. Introduction

Children's diet has deteriorated tremendously over the last decades, and has become a major source of preoccupation in developed countries, in particular in view of the rising rates of obesity among young children, observed across almost all developed countries.[1] According to the World Health Organization (2002), nutrition is related to five of the ten leading risks as causes of disease burden measured in DALYs (Disability Adjusted Life Years) in developed countries, i.e. high blood pressure, cholesterol, overweight (obesity) and iron deficiency.[2] Children's diet is a preoccupation not only because of the possible direct effects on health outcomes, but also because it may affect the ability to learn – a poor diet may result in deficiencies in those nutrients playing an essential role in cognitive development (see Lambert et al. (2004)). A number of studies point at the significant and *immediate* effect of diet on behaviour, concentration and cognitive ability; as well as on the immune system, and therefore the ability to attend school (see Sorhaindo and Feinstein (2006) for a review).

This study investigates whether and to what extent healthy food matters for learning and for educational outcomes. We exploit a unique "natural experiment" in the UK – the "Feed Me Better" campaign conducted in 2004-2005 by the British Chef Jamie Oliver and aimed at improving the nutritional standards at school. The campaign was designed and implemented as a large-scale experiment and therefore offers a unique opportunity to assess the effects of diet on educational outcomes. Drastic changes to school menus were introduced in all 80 schools of one borough – Greenwich – the idea being that these schools would then serve as examples for the rest of the country.

[1] For example, in the UK, 15% of children aged 2 to 10 were classified as "obese" in 2006, compared to 10% only 10 years ago (Health Survey for England)

[2] A number of studies provide quasi-experimental evidence of a causal relationship between diet and obesity (Whitmore (2005), Anderson and Butcher (2006a, 2006b)), and in particular between the availability of junk food at school on children's obesity.

School meals are of major importance in British schools. About 45% of school kids in primary and secondary schools eat school lunches every day[3]. School meals are therefore an obvious instrument for policy intervention in children's diet. In addition, school meals are part of a means-tested programme. Children from less privileged backgrounds receive school meals for free. In 2006, around 18% of the entire pupil population was eligible for the free school meal programme.[4] Hence, school meals provide a direct way for policy-makers to possibly reduce disparities in diet between children from more and less privileged socio-economic backgrounds, which in turn could contribute to reduce differences in educational outcomes. School meals seem also to be more important now than in the past because children rely more on food provided at school now than three decades ago. For example, Anderson, Butcher and Levine (2003) show that increases in maternal employment rates in the US have been associated with an increase in obesity rates, which they attribute partly to the decrease in the consumption of home cooked meals.

Using pupil and school-level data from the National Pupil Database (NPD) and from the School census covering the period 2002-2007, we evaluate the effect of the campaign on educational outcomes and on absenteeism in primary schools using a difference in differences (DD) approach; comparing educational outcomes (key stage 2 outcomes more specifically) before and after the reform, using neighbouring Local Education Authorities as a control group.

We find that the campaign coincided with an improvement in educational achievements. The proportion of children reaching level 5 or above increased relatively by 3 percentage points in Maths, 6 percentage points in English and 8 percentage points in Science. The proportion of children reaching level 4 of above increased by 3 percentage points in English and Maths, and by 2 percentage points in Science. However, the estimates are not very precise - we cannot exclude small positive effects. Next to these educational outcomes, we find clear evidence that *authorised* absences (which are more likely to be linked to sickness) dropped by 14% on average in Greenwich relatively to other LEAs. Interestingly, we find no such effect on *unauthorised* absences (less likely to be linked to sickness).

[3] Source: School Food Trust.

[4] See appendix for details of eligibility criteria

The critical issue of course is whether these estimated effects can plausibly be attributed to the Feed Me Better campaign. The campaign was designed as an experiment but it was not a randomised experiment. Also, the campaign generated media attention, which in itself could drive part of the changes. We consider systematically a number of alternative mechanisms that could explain the results: A Hawthorne effect (due to the publicity of the campaign), a selection effect (and in particular cross-LEA mobility) and, finally, other relevant changes in school inputs. Overall, we find no evidence supporting of any of these alternative explanations and conclude that the Feed Me Better campaign is the most plausible explanation for the observed changes.

Our results also show that the changes have been more pronounced among some groups of pupils than others. Specifically, the improvement in test scores is more pronounced among girls than boys and among children from middle and high socio-economic status. The second effect is not necessarily expected, because children from lower socio-economic status receive school meals for free and are therefore more likely to have been affected by the changes in menus. But these findings are in line with the evidence on the effect of interventions aimed at improving children's diet on health outcomes. More specifically, there is a bulk of evidence (Mueller et al., 2005, Perry et al., 1998, Kedler, 1995, Plachta-Danielzik et al., 2007) showing that interventions targeted at reducing the prevalence of obesity among children are also more effective for girls than boys, and for children from higher socio-economic status. The effects on boys and children from lower-socio economic status are more pronounced if we consider a *longer* horizon – two years after the intervention.

The paper is structured as follows. Section 2 discusses the existing evidence in the literature on the relationship between nutrition and educational outcomes. Section 3 describes the background of the "Feed me Better" campaign. Section 4 presents the data and descriptive statistics and Section 5 presents the results of the empirical analysis. Section 6 concludes.

2. Related literature

Despite the importance of the subject in the public and policy arenas, there are only a limited number of studies on the causal effect of children's diet on educational outcomes. The medical literature has carried out a number of studies on the relationship between diet and behaviour, concentration and cognitive ability. Sorhaindo and Feinstein (2006) provide a review of this literature. They mention four different channels through which nutrition may affect the ability to learn. The first channel is through physical development. A poor diet leaves children susceptible to illness and in turn, greater illness results in more days of absence and thereby a decrease in teacher contact hours. The second channel is through cognition and the ability to concentrate. Numerous studies have found a link between diet and the ability of children to think and concentrate. In particular deficiencies in iron can have an impact on the development of the central nervous system and also cognition in later life. Sorhaindo and Feinstein (2006) point out that the effects of diet on children's school performance are relatively immediate. The third channel mentioned in their review is behaviour. For example, there is a causal link between a deficiency in vitamin B and behavioural problems; particularly related to aggressive behaviour. McCann et al. (2007) find that artificial colouring and additives resulted in increased hyperactivity in 3-year-old and 8/9 year old children in the general population. Some studies even establish a link between diet and anti-social, violent and criminal behaviour (see Benton (2007) for a review), in particular the omega-3 fatty acid DHA decreased hostility and aggression. Behavioural problems could also spill-over on other pupils in the classroom through peer effects. The research in this area is more limited. Finally, the last channel mentioned is through school life and in particular difficult school inclusion due to obesity. Overall, the conclusion one can draw from the medical literature (see also Bellisle (2004)) is that a well balanced diet is the best way to enable good cognitive and behavioural performance at all times.

Economists have recently devoted more attention to the determinants and effects of obesity and child obesity in particular. Anderson and Butcher (2006a) review the literature investigating the possible reasons underlying the rise in child obesity. They conclude that there does not seem to be one single determining factor of the rise, rather a combination of factors. Interestingly, they do point at the important changes

in the school environment, such as the availability of vending machines in schools as a possible factor triggering calories intake and thereby obesity. One study they have carried out (Anderson and Butcher (2006b)) link school financial pressures to the availability of junk food in middle and high schools. They estimate that a 10 percentage point increase in the provision of junk food at school produces an average increase in BMI of 1 percent, while for adolescents with an overweight parent the effect is double. Effects of this size can explain about a quarter of the increase in average BMI of adolescents over the 1990's. Whitmore (2005) evaluates the effects of eating school lunches (from the US based National School Lunch Program) on childhood obesity. She uses two sources of variations to identify the effect of eating school lunches on children's obesity. First, she exploits within-individual time variation in school lunch participation and, second, she exploits the discontinuity in eligibility for reduced-price lunch – available to children from families earning less than 185 percent of the poverty rate – and compares children just above and just below the eligibility cut-off. She finds that students who eat school lunches are more likely to be obese. She attributes this effect to the poor nutritional content of lunches and concludes that healthier school meals could reduce child obesity.

There are a number of studies studying the effects of diet on educational outcomes. Some document correlations between *malnutrition* and educational outcomes (see Pollitt (1990), Behrman (1996), Alderman et al. (2001), Glewwe et al. (2001)), but most of this literature concentrates on developing countries (and therefore on malnourishment rather than poor eating habits), and few of them are able to establish a *causal* effect, i.e. they do not have a source of exogenous variation in nutritional habits. There are a couple of studies of small-scale interventions in the US. Kleinman et al. (2002) and Murphy et al. (1998) study the effects of an intervention providing free school breakfasts and found evidence of a positive effect on school performance. However, the evidence is limited to small-scale interventions.

A recent study by Figlio and Winicki (2005) finds that schools tend to change the nutritional content of their lunches on test days. They present this as evidence of strategic behaviour of schools, which seem to exploit the relationship between food and performance as a way of gaming the accountability system. Using disaggregate data from schools in the state of Virginia, they find that those schools who are most at

risk of receiving a sanction for not meeting proficiency goals, increase the number of calories of school lunches on test days. This strategy seems to be somewhat effective, with significant improvements in test scores for examinations that took place after lunch (mathematics and English). However, they argue that these changes are targeted at immediate and short-lived improvements in performance based on an increase of the number of calories and glucose intake rather than a long-term strategy aimed at providing a healthier and balanced diet to children.

3. Background: School Meals and the "Feed Me Better" Campaign

School meals in England[5]

School meals were introduced at the beginning of the 20th Century in England following a rising concern about severe malnutrition of children attending school. After the Second World War, the policy shifted from providing food to malnourished children to providing meals for all children. Nutritional standards were established in 1941 covering energy, protein and fat. In 1980, the obligation to meet any nutritional standards was lifted. Local Authorities had discretion on the price, type and quality of meals they provided. It was not until 2001 that compulsory minimum nutritional standards were reintroduced. These standards were relatively low though and hardly enforced. A survey conducted by Nelson et al. (2006) in the year 2005 (April to June) in England show that only 34 of the sampled 146 primary schools met all the compulsory nutritional standards. The two standards most commonly failed were "starchy food cooked in oil or fat to be available no more than three times a week" (failed by 53% of lunch services) and "fruit-based desserts to be available twice a week" (failed by 33%). The study finds that the most popular food choices among children were desserts, cakes, biscuits and ice cream (78% of pupils). Higher fat main dishes were chosen by nearly twice as many pupils (53%) as lower fat main dishes (29%), the same was true for chips and other potatoes (chosen by 48% of pupils) in comparison to potatoes not cooked in oil or fat (25%).

Overall, less than 50% of consumed meals met Caroline Walker Trust Nutritional guidelines for school Meals (guidelines for a balanced diet set by an expert working

[5] Nelson et al. (2004) and Nelson et. (2006) provide an extensive report on school meals in primary and secondary schools in England, based on a survey across a representative sample of schools and pupils.

group) for essential nutrients such as Vitamin A, folate (B vitamin), calcium, iron, percent of energy from fat and from saturated fat.

The "Feed me Better" Campaign

The British Chef Oliver started the campaign "Feed me Better" in 2004, drawing attention to the poor quality of meals offered in schools. The campaign was publicised through a TV documentary broadcast in February 2005 on one of UK channels (Channel 4). The programme featured mainly one school in Greenwich (Kidbrooke secondary school), the first school where the changes were implemented. Oliver's initial aim was to show that he could produce a meal within the budget and this school provided as a pilot for the rest of the borough. Then the idea of the campaign was to drastically change the school meal menus in all schools of the whole borough of Greenwich, as an "experiment" that would serve as an example for the rest of the country.

Typically, the Local Education Authorities are in charge of allocating a budget to schools. Schools have contractual agreements with catering companies – the largest one in the UK at the time was Scholarest. These contracts are long-term contracts and short-term changes to menus are very difficult to implement. Oliver obtained the agreement of the Council of Greenwich to change the menus (provided the menus would stay within budget). The large majority of schools in the Greenwich area switched from their old menus to the new menus in the school year of 2004-2005. Before the campaign, school meals were mainly based on low-budget processed food. In the Appendix, we provide an example of menus as they were before and after the Feed Me Better Campaign.

The campaign mobilised a lot of resources, involved retraining the cooks (most cooks participated to a three-day boot camp organised by the Chef) and equipping the schools with the appropriate equipment. In September 2004 at the start of the autumn term Oliver hosted an evening for all the head teachers in which they were invited to take part in the experiment. 81 of the 88 head teachers signed up. The aim was to substitute all junk food with healthy alternatives .The scheme was rolled out gradually across the borough, five schools at a time. By February 2005, more than 25 schools

had removed all processed foods and implemented the new menus.[6] The roll out had taken place fully by September 2005 with 81 of the 88 schools taking part in the scheme, with those unable to participate due to lack of kitchen facilities.

As part of the experiment the council increased the investment specifically into school meals: an initial increase in the school food budget by £628,850 was agreed in the February 2005 budget going to cover the cost of the extra staff hours that were needed for the preparation of the meals, equipment costs and promotion to the parents. By September 2007 a total £1.2 million had been invested in the experiment[7].

Despite the initial difficulties of implementation, the evaluation of the campaign has been quite positive. The website of the "Heath Education Trust"[8] for example mentions the following reactions: The Head teacher of Kidbrooke School said, "*Because the children aren't being stuffed with additives they're much less hyper in the afternoons now. It hasn't been an easy transition as getting older children to embrace change takes time*". One classroom teacher commented: "*Children enjoy the food and talk about it more than they did in the past. They seem to have more energy and can concentrate for longer*."

We have some information on the nutritional content of the meals offered to the children before the changes, although only through the TV programme. A nutritionist was asked to analyse a sample of the pre-campaign meals. The meals were lacking fruit and vegetables, and the meat/fish was reconstituted, rather than fresh. Overall, the meals were lacking in basic nutrients, such as iron and vitamin C. Furthermore, the reform included removing all junk food.

4. Data, sample and descriptive statistics

4.1 Data and Sample

We investigate the effects of the campaign on three outcome variables: Educational outcomes, absenteeism and free school meal take-up rates. We limit our analysis to primary schools, for two main reasons: 1) The recent economic literature has pointed

[6] In the pilot school of Kidbrooke, the healthy meals were initially being put alongside the original junk food. In most cases children preferred to stick to the junk food rather than opting for the healthy meals. This was not the case when the scheme was rolled out across the borough.

[7] Source: www.greenwich.gov.uk

[8] Source: http://www.healthedtrust.com/

to the importance of interventions in early childhood[9], 2) primary school children are typically not allowed to leave the school during lunch time, while secondary children are. Therefore, primary school children are less likely to have been able to substitute for school meals by alternative food (such as buying junk food in neighbouring outlets). Since the number of junk outlets per secondary school is 36.7 on average in the Inner London area[10], it is more challenging to identify with certainty the treated group.

We use detailed individual data from the National Pupil Database (NPD), which matches information collected through the Pupil Level Annual Schools Census (PLASC) to other data sources such as Key Stage attainment. Our empirical analysis follows closely Machin and McNally (2008). We use individual pupil data for the analysis of educational achievements and we use school level data for the analysis of absenteeism and free school meal take-up since this information is not available at the individual level for these two variables.

The NPD contains information on key pupil characteristics such as ethnicity, a low-income marker and information on Special Education Needs (SEN), that we have matched with Key Stage 2 attainment records.

Our first variable of interest is performance at the end of Key Stage 2, which corresponds to the grades 3 to 6 in England. All pupils take a standardized test at the end of the Key Stage (in year 6, typically at the age of 11). The test has three main components: English, Maths and Sciences. We will consider these three components separately.

Our second outcome measure is absenteeism at the school level, measured by the percentage of half days missed (the data has been extracted from the DCSF publication tables)[11]. We have two levels of absenteeism, authorised and unauthorised. Authorised absences are absences permitted by the school. This is

[9] Heckman et al. (2006) who stresses the importance of early interventions even before the children enter school.

[10] Source: School Food Trust; Inner London includes: Hammersmith and Fulham, Kensington and Chelsea, Westminster, Camden, Islington, City, Hackney, Tower Hamlets, Soutwark, Lambeth, Wandsworth, Lewisham and Greenwich; the number is calculated by dividing the total number of outlets in the area by the number of secondary schools in that area.

[11] Source: http://www.dcsf.gov.uk/performancetables/

typically, although not exclusively, because of illness. Unauthorised absences would in most cases include no illness based absences. Hence although we do not have any direct measures of health, authorised absenteeism is our closest proxy.

Finally, we investigate the effect of the campaign on take-up rates of school meals, for children who are eligible for free school meals (provided by the DCSF). There is no public information available on the take-up rate for all children, so this measure is the closest indicator we have to assess the effect of the campaign on take-up.

Control group areas should be chosen carefully. The campaign was implemented in one borough only, the idea being to use this as an experiment for the whole country. Of course, Greenwich has specific characteristics. It is in the neighbourhood of London and it is a relatively poor area. It was selected because of its relatively high rates of obesity.

There are potentially a large number of possible controls though: LEAs that are located in the inner London area and resemble Greenwich in terms of key indicators of health and socio-economic characteristics. Using information on local neighbourhood statistics, we selected five LEAs for our main control group: Lambeth, Lewisham, Southwark, Tower Hamlets and Newham, all located in the close vicinity of Greenwich. We selected an additional group of seven LEAs to serve as robustness control group: Wandsworth, Bexley, Croydon, Kingston, Merton, Richmond and Sutton. These seven LEAs are also in the close vicinity of Greenwich but present more dissimilarities with Greenwich in terms of socio-economic indicators, so we do not include them in our main control group. Figure 1 shows the exact geographical location of these LEAs.

Table 1 presents summary neighbourhood statistics of the LEAs forming the main control group and Table B1 presents the same statistics for the other seven LEAs. Rates of obesity are relatively high in Greenwich; around 20% of the adult population is classified as obese. These rates are similar to those observed in other areas in our main and extended control groups. The other LEAs are also very similar in terms of their smoking rates, binge drinking rates and rates of fruit and vegetable consumption. Importantly, the indicators of Greenwich are not systematically below or above the

other LEAs. Life expectancy rates are also very similar compared to the main control group, and slightly lower than the extended controls.

The control LEAs were also selected for their similarities in terms of socio-economic indicators. Long-term unemployment, percentage of households living in social housing and percentage of children eligible for free school meals are comparable in the LEAs of the main control group and in Greenwich. These indicators are more favourable in the extended control group. Education levels (in 2001) of those of a post-compulsory schooling age – capturing the education level of the adult age population including parents of pupils – are also comparable. Greenwich appears to be in the middle of our main control group. The only indicator showing a dissimilarity between Greenwich and the control group is the proportion of white people, which is higher in Greenwich. On the other, it is close to the proportion of white people in the extended control group LEAs.

We conduct the main analysis with the smaller control group. We conduct a robustness analysis with the extended control group in Section 5.2 e.

We concentrate the analysis on the school years from 2002 to 2007, and exclude the year 2005, because changes in menus were introduced in the course of the year 2004-05. Note that we do not have information about the exact timing of these changes in each school and even if we would have this information, differences in timing are unlikely to be exogenous. Thus, we chose to exclude the whole school year 04-05 from the analysis.

4.2 Descriptive statistics

Tables 2a, 2b and 2c compare control and treatment schools on a number of observable characteristics of the pupil population, as well as educational outcomes, before and after the campaign. Because the experiment was not a randomized experiment by design, it is important to describe carefully differences between control and treatment group areas. Of course we have chosen the control LEAs for their close resemblance to Greenwich, but nevertheless, it is worth describing carefully the similarities and differences between control and treatment groups before turning to the analysis.

First, regarding the individual pupil characteristics (Table 2a), we see that the socio-economic indicators (IDACI score and free school meal eligibility rates) are relatively comparable in Greenwich and non-Greenwich areas. The IDACI (Income Deprivation Affecting Children Index) is an indicator measuring the percentage of children living in low income households based upon their postcode. Greenwich scores slightly lower on both indicators. The share of children with "some special need"[12] is relatively comparable across treatment and control groups, although the score is slightly lower in Greenwich than in control areas. The numbers of pupils in year group and the pupil/teacher ratio are also comparable on average. There are two notable differences worth pointing out though: The share of non-white children is much lower in Greenwich and the share of children with English as first language is higher in Greenwich. This specific difference will be alleviated in the robustness analysis with the extended control group.

Turning to how these variables changed over time, we see some compositional changes both in Greenwich and non Greenwich areas. First, the percentage of pupils with English as first language decreased and the percentage of non-white pupils increased, as we will see both characteristics are associated with lower educational achievements. The difference in differences (before and after 2005, and comparing Greenwich and non-Greenwich areas) is not statistically significant though. Nevertheless we should keep these trends in mind when discussing the results. It will be important, for example, to see how controlling for these variables helps explaining relative changes in outcomes.

There is a significant difference in differences in two variables though, which is the pupil/teacher ratio and the average number of pupils in year group. The number of pupils falls both in Greenwich and non-Greenwich areas, and falls relatively more in Greenwich. On the other hand, the pupil/teacher ratio - number of pupils per teacher - falls both in Greenwich and non-Greenwich areas, but more so in non-Greenwich areas. Thus even though the number of pupils falls relatively more in Greenwich over

[12] "Some Special Need" refers to a form of learning difficultly that has been officially noted by the school, the most severe cases leads to a statement of that need which gives parents legal right to more help for their children, see http://www.direct.gov.uk/en/Parents/Schoolslearninganddevelopment/SpecialEducationalNeeds/DG_4000870 and http://www.direct.gov.uk/en/Parents/Schoolslearninganddevelopment/SpecialEducationalNeeds/DG_4008600

this period of time, the average class size is not falling as much in Greenwich than in other areas. This is important as it serves as an indication of changes in school policies that might be relevant to explain changes in educational outcomes. We will come back to this point later in the analysis.

Turning to educational outcomes, we present summary statistics regarding the raw test Key stage 2 scores, the percentile scores and the percentage of children reaching level 3 or above, level 4 or above, or 5 and above. If we first consider raw test scores, we see a remarkable similar trend in Greenwich and non-Greenwich areas over the period 2002-2005: for English and Science, there is a negative trend, and then an improvement in 2005. The post-2005 trends differ somewhat. For Maths, we see a gradual steady improvement in raw test scores over the whole period. The similarity of pre-2005 trends is reassuring and offers an additional validity test for the suitability of these LEAs as control groups. Turning to the percentile scores, which provide a direct indication of how the relative position of Greenwich might have changed in comparison to other LEAs, we observe the same pattern across all subjects: The relative position deteriorated up to 2004, then improved in 2005 (where Greenwich schools were above the median), improved further in 2006 and fell back somewhat in 2007.

Next to educational outcomes, we also look at authorised and unauthorised absenteeism. Again the pre-2005 trend are similar in Greenwich and non-Greenwich areas, both seem to decrease overall over the entire period.

Finally, the last outcome we consider is free school meal take-up. Again, we see similar trends both in control and treatment groups.

We now turn to the econometric analysis. The objective is first to identify whether there are *significant* differences in the changes of educational achievements, absenteeism and free school meal take up that are specific to Greenwich and, second, to investigate whether these changes can be plausibly attributed to the campaign or not.

5. Analysis

5.1 . *Effect on educational outcomes*

a) Before and after analysis

We start the analysis with a set of regressions on the sample of Greenwich schools only. The goal is to get a better sense of the trends that may be present in Greenwich and in particular get a sense of how the changes in observable characteristics of the pupil population may help explaining the changes in educational outcomes.

We consider raw scores and percentile scores again. Table 3 reports coefficients corresponding to a linear time trend and a dummy interacting Greenwich with the period post-campaign (2006-2007). Since the program was implemented *in the course* of 2004-2005, we exclude this year to avoid misclassification. Each column includes systematically more controls, first school fixed effects, then individual characteristics and, finally, school level year group characteristics. For English and Science, we observe a negative time trend overall, both in raw scores and percentile scores, but the coefficient of the intervention dummy (post 2005) is always large, positive and significant. Controlling for individual and year group characteristics changes little to the estimated coefficients.

For Maths, we observe a positive trend in raw scores but a negative trend in percentile scores. The post-2005 dummy only becomes significant when controlling for individual and year group characteristics. This is suggestive evidence of negative selection in observables – that is – the profile of the pupil population became less favourable for performance in maths (it is only suggestive because the coefficients are not significantly different from each other across specifications). These results are important because they show there is little indication of a *positive* selection in observables over the period under consideration.

Overall, the conclusion from this exercise is that there is evidence of an improvement in test scores after the campaign, in particular relatively to the control group, and this seems to have little to do with changes in the composition of the pupil population. We now turn to the difference in differences analysis.

b) Difference in differences analysis

As in Machin and McNally (2008), we estimate a difference-in-differences model on individual outcomes. We estimate the following model:

$$Y_{islt} = \alpha + \beta\ Greenwich_l + \gamma\ Greenwich_l * Post\text{-}2005_t + X_{ist}'\delta + \lambda Z_{st} + \pi_t\ T_t + \rho_l t + \varepsilon_{ist}$$

where Y_{islt} denotes the outcome variable for pupil *i* in school *s* and LEA *l* ; Greenwich is a dummy variable equal to 1 for the LEA of Greenwich and 0 for the five neighbouring LEAs; Post-2005 is a dummy variable equal to 1 for school years 2004-05, 2005-06 and 2006-07 and 0 for school years 2001-02, 2002-03, 2003-04, *X* is a vector of pupil characteristics, *Z* is a vector of average characteristics corresponding to the year group taking part to the Key stage 2 exam; T is a set of yearly dummies; and ε_{ist} is an error term. In addition to the Machin and McNally (2008) specification, we also allow for LEA specific trends (captured by the parameters ρ_l).

γ is our main parameter of interest. It shows how pupil performance changed in Greenwich schools in comparison to other LEAs. If the campaign had a positive effect on diet and performance, we should find a positive coefficient. It is important to note that only part of the pupils included in the analysis has truly been treated by the campaign: those who actually eat school meals and experienced a change in diet because of the campaign. Unfortunately, we do not have individual information about who is eating school meals and who is not – thus our estimates are at best a measure of the effects of the "intention-to-treat" and are likely to be a lower bound on treatment effects. As we mentioned earlier, 45% of the children eat school meals at school.

We start reporting the results regarding the percentile scores in all three subjects (Tables 4, 5 and 6). Our main coefficient of interest is the interaction between Greenwich and post-2006. We also report the coefficients of the variables capturing individual and year group characteristics. This helps identifying whether they matter or not, and whether they can explain the relative changes in educational achievements.

The results essentially confirm the previous findings. In the absence of any controls or trend, the intervention dummy is either slightly negative or close to zero. But the

coefficient becomes strongly positive and significant once we control for LEA-specific time trends, LEA dummies and year dummies. The relative improvement in percentile score is about 6 percentage points in English, 3 percentage points in Maths and 4.5 percentage points in Science. Again, the estimated coefficients remain remarkably similar when we control for individual and year group characteristics. Thus, the positive coefficient of the intervention dummy cannot be attributed to relative changes in observable characteristics of pupils.

Overall the results so far show some evidence that educational outcomes improved in the Greenwich area relatively to other neighbouring LEAs. The estimated coefficients are relatively high, but so are the standard errors. Thus, a careful conclusion is to note there is evidence pointing in the direction of a positive effect correlated with the timing of the campaign.

We now turn to a more detailed analysis, looking at how the probability of reaching different "levels" has changed in Greenwich in comparison to other LEAs. Levels are an ordinal measure corresponding to test scores, level 4 is the target level recommended by policy makers. Looking at different levels also allows us to identify whether the effects are concentrated in some parts of the distribution of pupils. We look at 3 dummy variables indicating whether the pupil has reached (1) level 3 or above, (2) level 4 or above and (3) level 5 or above. The results are reported in Table 7. We only report the coefficient of the intervention dummy since the coefficients of the other variables bring no additional insight. The results show that the improvements seem to be more concentrated among the higher levels: the proportion of children reaching level 5 or above increased relatively by 3 percentage points in Maths, 6 percentage points in English and 8 percentage points in Science. The proportion of children reaching level 4 of above increased by 3 percentage points in English and Maths, and by 2 percentage points in Science. On the other hand, we see no significant change in the proportion of pupils reaching level 3 or above. These effects suggest that the campaign had larger effects on pupils at the middle or top end of the test score distribution.

Heterogeneous effects

There is a bulk of evidence (Mueller et al., 2005, Perry et al. (1998), Kedler (1995), Plachta-Danielzik et al. (2007)) showing that interventions targeted at reducing the prevalence of obesity among children are more effective for some groups of children than others: Girls are more responsive than boys, and children from higher socio-economic status are more responsive than children from lower socio-economic status. We investigate whether there are similar heterogeneous effects here.

We first investigate whether the changes in educational outcomes differ between girls and boys. We interact the intervention dummy with the gender of the child. The results are presented in the bottom panel of Table 8. There is some evidence supporting the hypothesis that girls have been more affected than boys. The coefficient is indeed larger and positive for girls than for boys, although the difference is significant at conventional levels only for Maths.

The second individual characteristic we conjecture might have interplayed with the campaign is free school meal eligibility status.[13] 36% of children in Greenwich and 40% in the control LEAs are eligible for free school meals (Table 2). Predicting how free school meal status may have interplayed with the effects of the campaign is not straightforward though. On the one hand, free school meal status is the only variable measuring socio-economic status directly. Since lower socio-economic status has been found to be correlated with poorer dietary habits (see for example Johannson et al (1999)), and since interventions have been found to be more effective among higher socio-economic children (see for example Mueller (2007)), similar effects could be expected here in terms of educational outcomes. On the other hand, free school meal children are more likely to have been "treated" since they receive school meals for free, Their take-up rates are likely to be higher than the take-up rates of other children. Note that *eligibility* does not mean *take-up* or actual *consumption* of the meal. We have information on free school meal take-up rates at the school level – and we will investigate the effects of the campaign on these take-up rates in the next section – but

13 Free school meals eligibility criteria: Parents do not have to pay for school lunches if they receive any of the following: Income support, income-based Jobseeker's Allowance, support under Part VI of the Immigration and Asylum Act 1999, Child Tax Credit, provided they are not entitled to working tax credit and have an Annual income (as assessed by HM Revenue & Customs) that does not exceed £15,575, the Guarantee element of State Pension Credit.

we do not have information on the take-up rates (or actual consumption) of those who are not eligible for free school meals. Nevertheless, it seems reasonable to assume the FSM take-up rates are higher than the non-FSM take-up rates.

The bottom panel of Table 8 presents DD estimates when we split the sample according to the free school meal status. We find that most of the positive significant effects decrease or disappear entirely for the FSM children. That is, the children who improve their test scores most are those from more favourable socio-economic backgrounds. If those children are indeed less responsive, we might still expect to see positive coefficients over the longer term – when they had time to adjust to the new meals. To test for this hypothesis, we repeat the analysis excluding 2006. We find that the coefficients do indeed become larger for FSM children and some become significant. There is hardly change in the estimated coefficients for non-FSM children. We also distinguish between FSM girls and boys to see whether we find different effects across these two sub-groups. The results show again larger improvements for girls than boys. In fact, the coefficients are even negative for FSM boys in Maths and Science. If we exclude 2006, we find again that the coefficients are larger and more positive for girls, and the negative effects are attenuated or disappear for boys.

Overall these heterogeneous effects and differential effects over time are important to assess whether the campaign is a plausible candidate explanation for the observed changes. To summarise our results, we find that test scores have improved in Greenwich relatively to other LEAs, more so for girls than boys, more so for children from higher economic status and from the middle and top end of the test score distribution, and more so as time passed. All this in a context where there is no evidence of favourable relevant changes in the observable characteristics of pupils. These results provide good cues that the campaign is a plausible candidate. We now turn to the analysis of absenteeism, which should provide additional insight in that regard.

b) Effects on absenteeism

Regarding absenteeism, we have information at the *school level* on the percentage of authorised and unauthorised absences. Authorised absences are those that are formally

agreed by the school, thus most likely linked with sickness. We estimate a model at the school level, thus we do not control for *individual* pupil characteristics, but only for average individual characteristics at the year group level.

Table 9 shows the results of the DD analysis, both on the percentage of authorised an unauthorised absences. We find a large negative effect on authorised absences. The rate of absenteeism drops by about .60 percentage points, which corresponds to 14% of the average rate of absenteeism in Greenwich. On the other hand, we do not find a significant effect on unauthorised absences. Again, this asymmetric effect is noteworthy and consistent with the hypothesis that the changes in school meals had positive effects on health.

Note that the relative fall in absenteeism could in itself drive part of the improvement in educational outcomes, although obviously only a small part of the population of pupils has presumably been affected by this fall. We explore this hypothesis in Table 10, where we regress educational outcomes at the school level (percentile scores) on the intervention dummy and a number of control variables, including absenteeism or not. The coefficients remain very similar when we control for absenteeism, meaning that the relative improvements in educational achievements are not due to the change in absenteeism. This is maybe not so surprising given that the rates of absenteeism are low in absolute terms. It could be that for those children for whom absenteeism does change, the improvement in educational achievements is more substantial than for the others. Unfortunately, we are unable to identify those children in the pupil-level data.

c) Effect on take-up rates

We now examine changes in take-up rates of free school meals. As we mentioned earlier, we do not have information on whether children did indeed consume the meals or not – the anecdotal information we have points that children were far from enthusiastic at the beginning but did adjust relatively quickly to the new menus – nor do we have information on the overall take-up rates of school lunches. We do have, however, detailed information at the school level on the percentage of children taking up *free* school meals.

Changes in take-up rates are important to look at because, obviously, falling take-up rates would jeopardise the success of the campaign. On the other hand, it could be that improvements in the quality of the food encourage take-up.

We report the results in Table 11. We find no evidence of a relative change in take-up rates. Obviously, this does not mean that there has been no change in the actual consumption of school meals. But at least these results show that there was no change in the recorded take-up rates.

d) Robustness checks

To conclude the analysis, we conduct a number of robustness checks. Appendix B presents the results of the robustness analysis on Key Stage 2 scores and Appendix C presents the results of the robustness analysis on absenteeism. First, we conducted a placebo analysis attributing the role of treated successively to each LEA included in the control group (Tables B3-B10 and C1). The results we find are much less consistent. More precisely it is only in Greenwich that we find systematically and consistently positive DD estimates for Key Stage 2 scores and negative DD estimates for absenteeism. We find no such pattern in any of the other LEAs. Second, we conducted a placebo analysis by attributing the year of treatment successively to 2002-2003 and 2003-2004 (Tables B8-B9 and C2). None of the coefficients are significant when the treatment year is attributed to a placebo year. Finally, we considered a wider group of control LEAs, including LEAs that are not as close to Greenwich as the ones we selected for the main analysis[14]. Table B1 and B2 show the characteristics of these other LEAs. They are more similar in ethnic background but differ in the free school meal eligibility rate and the indicator of social deprivation (IDACI). Again, we find evidence of statistically significant relative improvements in test scores in English and Science, but the evidence of positive improvements in maths is weaker. The coefficients are positive but no longer significant. Regarding the effects on levels, we find that it is mostly the percentage of pupils passing level 4 or above in English and level 5 or above in Science that have increased. Overall these

[14] Lambeth, Lewisham, Southwark, Tower Hamlets, Wandsworth, Bexley, Croydon, Kingston upon Thames, Merton, Newham, Richmond, Sutton; see Figure 1.

results confirm the results found with the restricted group but the estimates are more conservative.

e) Alternative explanations

So far we have identified changes in educational outcomes and authorised absenteeism that are specific to Greenwich and are robust. We have also identified a number of asymmetric effects (across gender, free school meal status and time) that are consistent with the expected effects of the campaign. Of course they key issue is whether there could be alternative explanations for the observed changes. Specifically, we consider three obvious alternative explanations: a Hawthorne effect[15], positive selection in Greenwich or changes in school policies specific to Greenwich.

Hawthorne effect

The most obvious alternative explanation for the observed changes is a possible "Hawthorne-effect": The schools were obviously aware they were part of a pilot experiment and the campaign received a lot of media attention. Schools might have been particularly attentive to their outcomes while being under the public watch. Thus, we should worry that the effect we measure is due to a Hawthorne effect rather than an actual effect of the campaign. In that regard, we should point out that the media attention was very much focused on the health benefits of changes in meals and the problem of obesity rather than school performance. Also, we are looking at outcomes *more than a year* after the campaign and have excluded the year of the campaign itself and it seems implausible that school children would remain motivated

[15] From Gale (2004) on the Hawthorne effect: 'The story relates to the first of many experiments performed at the Hawthorne works of the Western Electric Company in Chicago from November 1924 onwards. The original aim was to test claims that brighter lighting increased productivity, but uncontrolled studies proved uninterpretable. The workers were therefore divided into matched control and test groups and, to the surprise of the investigators, productivity rose equally in both. In the next experiment, lighting was reduced progressively for the test group until, at 1.4 foot-candles, they protested that they could not see what they were doing. Until then the productivity of both groups had once again risen in parallel. The investigators next changed the light bulbs daily in the sight of the workers, telling them that the new bulbs were brighter. The women commented favourably on the change and increased their workrate, even though the new bulbs were identical to those that had been removed. This and other manoeuvres showed beyond doubt that productivity related to what the subjects believed, and not to objective changes in their circumstances. These at least seem to be the main facts behind the popular legend, although these particular experiments were never written up, the original study reports were lost, and the only contemporary account of them derives from a few paragraphs in a trade journal'. Levitt and List (2009) provide evidence that the Hawthorne effect was not as clear cut as was originally first thought

by this effect more than a year after the campaign has been implemented. Nonetheless, the setting gives us some scope to investigate the hypothesis of a Hawthorne effect. The campaign was part of a television programme broadcast on one of the major channels in the UK and some of the treated schools were explicitly mentioned in the TV broadcast. One could expect that for those schools, the Hawthorne-effect could be stronger than for others. However, there were only 7 schools explicitly mentioned in the programme, so we should be careful in interpreting the results as idiosyncratic changes in any of these schools will weigh more on the estimates.

We extend the analysis by adding an interaction term for those schools that were explicitly mentioned during the programme (note that some of them were just very briefly mentioned, there was no filming on location). We present the results in Table 12 for English, Maths and Science respectively. The interaction coefficient is significant and negative, indicating a disruption effect rather than a positive Hawthorne effect. This is consistent with the anecdotal evidence showing many initial problems in the schools that took on the scheme early on. The scheme was rolled out a bit differently over time, for example by organising a "food week" at the same time and tasting sessions for parents. Hence those later schools would have had a slightly different treatment than the early schools and the overall effects of the campaign could have been more beneficial. Since there are only few schools that were explicitly mentioned on TV, we do not wish to draw strong conclusions from these estimates. But we conclude that there is little evidence of a positive Hawthorne effect.

One additional legitimate concern regarding the implications of the publicity of the campaign is the possible spill-overs on other LEAs. This could not be an explanation for the changes we observe though since spill-overs would reduce the estimated effect of the campaign. Nevertheless, it seems legitimate to question how the campaign affected schools outside Greenwich. We have two comments in that regard. First, the campaign proved to be quite resource-intensive and not straightforward to implement – it involved re-training kitchen staff and improving the kitchen equipment. Other schools could not realistically have implemented similar changes at the same time. Second, schools are involved in long-term contracts with catering services and thus could not directly renegotiate menus and food provision. Nevertheless, it could be that

the campaign raised public awareness and this may have affected parental behaviour, possibly even at home. We have no indication that such changes have taken place but we lack objective measures in that regard – for example about diet at home. Nevertheless, if such changes had taken place, this would imply that our results provide a lower bound on the effects of diet on educational achievements.

Selection effects

A second plausible explanation for the observed changes is positive selection. As we discussed earlier already, there is little indication that any relevant selection took place in Greenwich in terms of observable characteristics. Controlling for observable characteristics had little impact on the estimated coefficients. If anything, the evidence pointed weakly in the direction of negative selection. Thus, a priori, it seems unlikely that a large positive selection in unobservables would have taken place.

It could be though that the new menus made Greenwich schools more attractive relative other LEAs. Mobility across LEAs could introduce a selection issue and bias our estimates if those children who move towards healthier schools are relatively better pupils in terms of educational performance and presence at school. We do not have data on the number of applications to primary schools but we do have information on the number of pupils and the profile of these pupils. If anything, we see a slight fall in the numbers of pupils and, as documented earlier, the evidence does not show an improvement in the socio-economic profile of pupils. Thus, the hypothesis that cross-LEA mobility did take place and is driving the results seems implausible.

School policies

The third plausible explanation for the observed changes would be a specific response of Greenwich schools – a change in policy that could explain improvements in educational outcomes. Given the deterioration in their relative position, it could be that Greenwich schools reacted in a specific way to raise educational achievements and lower absenteeism (to the extent they realised the deterioration in their relative position). A possible objective measure of whether changes might have taken place or not is to look at indicators of school inputs. If Greenwich schools attempted to improve their relative position, we would expect to see an increase in school inputs around that time. One of the most obvious inputs to look at is the pupil teacher ratio

(Table 2), which corresponds to the number of pupils per teacher. As we mentioned earlier, the ratio went down slightly over time, but more so in non-Greenwich areas than in Greenwich. That is, the average class size went down more in other areas than in Greenwich. Obviously, this is only one indicator of school policies – the only one we have – but it provides little evidence that Greenwich schools were putting in more additional resources to improve educational outcomes than other areas. On the contrary, because the number of pupils has been decreasing more in Greenwich than in non-Greenwich areas, the mechanical effect – holding the number of teachers constant - should have been a larger fall in the number of pupils per teacher, and we see the opposite trend.

Table 12 shows how the coefficients measuring the effects of the intervention dummy on educational outcomes change when we control for the pupil/teacher ratio. We see hardly any change. Thus, the changes in pupil/teacher ratio seem to have had little effects on educational outcomes.

To summarise our findings, the evidence is not supportive of plausible alternative explanations for the relative improvements in results observed in Greenwich. These relative improvements cannot be convincingly attributed to a Hawthorne effect or to cross-LEA mobility; positive selection seems unlikely and, finally, other relevant changes in school inputs also seem unlikely. On the other hand, we have identified notable asymmetries in the effects on educational achievements (according to gender, socio-economic status and time) and on absenteeism (authorised absenteeism fell in relative terms while unauthorised absenteeism does not), effects that are consistent with hypotheses regarding how such campaign might have affected pupils. Thus, the campaign appears to be the most plausible explanation for the observed changes.

g) Costs and benefits

The last exercise we propose is a back-of-the-envelope costs and benefits analysis. Note that since we do not have detailed information about health outcomes, our estimates probably provide also a lower bound on the *overall* benefits of the program. As indicated by the relative fall in absenteeism, it is likely that children's health improved as well, which could also have long-lasting consequences for the children

involved not only through improved educational achievements but also in terms of their life expectancy, quality of life, and productive capacity on the labour market. We can only provide an estimate of the long-term benefits accrued through better learning and better educational achievements. The effects we have identified are comparable in magnitude to those estimates by Machin and McNally (2008) for the "Literacy Hour". The "Literacy Hour" was a reform implemented in the nineties in the UK to raise standards of literacy in schools by improving the quality of teaching through more focused literacy instruction and effective classroom management. They found that the reform increased the proportion of pupils reaching level 4 or more in reading increased by 3.2 percentage points, an effect very similar to the effect we have estimated.

They calculated the overall benefit in terms of future labour market earnings using the British Cohort Study, that includes information on wages at age 30 and reading scores at age 10. They estimate the overall benefit of the reform to be between £75.40 and £196.32 (depending on the specification) per annum, and assuming a discount rate of 3% and a labour market participation of 45 years (between 20 and 65) implies an overall lifetime benefit between £2,103 and £5,476.

It is worthwhile discussing not only the benefits of the programs but also the costs. As we have mentioned earlier, the campaign lead to substantial increases in costs in terms of retraining the cooking staff, refurbishing kitchens and even the food costs have increased slightly as well. By September 2007, the council of Greenwich alone had invested £1.2 million in the campaign. About 28,000 school children in the county benefited from the healthy school meals, thus, the cost per pupil was around £43. The largest proportion of these costs was one-off costs (refurbishing kitchens, retraining staff), such that in the long-term, the long-term cost per pupil should be substantially lower. There is therefore no doubt that the campaign provides large benefits in comparison to its costs per pupil.

5. Conclusion

This paper exploits the unique features of the "Jamie Oliver Feed Me Better" campaign, lead in 2004 in the UK, to evaluate the impact of healthy school meals on

educational outcomes. The campaign introduced drastic changes in the menus of meals served in schools of one borough – Greenwich – and banned junk food in those schools. Since the meals were introduced in one Local Education Area only at first, we can use a difference in differences approach to identify the *causal* effect of healthy meals on educational performance.

Using pupil and school level data, we evaluate the effect of the reform on educational performance in primary schools; more precisely we compare Key Stage 2 test scores results before and after the campaign using neighbouring local education areas as a control group. We identify positive effects of the "Feed me Better Campaign" on Key Stage 2 test scores in English and Sciences. The effects are quite large: The proportion of children reaching level 5 or above increased relatively by 3 percentage points in Maths, 6 percentage points in English and 8 percentage points in Science. The proportion of children reaching level 4 of above increased by 3 percentage points in English and Maths, and by 2 percentage points in Science. We also find that authorised absences (which are likely to be linked to sickness) drop by 14% on average. These effects are particularly noteworthy since they only capture direct and relatively short-term effects of improvement in children's diet on educational achievements. One could have expected that changing diet habits is a long and difficult process, which would possibly only have effects after a long time, effects that would be hard to measure.

References

Alderman, H., Behrman, J., Lavy, V., and Menon, R. (2001) Child health and school enrollment: a longitudinal analysis, *Journal of Human Resources*, 36, 185–205.

Anderson P.M. and K.F. Butcher (2006a), Childhood Obesity: Trends and Potential Causes, *The Future of Children* 16(1), 19-45.

Anderson P.M. and K.F. Butcher (2006b), Reading, Writing, and Refreshments: Are School Finances Contributing to Children's Obesity? *Journal of Human Resources*, 41, 467-494.

Anderson, P.M., K.F. Butcher and P.B. Levine (2003), Maternal employment and overweight children, *Journal of Health Economics* 22(3), 477-504.

Behrman, J. (1996) The impact of health and nutrition on education. World Bank Research Observer, 11, 23–37.

Bellisle, F. (2004) 'Effects of diet on behaviour and cognition in children', *British Journal of Nutrition*, suppl. 2: S227-S232.

Bryan, J., Osendarp, S., Hughes, D., Calvaresi, E., Baghurst, K. and van Klinken, J. (2004), Nutrients for cognitive development in school-aged children, *Nutrition Reviews* 62(8), 295-306.

Delange F. (2000), The role of iodine in brain development. *Proceedings of the Nutrition Society* 59, 75-79.

Feinstein, L., Sabates, R., Sorhaindo, A., Rogers, I., Herrick, D., Northstone, K., and P. Emmett (2008), Diet patterns related to attainment in school: the importance of early eating patterns, *Journal Epidemiol Community Health*, 62: 734-739

Figlio, D.N. and J. Winicki (2005), Food for thought: the effects of school accountability plans on school nutrition, *Journal of Public Economics*, 89, 381-94.

Gale, E.A.M., The Hawthorne studies—a fable for our times? (2004) *Quarterly Journal of Medicine,* 97, 439–449.

Glewwe, P., Jacoby, H., and King, E. (2001) Early childhood nutrition and academic achievement: a longitudinal analysis, Journal of Public Economics, 81, 345–68.

Heckman, J. (2006), Skill Formation and the Economics of Investing in Disadvantaged Children, *Science* 30, vol. 312, no. 5782, 1900-1902

Johansson, L., Thelle, D.S., Solvoll, K., Bjørneboe, G.A., and Drevon, C.A. (1999), Healthy dietary habits in relation to social determinants and lifestyle factors, *British Journal of Nutrition*, 81, 211-220

Kelder, S.H., Perry, C.L., Lytle, L.A., and Klepp, K., (1995), *Health Education Research*, Vol. 2, No.2, 119-131

Kleinman R.E.., S. Hall, H. Green, D. Korzec-Ramirez, K. Patton, M.E. Pagano J.M. Murphy (2002), Diet, Breakfast, and Academic Performance in Children, *Annales of Nutrition and Metabolism* 46(suppl 1), 24–30

Lambert, J., Agostoni, C., Elmadfa, I., Hulsof, K., Krause, E., Livingstone, B., Socha, P., Pannemans, D. and Samartins, S. (2004) 'Dietary intake and nutritional status of children and adolescents in Europe', *British Journal of Nutrition*, 92(suppl 2): S147-211.

Levitt, S.D., and J., List, (2009), Was there really a Hawthorne Effect at the Hawthorne Plant? An Analysis of the Original Illumination Experiment, *NBER Working Paper 15016*, www.nber.org/papers/w15016

Machin, S. and S. Mcnally (2008), The Literacy Hour, *Journal of Public Economics* 92 (5-6), 1441-62.

McCann, D., Barrett, A., Cooper, A., Crumpler, D., Dalen, L., Grimshaw, K., Kitchin, E., Lok, K., Porteous, L., Prince, E., Sonuga-Barke, E., Warner, J.O. and Stevenson, J. (2007) Food additives and hyperactive behaviour in 3-year-old and 8/9-year-old children in the community: a randomised, double-blinded, placebo-controlled trial. *The Lancet*, 370, (9598), 1560-1567.

Mueller, M., S. Danielzik and S. Pust (2005), School- and family-based interventions to prevent overweight in children, Proceedings of the Nutrition Society 64, 249-54.

Murphy, J.M., M.E. Pagano, J. Nachmani, P. Sperling; S. Kane and R.E. Kleinman (1998), The Relationship of School Breakfast to Psychosocial and Academic Functioning Cross-sectional and Longitudinal Observations in an Inner-city School Sample, *Archives of Pediatrics & Adolescent Medicine* 152, 899-907.

Nelson, M., Bradbury, J., Poulter, J., McGee, A., Msebele, S. And L. Jarvis (2004), School Meals in Secondary Schools in England, *National Centre for Social Research – Nutrition Works*

Nelson, M., Nicholas, J., Suleiman, S., Davies, O., Prior, G., Hall, L., Wreford, S. and J., Poulter, (2006), School Meals in Primary Schools in England, *National Centre for Social Research – Nutrition Works*

Perry, C.L., Bishop, D.B., Taylor, G., Murray, D.M., Mays, R.W., Dudovitz, B.S., Smyth, M., Story, M. (1998), Changing Fruit and Vegetable Consumption among Children: The 5-a-Day Power Plus Progam in St. Paul, Minnesota, *American Journal of Public Health* Vol. 88, No. 4

Plachta-Danielzik, S., S. Pust, I. Asbeck, M. Czerwinski-Mast, K. Langna¨se, C. Fischer, A. Bosy-Westphal, P. Kriwy and M.J. Mueller (2005), Four-year Follow-up of School-based Intervention on Overweight Children: The KOPS Study, Obesity 15(12).

Pollitt, E. (1990). Malnutrition and Infection in the Classroom. Paris: UNESCO.

Pollitt, E. and Gorman, K.S. (1994) 'Nutritional deficiencies as developmental risk factors'. In Nelson, C.A. (ed.) Threats to optimal development: integrating biological,psychological and social risk factors, New Jersey, US: Lawrence Erlbaum Associates

Sorhaindo, A. and L. Feinstein (2006), What is the Relationship Between Child Nutrition and School Outcomes, *Wider Benefits of Learning Research Report* No.18, Centre for Research on the Wider Benefits of Learning.

von Hinke Kessler Scholder, S., C. Propper, F. Windmeijer, G. D. Smith, D. A. Lawlor, (2009), "The Effect of Child Weight on Academic Performance: Evidence using Genetic Markers", Working Paper

Whitmore, D. (2005), Do School Lunches Contribute to Childhood Obesity, *Harris School Working Paper Series* 05.13.

TABLES AND FIGURES

Figure 1: Local education authorities in the London area

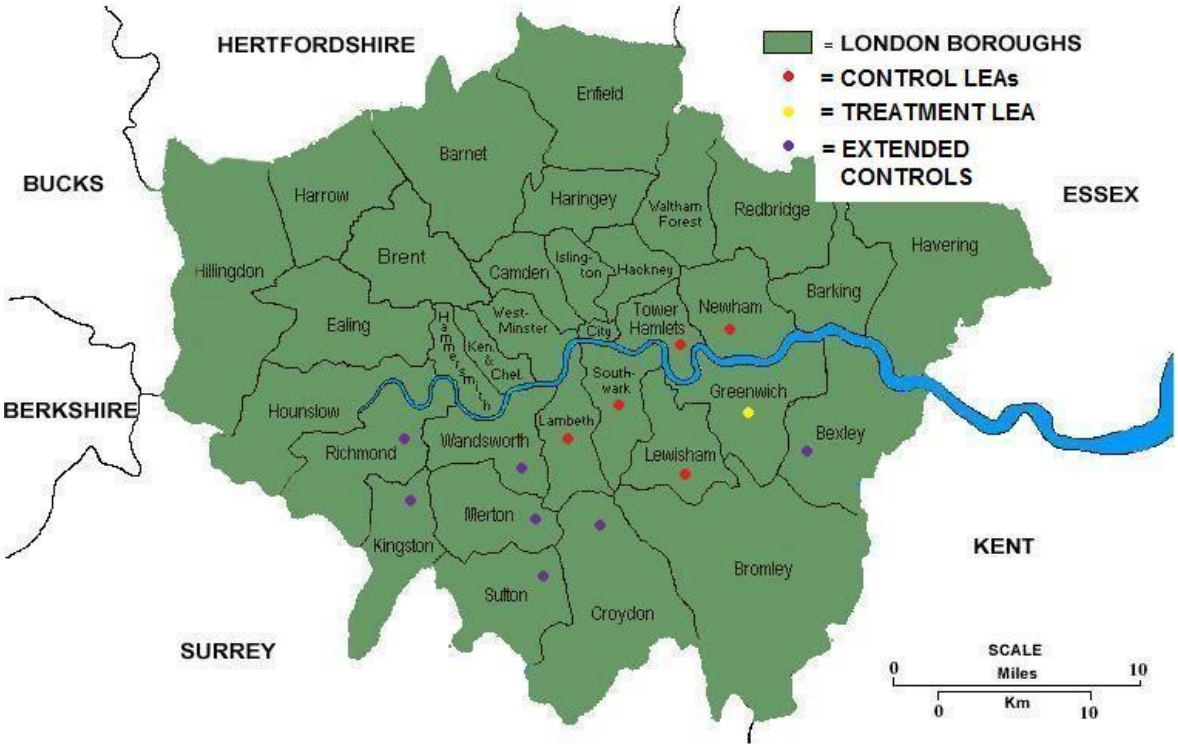

Table 1 – Neighbourhood Statistics – Greenwich and main control group

	Greenwich	Lambeth	Lewsiham	Southwark	Tower Hamlets	Newham
Rate of Obesity[1] (%)	20.2	16.8	19.7	19.2	21.2	11.9
Smoking[2] (%)	26.6	28.1	26.8	27.7	26	25.1
Binge Drinking[3] (%)	12.6	16.8	12.9	14.8	14.8	12.3
Fruit & Veg. Consumption[4] (%)	24.7	30.3	26.9	29.9	24.2	22.7
Life Expectancy at Birth, Males[5]	74.5	75.73	75.1	74.9	73.8	74.4
Life Expectancy at Birth, Females[5]	80.1	81.01	79.5	80.4	79.2	78.8
Free School meals Eligility[6] (%)	36.4	39.0	37.8	29.2	37.9	55.0
Long-Term Unemployed[7] (%)	1.9	2.0	2.1	1.9	2.1	2.2
Social Housing[8](%)	39.5	41.4	53.4	35.6	36.5	52.5
Qualifications[9]						
No qualifications	29.36	20.08	24.19	24.44	34.26	33.58
Attained level 1	15.01	10.15	14.21	10.97	10.26	13.92
Attained level 2	17.57	14.04	17.42	14.64	12.35	16.28
Attained level 3	8.33	9.82	9.09	10.02	9.47	8.91
Attained level 4 / 5	23.69	40.94	29.42	34.84	29.63	21.31
Proportion of Whites[10] (%)	77.1	62.4	63.0	65.9	39.4	51.4

Source: Office for National Statistics (Neighbourhood Statistics)

1) Obesity rates among adults (obesity is such that body mass index > 20), survey from 2003-2005.

2) A model based estimate of current smoking of adults, survey from 2003-2005.

3) A model based estimate for the prevalence of binge drinking in adults. Adult respondents defined to binge drink if men had consumed 8 or more units of alcohol or women, 6 or more units of alcohol on their heaviest drinking day in the past week.

4) A model based estimate for the prevalence of 5 or more daily Fruit & Vegetable Consumption in adults. Adult respondents were defined to consume Fruit & Vegetables if they had consumed 5 or more portions of fruit and vegetables on the previous day.

5) Jan 02- Dec04.

6) Percentage of pupils eligible for free school meals (School Census 2004).

7) People aged 16-74: Economically active: Unemployed (Persons, census April 2001).

8) Percentage of households living in housing rented to the Local area council (Census 2001).

9) All people aged 16 to 74 who were usually resident in the area at the time of the 2001 Census. Level 1 qualifications cover: 1+'O' level passes; 1+ CSE/GCSE any grades; NVQ level 1; or Foundation level GNVQ. Level 2 qualifications cover: 5+'O' level passes; 5+ CSE (grade 1's); 5+GCSEs (grades A-C); School Certificate; 1+'A' levels/'AS' levels; NVQ level 2; or Intermediate GNVQ. Level 3 qualifications cover: 2+ 'A' levels; 4+ 'AS' levels; Higher School Certificate; NVQ level 3; or Advanced GNVQ. Level 4/5 qualifications cover: First Degree, Higher Degree, NVQ levels 4 and 5; HNC; HND; Qualified Teacher Status; Qualified Medical Doctor; Qualified Dentist; Qualified Nurse; Midwife; or Health Visitor.

10) survey from 2003-2005.

Table 2a – Descriptive statistics – Individual Pupil Characteristics							
Greenwich	2002	2003	2004	2005	2006	2007	p-value[1]
IDACI Score	38.49	38.56	38.23	38.04	38.31	37.96	-0.383
	(18.36)	(18.29)	(18.29)	(18.29)	(18.29)	(18.29)	0.217
FSM eligibility (%)	38.1	37.81	38.2	36.67	35.94	34.98	-0.504
	(48.57)	(48.5)	(48.5)	(48.5)	(48.5)	(48.5)	0.596
Some Special Need (%)	39.93	31.66	33.03	33.27	32.09	35.18	-0.737
	(48.99)	(46.52)	(46.52)	(46.52)	(46.52)	(46.52)	0.404
Statemented (%)	4.15	4.29	3.51	3.32	3.39	4.16	0.304
	(19.95)	(20.28)	(20.28)	(20.28)	(20.28)	(20.28)	0.407
Female (%)	50.88	48.18	50.09	49.05	49.19	48.31	-1.378
	(50)	(49.98)	(49.98)	(49.98)	(49.98)	(49.98)	0.154
Non White (%)	32.95	35.01	37.22	38.98	42.68	42.78	1.832
	(47.01)	(47.71)	(47.71)	(47.71)	(47.71)	(47.71)	0.041
English 1st Language (%)	78.95	76.09	75.16	75.34	72.03	69.96	-1.124
	(40.77)	(42.66)	(42.66)	(42.66)	(42.66)	(42.66)	0.235
Pupils in year group	47.76	48.67	46.54	45.57	45.79	45.06	-1.83
	(17.1)	(17.08)	(17.08)	(17.08)	(17.08)	(17.08)	0.000
Pupil teacher ratio	21.16	22.19	21.67	21.86	20.74	20.37	0.977
	(4.47)	(5.20)	(5.09)	(5.23)	(4.61)	(4.95)	0.000
Non-Greenwich							
IDACI Score	44.57	44.5	44.53	44.66	44.63	44.69	
	(18.29)	(18.29)	(18.29)	(18.29)	(18.29)	(18.29)	
FSM eligibility (%)	42.82	42.74	42.41	42.88	41.18	40.24	
	(48.5)	(48.5)	(48.5)	(48.5)	(48.5)	(48.5)	
Female (%)	49.15	49.14	50.27	48.86	50.44	49.5	
	(49.98)	(49.98)	(49.98)	(49.98)	(49.98)	(49.98)	
Some Special Need (%)	31.58	27.47	27.95	28.79	28.23	28.74	
	(46.52)	(46.52)	(46.52)	(46.52)	(46.52)	(46.52)	
Statemented (%)	4.01	3.86	3.93	3.49	3.55	3.13	
	(20.28)	(20.28)	(20.28)	(20.28)	(20.28)	(20.28)	
Non White (%)	64.59	67.19	69.6	70.56	72.36	73.51	
	(47.71)	(47.71)	(47.71)	(47.71)	(47.71)	(47.71)	
English 1st Language (%)	50.45	50.23	49.26	47.49	46.21	44.69	
	(42.66)	(42.66)	(42.66)	(42.66)	(42.66)	(42.66)	
Pupils in year group	53.75	54.69	53.67	53.4	53.26	54.06	
	(17.08)	(17.08)	(17.08)	(17.08)	(17.08)	(17.08)	
Pupil teacher ratio	21.31	22.29	22.06	21.08	20.52	19.77	
	(4.99)	(6.45)	(5.82)	(5.61)	(5.08)	(4.73)	

[1] p-value corresponding to the difference in differences between Greenwich and Non-Greenwich areas, between the period 2006-2007 and 2002-2004.

Table 2b - Descriptive statistics – Individual Pupil Characteristics – Outcome variables

Year Group Level Greenwich	(1) 2002	(2) 2003	(3) 2004	(4) 2005	(5) 2006	(6) 2007
Raw score English	57.7	53.5	50.9	54.1	57.1	56.0
	(16.1)	(18.3)	(16.1)	(16.5)	(18.2)	(18.3)
Percentile score English	51.2	48.6	48.5	50.0	50.0	48.2
	(29.1)	(29.3)	(28.9)	(29.7)	(29.8)	(29.6)
Raw score Maths	59.3	57.3	61.1	61.5	61.3	61.2
	(21.3)	(23.0)	(22.6)	(21.6)	(23.0)	(22.7)
Percentile score Maths	49.6	49.6	49.3	49.8	50.2	49.0
	(28.9)	(29.1)	(29.1)	(29.3)	(29.4)	(28.9)
Raw score Science	54.6	53.7	52.4	56.2	54.9	55.6
	(14.1)	(14.2)	(13.7)	(13.6)	(14.2)	(13.3)
Percentile score Science	49.5	49.2	48.7	49.4	50.3	48.7
	(27.7)	(28.7)	(28.5)	(29.2)	(29.1)	(13.3)
English Level 3 (%)	89.24	88.36	89.01	90.97	90.64	91.45
	(31)	(32.08)	(32.08)	(32.08)	(32.08)	(32.08)
English Level 4 (%)	67.82	69.4	69.84	73.29	73.46	72.31
	(46.73)	(46.09)	(46.09)	(46.09)	(46.09)	(46.09)
English Level 5 (%)	22.92	23.4	20.31	21.81	26.66	26.08
	(42.04)	(42.34)	(42.34)	(42.34)	(42.34)	(42.34)
Maths Level 3 (%)	91.07	89.63	90.83	92.01	90.68	88.35
	(28.52)	(30.49)	(30.49)	(30.49)	(30.49)	(30.49)
Maths Level 4 (%)	66.61	66.05	67.8	68.24	70.76	69.8
	(47.17)	(47.36)	(47.36)	(47.36)	(47.36)	(47.36)
Maths Level 5 (%)	20.32	23.58	23.9	24.51	26.85	23.25
	(40.24)	(42.46)	(42.46)	(42.46)	(42.46)	(42.46)
Science Level 3 (%)	94.38	95.12	94.75	95.64	94.68	94.98
	(23.04)	(21.54)	(21.54)	(21.54)	(21.54)	(21.54)
Science Level 4 (%)	80.9	81.22	79.24	81.36	81.55	83.1
	(39.32)	(39.06)	(39.06)	(39.06)	(39.06)	(39.06)
Science Level 5 (%)	30.24	29.95	30.35	36.63	37.33	37.8
	(45.94)	(45.81)	(45.81)	(45.81)	(45.81)	(45.81)
Authorised Absence (%)	5.77	5.57	5.51	5.25	5.34	4.54
	(1.62)	(1.64)	(1.17)	(1.30)	(1.22)	(1.45)
Unauthorised Absence (%)	1.38	1.42	1.21	1.22	1.27	1.31
	(1.26)	(1.36)	(1.10)	(1.01)	(0.94)	(0.89)
FSM take up rate (%)	27.26	27.44	27.79	25.19	26.13	25.55
	(12.38)	(12.25)	(12.25)	(12.25)	(12.25)	(12.25)

Table 2c - Descriptive statistics – Individual Pupil Characteristics – Outcome variables

Year Group Level	(1)	(2)	(3)	(4)	(5)	(6)
Non-Greenwich	2002	2003	2004	2005	2006	2007
Raw score English	57.0	54.7	51.9	54.1	57.3	57.5
	(16.1)	(17.7)	(16.1)	(15.9)	(17.3)	(17.4)
Percentile score English	49.8	50.3	50.3	50.0	50.0	50.3
	(28.8)	(28.8)	(28.8)	(28.7)	(28.7)	(28.7)
Raw score Maths	59.7	57.8	61.8	61.7	61.5	62.2
	(21.2)	(22.7)	(22.4)	(21.3)	(22.2)	(22.4)
Percentile score Maths	50.1	50.1	50.1	50.0	50.0	50.2
	(28.9)	(28.8)	(28.8)	(28.8)	(28.8)	(28.8)
Raw score Science	54.9	54.1	53.0	56.5	54.8	56.3
	(14.2)	(14.2)	(14.0)	(13.5)	(14.0)	(13.0)
Percentile score Science	50.1	50.2	50.3	50.1	49.9	50.2
	(28.9)	(28.9)	(28.9)	(18.8)	(28.8)	(28.8)
English Level 3 (%)	88.8	88.1	89.48	90.72	91.94	92.74
	(32.08)	(32.08)	(32.08)	(32.08)	(32.08)	(32.08)
English Level 4 (%)	67.22	70.17	72.13	74.9	76.14	76.52
	(46.09)	(46.09)	(46.09)	(46.09)	(46.09)	(46.09)
English Level 5 (%)	20.85	22.95	22.39	20.96	26.72	26.98
	(42.34)	(42.34)	(42.34)	(42.34)	(42.34)	(42.34)
Maths Level 3 (%)	90.19	89.87	90.94	91.32	91.34	91.91
	(30.49)	(30.49)	(30.49)	(30.49)	(30.49)	(30.49)
Maths Level 4 (%)	66.47	66.66	68.96	70.63	71.43	73.18
	(47.36)	(47.36)	(47.36)	(47.36)	(47.36)	(47.36)
Maths Level 5 (%)	21.01	23.34	25.23	25	26.18	26.26
	(42.46)	(42.46)	(42.46)	(42.46)	(42.46)	(42.46)
Science Level 3 (%)	94.25	94.47	94.19	94.73	94.64	95.32
	(21.54)	(21.54)	(21.54)	(21.54)	(21.54)	(21.54)
Science Level 4 (%)	81.02	80.49	80.49	82.11	82.34	84.4
	(39.06)	(39.06)	(39.06)	(39.06)	(39.06)	(39.06)
Science Level 5 (%)	30.76	31.62	33.92	38.51	36.3	40.16
	(45.81)	(45.81)	(45.81)	(45.81)	(45.81)	(45.81)
Authorised Absence (%)	5.75	5.50	5.04	5.02	5.29	4.38
	(1.79)	(1.85)	(1.70)	(1.57)	(1.59)	(1.54)
Unauthorised Absence (%)	1.39	1.22	1.10	1.12	1.11	1.16
	(1.24)	(1.12)	(1.28)	(1.18)	(1.05)	(1.03)
FSM take up rate (%)	31.42	31.43	31.76	29.86	30.78	30.13
	(12.25)	(12.25)	(12.25)	(12.25)	(12.25)	(12.25)

Table 3 – Before and After analysis – Raw scores and Percentile scores				
	(1)	(2)	(3)	(4)
English raw scores				
Post-2005 dummy	12.794	12.923	13.491	12.857
	(0.814)***	(0.758)***	(0.663)***	(0.669)***
Time trend	-2.946	-2.982	-3.253	-3.064
	(0.215)***	(0.201)***	(0.176)***	(0.182)***
R-squared	0.02	0.02	0.31	0.32
English percentile scores				
Post-2005 dummy	4.730	5.035	6.016	5.060
	(1.367)***	(1.275)***	(1.122)***	(1.133)***
Time trend	-1.442	-1.539	-1.991	-1.723
	(0.362)***	(0.339)***	(0.298)***	(0.308)***
R-squared	0.00	0.00	0.29	0.29
Observations	13128	13128	12368	12368
Math raw scores				
Post-2005 dummy	-0.366	0.127	1.226	0.494
	(1.042)	(0.979)	(0.894)	(0.900)
Time trend	0.682	0.482	0.027	0.356
	(0.275)**	(0.259)*	(0.237)	(0.244)
R-squared	0.00	0.00	0.23	0.24
Math percentile scores				
Post-2005 dummy	1.288	1.995	3.286	2.473
	(1.343)	(1.260)	(1.159)***	(1.168)**
Time trend	-0.352	-0.632	-1.182	-0.800
	(0.355)	(0.334)*	(0.307)***	(0.317)**
R-squared	0.00	0.00	0.22	0.22
Observations	13346	13346	12586	12586
Science raw scores				
Post-2005 dummy	4.273	4.799	5.461	5.238
	(0.639)***	(0.590)***	(0.550)***	(0.556)***
Time trend	-0.744	-0.909	-1.138	-1.079
	(0.169)***	(0.156)***	(0.146)***	(0.151)***
R-squared	0.00	0.01	0.20	0.20
Science Percentile scores				
Post-2005 dummy	2.646	3.788	5.283	4.840
	(1.324)**	(1.216)***	(1.141)***	(1.152)***
Time trend	-0.634	-0.997	-1.514	-1.439
	(0.349)*	(0.322)***	(0.302)***	(0.312)***
R-squared	0.00	0.00	0.18	0.18
Observations	13560	13560	12785	12785
Time trend	Yes	Yes	Yes	Yes
School fixed effects	No	Yes	Yes	Yes
Individual pupil characteristics	No	No	Yes	Yes
Year group average characteristics	No	No	No	Yes

Note: *** p<0.01, ** p<0.05, * p<0.1. Individual controls include: free school meal eligibility, gender, some special needs requirement, special needs statement, ethnicity, English as a first language, Income Deprivation Affecting Children Index score (idaci), month of birth dummies. School controls include: % with free school meal eligibility; % girls; % require special needs, with and with-out statement, % of different ethnicities , % English as a first language, average Income Deprivation Affecting Children Index (idaci), faith school indicator.

Table 4 – Differences in differences – English Percentile Scores

	(1)	(2)	(3)	(4)
Greenwich × Post 2005	-0.884*	6.117***	6.201***	5.639***
	(0.345)	(1.120)	(0.836)	(1.033)
FSM			-7.800***	-6.167***
			(0.524)	(0.289)
IDACI Score			-13.70***	-8.028***
			(3.191)	(0.740)
Female			5.168***	4.816***
			(0.215)	(0.235)
English First Language			3.013**	2.153***
			(0.757)	(0.533)
Statemented			-5.623***	-4.708***
			(1.095)	(1.051)
Some SEN			-28.11***	-28.36***
			(0.442)	(0.371)
Non-White			-0.523	0.0325
			(0.938)	(0.960)
Year Group mean characteristics				
FSM				-21.20***
				(3.145)
IDACI Score				-5.870
				(4.803)
Female				10.94***
				(1.823)
English First Language				-0.506
				(3.201)
White				1.845
				(4.245)
Statement				-10.17
				(5.122)
Some SEN				7.071**
				(1.952)
Year group size				-0.0600**
				(0.0229)
Pupil Teacher Ratio				0.0184
				(0.0809)
Observations	78687	78687	78687	78687
LEA Fixed Effects	No	Yes	Yes	Yes
LEA Trend	No	Yes	Yes	Yes
Year Dummies	No	Yes	Yes	Yes
Individual Controls	No	No	Yes	Yes
Year Group Controls	No	No	No	Yes

Note: *** p<0.01, ** p<0.05, * p<0.1, robust standard errors in parentheses, control LEAs include: Southwark, Lewisham, Tower Hamlets, Newham and Lambeth, see also notes Table 3 for description of individual and year group controls.

Table 5 – Differences in differences – Maths Percentile Scores

	(1)	(2)	(3)	(4)
Greenwich × Post 2005	-0.110	2.180*	2.825***	2.740***
	(0.549)	(0.855)	(0.612)	(0.405)
FSM			-6.726***	-5.466***
			(0.403)	(0.270)
IDACI Score			-14.10***	-8.058***
			(2.240)	(0.471)
Female			-6.279***	-6.666***
			(0.227)	(0.221)
English First Language			-0.151	-0.508
			(0.663)	(0.438)
Statemented			-6.653***	-5.938***
			(1.429)	(1.031)
Some SEN			-26.73***	-26.93***
			(0.483)	(0.470)
Non-White			-2.934**	-2.396**
			(0.988)	(0.862)
Year group mean characteristics				
FSM				-16.31***
				(2.127)
IDACI Score				-10.04**
				(3.635)
Female				12.82***
				(2.076)
English First Language				-2.431
				(3.950)
White				3.126
				(4.514)
Statement				-7.148
				(6.491)
Some SEN				5.312*
				(2.434)
Year group size				-0.0391
				(0.0220)
				-0.135
				(0.120)
Observations	79785	79785	79785	79785
LEA Fixed Effects	No	Yes	Yes	Yes
LEA Trend	No	Yes	Yes	Yes
Year Dummies	No	Yes	Yes	Yes
Individual Controls	No	No	Yes	Yes
Year Group Controls	No	No	No	Yes

Note: *** p<0.01, ** p<0.05, * p<0.1, robust standard errors in parentheses, control LEAs include: Southwark, Lewisham, Tower Hamlets, Newham and Lambeth, see also notes Table 3 for description of individual and year group controls.

Table 6 – Differences in differences – Science Percentile Scores

	(1)	(2)	(3)	(4)
Greenwich × Post 2005	0.322	4.075**	4.451***	4.506***
	(0.413)	(1.195)	(0.874)	(0.945)
FSM			-7.095***	-5.843***
			(0.494)	(0.216)
IDACI Score			-15.67***	-8.144***
			(2.543)	(0.583)
Female			-2.477***	-2.864***
			(0.240)	(0.227)
English First Language			3.247**	3.022***
			(0.835)	(0.599)
Statemented			-7.299***	-5.865***
			(1.717)	(0.771)
Some SEN			-22.88***	-22.90***
			(0.388)	(0.448)
Non-White			-3.129**	-2.460**
			(0.971)	(0.728)
Year group mean characteristics				
FSM				-15.36***
				(2.309)
IDACI Score				-14.22**
				(4.620)
Female				13.33***
				(2.108)
English First Language				-3.288
				(4.996)
White				4.726
				(5.575)
Statement				-11.75
				(7.266)
Some SEN				2.706
				(3.045)
Year group size				-0.0281
				(0.0257)
Pupil Teacher Ratio				-0.208
				(0.122)
Observations	80825	80825	80825	80825
LEA Fixed Effects	No	Yes	Yes	Yes
LEA Trend	No	Yes	Yes	Yes
Year Dummies	No	Yes	Yes	Yes
Individual Controls	No	No	Yes	Yes
Year Group Controls	No	No	No	Yes

Note: *** p<0.01, ** p<0.05, * p<0.1, robust standard errors in parentheses control LEAs include: Southwark, Lewisham, Tower Hamlets, Newham and Lambeth, see also notes Table 3 for description of individual and year group controls.

Table 7 – Differences in differences – Levels				
	(1)	(2)	(3)	(4)
English				
Level 3 and above				
Greenwich × Post 2005	-1.348***	0.102	0.314	0.183
	(0.247)	(0.392)	(0.484)	(0.542)
Level 4 and above				
Greenwich × Post 2005	-2.555***	2.768*	3.150*	2.682*
	(0.440)	(1.340)	(1.243)	(1.065)
Level 5 and above				
Greenwich × Post 2005	-0.610*	5.982**	6.097***	5.619**
	(0.281)	(1.491)	(1.326)	(1.700)
Maths				
Level 3 and above				
Greenwich × Post 2005	-2.234***	1.232	1.635	1.593
	(0.301)	(0.705)	(0.824)	(0.821)
Level 4 and above				
Greenwich × Post 2005	-1.442	2.403	3.176*	2.939**
	(0.901)	(1.570)	(1.519)	(0.914)
Level 5 and above				
Greenwich × Post 2005	-0.525	2.961***	3.522***	3.385**
	(0.592)	(0.524)	(0.704)	(0.900)
Science				
Level 3 and above				
Greenwich × Post 2005	-0.558**	-0.790	-0.604	-0.458
	(0.205)	(0.748)	(0.811)	(0.806)
Level 4 and above				
Greenwich × Post 2005	-0.813	1.276*	1.665**	1.818***
	(0.533)	(0.553)	(0.584)	(0.390)
Level 5 and above				
Greenwich × Post 2005	1.271*	7.954***	8.443***	8.417***
	(0.533)	(1.772)	(1.476)	(1.563)
Observations	84152	84152	84152	84152
LEA Fixed Effects	No	Yes	Yes	Yes
LEA Trend	No	Yes	Yes	Yes
Year Dummies	No	Yes	Yes	Yes
Individual Controls	No	No	Yes	Yes
Year Group Controls	No	No	No	Yes

Note: *** p<0.01, ** p<0.05, * p<0.1, robust standard errors in parentheses, control LEAs include: Southwark, Lewisham, Tower Hamlets, Newham and Lambeth, see also notes Table 3 for description of individual and year group controls.

Table 8 – Difference in Differences – Heterogeneous effects			
Greenwich × Post 2005	(1) English	(2) Maths	(3) Science
× Girls	6.990***	4.036***	6.230***
	(1.108)	(0.434)	(0.828)
× Boys	4.412**	1.480*	2.901*
	(1.221)	(0.589)	(1.161)
P-value difference = 0	0.621	0.0198	0.275
× Non FSM	7.970***	5.200***	6.725***
	(1.135)	(0.717)	(1.313)
× FSM	1.663	-1.342*	0.621
	(0.970)	(0.577)	(0.581)
P-value difference = 0	0.181	0.423	0.593
× FSM & female	3.391**	1.873*	3.406**
	(0.936)	(0.857)	(1.137)
× FSM & male	-0.0911	-4.774**	-2.314*
	(1.381)	(1.481)	(0.905)
P-value difference = 0	0.428	0.0531	0.230
Excluding year 2006			
× Non-FSM	8.383***	4.647***	5.822**
	(1.721)	(1.006)	(1.853)
× FSM	4.197**	-1.400	2.323*
	(1.500)	(1.054)	(0.952)
P-value difference = 0	0.665	0.996	0.629
Excluding year 2006			
× FSM & female	5.888***	1.658	5.907***
	(1.301)	(1.519)	(1.406)
× FSM & male	2.582	-4.851*	-1.455
	(1.850)	(1.919)	(1.499)
P-value difference = 0	0.749	0.0302	0.276

Note: *** p<0.01, ** p<0.05, * p<0.1, robust standard errors in parentheses, control LEAs include: Southwark, Lewisham, Tower Hamlets, Newham and Lambeth, see also notes Table 3 for description of individual and year group controls.

Table 9 – Differences in differences - Absenteeism			
	(1)	(2)	(3)
Authorised			
Greenwich × Post 2005	-0.0826	-0.801**	-0.617*
	(0.124)	(0.202)	(0.287)
Observations	2011	2011	1986
Unauthorised			
Greenwich × Post 2005	0.0473	-0.130	-0.0175
	(0.0906)	(0.123)	(0.132)
Observations	2011	2011	1986
LEA Fixed Effects	No	Yes	Yes
LEA Trend	No	Yes	Yes
Year Dummies	No	Yes	Yes
Year Group Controls	No	No	Yes

Note: *** p<0.01, ** p<0.05, * p<0.1, robust standard errors in parentheses, control LEAs include: Southwark, Lewisham, Tower Hamlets, Newham and Lambeth, see also notes Table 3 for description of year group controls.

Table 10: Differences in differences – Percentile test scores – Controlling for absenteeism

	(1) English	(2) English	(3) Maths	(4) Maths	(5) Science	(6) Science
Percentile Score						
Greenwich × Post 2005	5.639***	5.604***	2.740***	2.841***	4.506***	4.605***
	(1.033)	(1.117)	(0.405)	(0.446)	(0.945)	(1.037)
Authorised Absence		-1.071*		-0.680**		-0.637
		(0.478)		(0.218)		(0.460)
Level 3 and above						
Greenwich × Post 2005	0.183	0.296	1.593	1.852*	-0.458	-0.249
	(0.542)	(0.539)	(0.821)	(0.736)	(0.806)	(0.707)
Authorised Absence		-1.010***		-0.856**		-1.079**
		(0.175)		(0.217)		(0.291)
Level 4 and above						
Greenwich × Post 2005	2.682*	2.700*	2.939**	3.254***	1.818***	2.415***
	(1.065)	(1.135)	(0.914)	(0.775)	(0.390)	(0.428)
Authorised Absence		-1.229**		-1.076**		-1.143**
		(0.340)		(0.386)		(0.418)
Level 5 and above						
Greenwich × Post 2005	5.619**	5.503**	3.385**	3.385**	8.417***	8.471***
	(1.700)	(1.823)	(0.900)	(1.072)	(1.563)	(1.600)
Authorised Absence		-1.067		-0.683*		-1.030
		(0.573)		(0.290)		(0.536)
Absenteeism	No	Yes	No	Yes	No	Yes
LEA Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes
LEA Trend	Yes	Yes	Yes	Yes	Yes	Yes
Year Dummies	Yes	Yes	Yes	Yes	Yes	Yes
Individual Controls	Yes	Yes	Yes	Yes	Yes	Yes
Year Group Controls	Yes	Yes	Yes	Yes	Yes	Yes

Note: *** p<0.01, ** p<0.05, * p<0.1, robust standard errors in parentheses, control LEAs include: Southwark, Lewisham, Tower Hamlets, Newham and Lambeth, see also notes Table 3 for description of individual and year group controls.

Table 11 – Differences in differences - Free school meal take-up

	(1)	(2)	(3)
Greenwich × Post 2005	-0.328	0.701	0.883
	(0.308)	(1.250)	(1.254)
Observations	2012	2012	1987
LEA Fixed Effects	No	Yes	Yes
LEA Trend	No	Yes	Yes
Year Dummies	No	Yes	Yes
Year Group Controls	No	No	Yes

Note: *** p<0.01, ** p<0.05, * p<0.1, robust standard errors in parentheses, control LEAs include: Southwark, Lewisham, Tower Hamlets, Newham and Lambeth, see also notes Table 3 for description of year group controls.

Table 12 – Hawthorne effect

	(1) English	(2) Maths	(3) Science
Percentile Score			
Greenwich × Post 2005	5.881***	3.515***	5.169***
	(1.001)	(0.417)	(0.945)
TV × Post2005	-2.265***	-6.679***	-5.770***
	(0.299)	(0.192)	(0.246)
Level 3 and above			
Greenwich × Post 2005	0.277	1.471	-0.418
	(0.537)	(0.809)	(0.788)
TV × Post2005	-0.851***	1.073***	-0.492**
	(0.0976)	(0.200)	(0.181)
Level 4 and above			
Greenwich × Post 2005	3.019**	3.633***	2.206***
	(1.042)	(0.887)	(0.375)
TV × Post2005	-3.037***	-5.508***	-3.245***
	(0.265)	(0.405)	(0.342)
Level 5 and above			
Greenwich × Post 2005	5.752**	4.477***	9.254***
	(1.665)	(0.939)	(1.553)
TV × Post2005	-1.599***	-9.213***	-7.304***
	(0.314)	(0.371)	(0.352)
LEA Fixed Effects	Yes	Yes	Yes
LEA Trend	Yes	Yes	Yes
Year Dummies	Yes	Yes	Yes
Individual Controls	Yes	Yes	Yes
Year Group Controls	Yes	Yes	Yes

Note: *** p<0.01, ** p<0.05, * p<0.1, robust standard errors in parentheses, control LEAs include: Southwark, Lewisham, Tower Hamlets, Newham and Lambeth, see also notes Table 3 for description of individual and year group controls.

Table 13: Differences in differences – Percentile test scores – Controlling for Pupil Teacher Ratio

	(1) English	(2) English	(3) Maths	(4) Maths	(5) Science	(6) Science
Percentile Score						
Greenwich × Post 2005	5.710***	5.639***	2.712***	2.740***	4.517***	4.506***
	(1.044)	(1.033)	(0.496)	(0.405)	(0.894)	(0.945)
Level 3 and above	0.162	0.183	1.568	1.593	-0.511	-0.458
Greenwich × Post 2005	(0.553)	(0.542)	(0.827)	(0.821)	(0.826)	(0.806)
Level 4 and above	2.750**	2.682*	2.917**	2.939**	1.830***	1.818***
Greenwich × Post 2005	(1.031)	(1.065)	(1.098)	(0.914)	(0.442)	(0.390)
Level 5 and above	5.685**	5.619**	3.349**	3.385**	8.384***	8.417***
Greenwich × Post 2005	(1.696)	(1.700)	(0.892)	(0.900)	(1.440)	(1.563)
Pupil Teacher Ratio	No	Yes	No	Yes	No	Yes
LEA Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes
LEA Trend	Yes	Yes	Yes	Yes	Yes	Yes
Year Dummies	Yes	Yes	Yes	Yes	Yes	Yes
Individual Controls	Yes	Yes	Yes	Yes	Yes	Yes
Year Group Controls	Yes	Yes	Yes	Yes	Yes	Yes

Note: *** p<0.01, ** p<0.05, * p<0.1, robust standard errors in parentheses, control LEAs include: Southwark, Lewisham, Tower Hamlets, Newham and Lambeth, see also notes Table 3 for description of individual and year group controls.

APENDIX: Sample of menus

Before the Feed Me Better Campaign

Mains: burgers and chips; sausage rolls; fish fingers; turkey drummers; chicken dinosaurs

Desserts: sponge pudding and custard; milk shake and home made biscuit; fruit salad

Example of weekly menus introduced with the Jamie Oliver campaign

* = Meat Option ** = Fish Option V = Vegetarian Option

	MONDAY	*TUESDAY*	*WEDNESDAY*	*THURSDAY*	*FRIDAY*
WEEK 1 Bread & Salad Bar Everyday	* Proper Sausages Creamy Mash Peas & Sweetcorn Mexican Bean Wrap (v) Cheesy Leek Pasta (v) Peas & Sweetcorn Salad Vanilla Sponge & Custard	* Chicken & Mushroom Casserole * Chilli Con Carne Savoury Rice & Salad Vegetable Chow Mein (v) Salad Fruit Crumble & Custard	* Roast Beef Roast Potatoes, Green Beans & Gravy Mushroom & Lentil Bake (v) Roast Potatoes & Green Beans ** Tuna Jacket Potato Green Beans Fresh Fruit Platter & Custard	* Lamb & Vegetable Pie Veggie Mince Pie (v) ** Creamy Coconut Fish New Potatoes Broccoli Creamed Rice Pudding	* BBQ Chicken Cheese Flan (v) Jacket Wedges Salad * Cottage Pie Seasonal Vegetable Fresh Fruit & Custard

source: www.greenwich.gov.uk

Appendix B - Robustness checks for results regarding Key Stage 2 tests

Table B1 – Descriptive statistics – Neighbourhood Statistics

	Wandsworth	Bexley	Croydon	Kingston	Merton	Richmond	Sutton
Rate of Obesity (%)	14.2	21.5	19.3	17.3	17.3	14.3	19.3
Smoking (%)	24.2	27.8	23.2	21.7	20.9	19.3	25.4
Binge Drinking (%)	13.9	10.7	11	12.3	12.3	12.3	11.4
Fruit & Veg. Consumption (%)	31.1	25.4	27.8	33.4	31.7	37.1	29.1
Life Expectancy at Birth, Males	76.1	77.6	77	78.3	77.7	78.7	78
Life Expectancy at Birth, Females	80.5	81.5	80.7	81.5	82.2	82.4	81.2
Free School meals Eligibility (%)	31	15	22.7	9.2	14.4	12.0	16.1
Long-Term Unemployed (%)	1.1	0.9	1.3	0.7	0.9	0.6	0.7
Social Housing (%)	23	13.6	16.8	11.1	14.2	11.7	15.4
Qualifications							
No qualifications	16.33	28.74	22.89	17.15	19.94	13.64	23.33
Attained level 1	8.05	20.56	16.66	12.21	12.4	9.36	18.21
Attained level 2	13.33	22.61	21.4	18.45	16.72	16.35	21.63
Attained level 3	11.1	6.89	9.32	12.38	9.71	11.44	8.85
Attained level 4 / 5	47.25	13.26	23.62	34.57	35.73	45.11	21.22
Proportion of Whites (%)	78	91.4	70.2	84.5	75	91	89.2

See notes to table 1

Table B2 – Summary statistics – Extended Control group						
Year Group Level	(1)	(2)	(3)	(4)	(5)	(6)
	2002	2003	2004	2005	2006	2007
English Level 3 (%)	90.73	90.26	91.05	92.09	92.73	93.79
	(32.08)	(32.08)	(32.08)	(32.08)	(32.08)	(32.08)
English Level 4 (%)	72.28	74.39	75.73	77.92	78.98	79.5
	(46.09)	(46.09)	(46.09)	(46.09)	(46.09)	(46.09)
English Level 5 (%)	26.91	27.41	26.05	25.54	31.73	32.13
	(42.34)	(42.34)	(42.34)	(42.34)	(42.34)	(42.34)
Maths Level 3 (%)	91.8	90.82	92.06	92.44	92.39	92.95
	(30.49)	(30.49)	(30.49)	(30.49)	(30.49)	(30.49)
Maths Level 4 (%)	70.44	69.24	71.79	73.09	74.12	75.9
	(47.36)	(47.36)	(47.36)	(47.36)	(47.36)	(47.36)
Maths Level 5 (%)	25.9	26.98	29.42	29.09	31.42	31.35
	(42.46)	(42.46)	(42.46)	(42.46)	(42.46)	(42.46)
Science Level 3 (%)	95.18	95.27	95.22	95.23	95.4	95.97
	(21.54)	(21.54)	(21.54)	(21.54)	(21.54)	(21.54)
Science Level 4 (%)	83.86	83.44	82.76	83.88	84.71	86.52
	(39.06)	(39.06)	(39.06)	(39.06)	(39.06)	(39.06)
Science Level 5 (%)	35.02	36.46	38.35	42.32	41.65	44.37
	(45.81)	(45.81)	(45.81)	(45.81)	(45.81)	(45.81)
Pupils in year group	60.8	60.49	55.72	55.72	55.71	55.67
	(17.08)	(17.08)	(17.08)	(17.08)	(17.08)	(17.08)
FSM eligibility (%)	29.67	29.56	29.64	29.54	27.96	27.9
	(48.5)	(48.5)	(48.5)	(48.5)	(48.5)	(48.5)
FSM take-up (% all children)	22.29	22.2	22.5	21.29	21.56	21.43
	(12.25)	(12.25)	(12.25)	(12.25)	(12.25)	(12.25)
Female (%)	49.34	49.12	49.74	49.06	50.04	49.35
	(49.98)	(49.98)	(49.98)	(49.98)	(49.98)	(49.98)
Some Special Need (%)	29.11	25.21	25.31	26.01	26.09	26.34
	(46.52)	(46.52)	(46.52)	(46.52)	(46.52)	(46.52)
Statemented (%)	3.72	3.77	3.67	3.62	3.63	3.31
	(20.28)	(20.28)	(20.28)	(20.28)	(20.28)	(20.28)
Non White (%)	44.35	48.87	50.21	51.3	52.94	54.27
	(47.71)	(47.71)	(47.71)	(47.71)	(47.71)	(47.71)
English 1st Language (%)	69.06	67.91	66.67	65.53	63.69	62.27
	(42.66)	(42.66)	(42.66)	(42.66)	(42.66)	(42.66)
IDACI Score	32.32	32.48	32.58	32.46	32.41	32.59
	(18.29)	(18.29)	(18.29)	(18.29)	(18.29)	(18.29)
Authorised Absence (%)	5.83	5.67	5.24	5.25	5.48	4.66
	(1.83)	(1.86)	(1.69)	(1.74)	(1.62)	(1.62)
Unauthorised Absence (%)	0.96	0.90	0.85	0.85	0.86	0.99
	(1.20)	(1.21)	(1.35)	(1.17)	(1.17)	(1.30)

Table B3 – Placebo treatment area – Difference in differences			
Lambeth	(1) English	(2) Maths	(3) Science
Percentile Score			
Lambeth × Post 2005	2.374***	-0.278	-0.595
	(0.344)	(0.279)	(0.407)
Level 3 or above			
Lambeth × Post 2005	0.720***	2.444***	0.959***
	(0.137)	(0.432)	(0.218)
Level 4 or above			
Lambeth × Post 2005	1.871*	-0.654	1.424**
	(0.907)	(0.725)	(0.367)
Level 5 or above			
Lambeth × Post 2005	2.258***	0.436	-2.359***
	(0.316)	(0.264)	(0.494)
LEA Fixed Effects	Yes	Yes	Yes
LEA Trend	Yes	Yes	Yes
Year Dummies	Yes	Yes	Yes
Individual Controls	Yes	Yes	Yes
Year Group Controls	Yes	Yes	Yes

Note: *** p<0.01, ** p<0.05, * p<0.1, robust standard errors in parentheses, see also notes Table 3 for description of individual and year group controls.

Table B4 – Placebo treatment area – Difference in differences			
Lewisham	(1) English	(2) Maths	(3) Science
Percentile Score			
Lambeth × Post 2005	0.862*	0.347	-0.316
	(0.395)	(0.305)	(0.662)
Level 3 or above			
Lambeth × Post 2005	-1.021*	-2.134**	-3.682***
	(0.488)	(0.777)	(0.421)
Level 4 or above			
Lambeth × Post 2005	1.719	-3.787**	-2.224***
	(1.092)	(0.943)	(0.433)
Level 5 or above			
Lambeth × Post 2005	2.945	-2.721**	5.129**
	(1.833)	(0.867)	(1.688)
LEA Fixed Effects	Yes	Yes	Yes
LEA Trend	Yes	Yes	Yes
Year Dummies	Yes	Yes	Yes
Individual Controls	Yes	Yes	Yes
Year Group Controls	Yes	Yes	Yes

Note: *** p<0.01, ** p<0.05, * p<0.1, robust standard errors in parentheses, see also notes Table 3 for description of individual and year group controls.

Table B5 – Placebo treatment area – Difference in differences			
Southwark	(1) English	(2) Maths	(3) Science
Percentile Score			
Lambeth × Post 2005	1.984***	1.834***	1.111**
	(0.338)	(0.268)	(0.387)
Level 3 or above			
Lambeth × Post 2005	1.649**	2.761**	2.397**
	(0.494)	(0.700)	(0.701)
Level 4 or above			
Lambeth × Post 2005	3.373**	4.451**	2.324***
	(1.305)	(1.180)	(0.569)
Level 5 or above			
Lambeth × Post 2005	0.839	-2.275**	-2.127
	(2.171)	(0.780)	(2.230)
LEA Fixed Effects	Yes	Yes	Yes
LEA Trend	Yes	Yes	Yes
Year Dummies	Yes	Yes	Yes
Individual Controls	Yes	Yes	Yes
Year Group Controls	Yes	Yes	Yes

Note: *** p<0.01, ** p<0.05, * p<0.1, robust standard errors in parentheses, see also notes Table 3 for description of individual and year group controls.

Table B6 – Placebo treatment area – Difference in differences			
Tower Hamlets	(1) English	(2) Maths	(3) Science
Percentile Score			
Lambeth × Post 2005	1.746*	2.569**	1.146
	(0.717)	(0.757)	(0.713)
Level 3 or above			
Lambeth × Post 2005	1.060	1.580	0.776
	(0.558)	(0.874)	(0.883)
Level 4 or above			
Lambeth × Post 2005	0.869	-1.573	-1.201
	(1.439)	(1.543)	(0.634)
Level 5 or above			
Lambeth × Post 2005	-3.432	1.690	-5.555*
	(2.167)	(0.963)	(2.181)
LEA Fixed Effects	Yes	Yes	Yes
LEA Trend	Yes	Yes	Yes
Year Dummies	Yes	Yes	Yes
Individual Controls	Yes	Yes	Yes
Year Group Controls	Yes	Yes	Yes

Note: *** p<0.01, ** p<0.05, * p<0.1, robust standard errors in parentheses, see also notes Table 3 for description of individual and year group controls.

Table B7 – Placebo treatment area – Difference in differences			
Newham	(1) English	(2) Maths	(3) Science
Percentile Score			
Lambeth × Post 2005	0.589	-0.238	-0.0155
	(0.696)	(0.393)	(0.408)
Level 3 or above			
Lambeth × Post 2005	-1.868***	-2.557**	-0.676
	(0.440)	(0.813)	(0.997)
Level 4 or above			
Lambeth × Post 2005	-3.417**	1.494	-0.413
	(1.294)	(1.721)	(0.992)
Level 5 or above			
Lambeth × Post 2005	-6.919***	-0.754	-0.925
	(1.478)	(1.004)	(2.620)
LEA Fixed Effects	Yes	Yes	Yes
LEA Trend	Yes	Yes	Yes
Year Dummies	Yes	Yes	Yes
Individual Controls	Yes	Yes	Yes
Year Group Controls	Yes	Yes	Yes

Note: *** p<0.01, ** p<0.05, * p<0.1, robust standard errors in parentheses, see also notes Table 3 for description of individual and year group controls.

Table B8 – Placebo treatment year 2003 – Difference in differences			
Placebo Year 2002-2003	(1)	(2)	(3)
	English	Maths	Science
Percentile Score			
Greenwich × Post 2003	-3.166***	-0.752	-1.425
	(0.494)	(0.973)	(0.811)
Level 3 or above			
Greenwich × Post 2003	-0.391	-0.506	0.433
	(0.498)	(0.416)	(0.437)
Level 4 or above			
Greenwich × Post 2003	-1.637*	-1.294	-0.295
	(0.693)	(1.015)	(0.610)
Level 5 or above			
Greenwich × Post 2003	-2.719**	0.175	-2.971*
	(0.974)	(0.855)	(1.234)
LEA Fixed Effects	Yes	Yes	Yes
LEA Trend	Yes	Yes	Yes
Year Dummies	Yes	Yes	Yes
Individual Controls	Yes	Yes	Yes
Year Group Controls	Yes	Yes	Yes

Note: *** p<0.01, ** p<0.05, * p<0.1, robust standard errors in parentheses, see also notes Table 3 for description of individual and year group controls.

Table B9 – Placebo treatment year 2004 – Difference in differences			
Placebo Year 2003-2004	(1) English	(2) Maths	(3) Science
Percentile Score			
Greenwich × Post 2004	-1.707	-1.012	-1.823
	(1.313)	(0.875)	(0.987)
Level 3 or above			
Greenwich × Post 2004	-1.601	0.390	-0.780*
	(0.900)	(0.568)	(0.319)
Level 4 or above			
Greenwich × Post 2004	-1.619	-0.316	-2.801*
	(1.648)	(1.229)	(1.242)
Level 5 or above			
Greenwich × Post 2004	-3.136*	-0.511	-2.497
	(1.341)	(0.792)	(1.501)
LEA Fixed Effects	Yes	Yes	Yes
LEA Trend	Yes	Yes	Yes
Year Dummies	Yes	Yes	Yes
Individual Controls	Yes	Yes	Yes
Year Group Controls	Yes	Yes	Yes

Note: *** p<0.01, ** p<0.05, * p<0.1, robust standard errors in parentheses, see also notes Table 3 for description of individual and year group controls.

Table B10 – Extended control group – Difference in differences				
	(1)	(2)	(3)	(4)
English				
Percentile Rank				
Greenwich × Post 2005	-0.739*	4.123***	4.281***	3.775***
	(0.362)	(0.923)	(0.855)	(0.886)
Level 3 and above				
Greenwich × Post 2005	-0.359	0.792*	0.855*	0.680
	(0.336)	(0.434)	(0.454)	(0.424)
Level 4 and above				
Greenwich × Post 2005	-1.200**	2.299***	2.551***	2.059***
	(0.500)	(0.744)	(0.756)	(0.640)
Level 5 and above				
Greenwich × Post 2005	-0.996*	2.451	2.668*	2.232
	(0.480)	(1.470)	(1.414)	(1.510)
Maths				
Percentile Rank				
Greenwich × Post 2005	-0.549	0.379	0.981	0.850
	(0.336)	(0.783)	(0.731)	(0.791)
Level 3 and above				
Greenwich × Post 2005	-2.048***	0.769*	0.980*	0.846
	(0.209)	(0.386)	(0.473)	(0.496)
Level 4 and above				
Greenwich × Post 2005	-1.048*	1.273	1.847*	1.489
	(0.563)	(0.926)	(0.903)	(0.840)
Level 5 and above				
Greenwich × Post 2005	-1.487***	1.033	1.565	1.370
	(0.485)	(0.935)	(0.973)	(1.096)
Science				
Percentile Rank				
Greenwich × Post 2005	0.0576	2.983***	3.428***	3.416***
	(0.298)	(0.770)	(0.665)	(0.707)
Level 3 and above				
Greenwich × Post 2005	-0.336**	-0.469	-0.411	-0.407
	(0.121)	(0.360)	(0.384)	(0.406)
Level 4 and above				
Greenwich × Post 2005	-0.382	0.855*	1.117**	1.007**
	(0.387)	(0.404)	(0.405)	(0.445)
Level 5 and above				
Greenwich × Post 2005	0.970**	7.280***	7.790***	7.755***
	(0.352)	(0.994)	(0.895)	(0.921)
Observations	162625	162625	162625	162625
LEA Fixed Effects	No	Yes	Yes	Yes
LEA Trend	No	Yes	Yes	Yes
Year Dummies	No	Yes	Yes	Yes
Individual Controls	No	No	Yes	Yes
Year Group Controls	No	No	No	Yes

Note: *** p<0.01, ** p<0.05, * p<0.1, robust standard errors in parentheses, see also notes Table 3 for description of individual and year group controls.

Appendix C - Robustness checks - absenteeism

Table C1 – Placebo treatment areas – Difference in differences			
	(1)	(2)	(3)
Lambeth			
Authorised			
Lambeth × Post 2005	0.0847	-0.484	-0.782**
Unauthorised	(0.155)	(0.228)	(0.261)
Lambeth × Post 2005	0.294**	-0.192	-0.309
	(0.0899)	(0.149)	(0.164)
Lewisham			
Authorised			
Lewisham × Post 2005	-0.540***	-0.300	-0.288
Unauthorised	(0.0794)	(0.247)	(0.327)
Lewisham × Post 2005	0.0694	0.344*	0.393*
	(0.115)	(0.130)	(0.142)
Southwark			
Authorised			
Southwark × Post 2005	0.132	-0.333	-0.382
Unauthorised	(0.157)	(0.246)	(0.298)
Southwark × Post 2005	-0.385***	-0.315*	-0.345*
	(0.0550)	(0.136)	(0.152)
Tower Hamlets			
Authorised			
Tower Hamlets × Post 2005	-0.0710	0.911***	1.063***
Unauthorised	(0.158)	(0.112)	(0.189)
Tower Hamlets × Post 2005	0.114	-0.241	-0.179
	(0.111)	(0.146)	(0.148)
Newham			
Authorised			
Newham × Post 2005	0.427**	0.211	0.381
Unauthorised	(0.120)	(0.248)	(0.320)
Newham × Post 2005	-0.0585	0.427**	0.463**
	(0.113)	(0.118)	(0.137)
Observations	1677	1677	1655
LEA Fixed Effects	No	Yes	Yes
LEA Trend	No	Yes	Yes
Year Dummies	No	Yes	Yes
Year Group Controls	No	No	Yes

Note: *** p<0.01, ** p<0.05, * p<0.1, robust standard errors in parentheses, see also notes Table 3 for description of year group controls.

Table C2 – Placebo treatment year – Difference in differences			
	(1)	(2)	(3)
Authorised			
Greenwich × Post 2003	0.168	0.240*	0.165
	(0.0922)	(0.109)	(0.160)
Unauthorised			
Greenwich × Post 2003	0.171*	0.198**	0.131*
	(0.0794)	(0.0674)	(0.0629)
Authorised			
Greenwich × Post 2004	0.185	0.516**	0.571**
	(0.144)	(0.147)	(0.162)
Unauthorised	0.0430	-0.0529	-0.0847
Greenwich × Post 2004	(0.0971)	(0.0690)	(0.0698)
Observations	2011	2011	1986
LEA Fixed Effects	No	Yes	Yes
LEA Trend	No	Yes	Yes
Year Dummies	No	Yes	Yes
Year Group Controls	No	No	Yes

Note: *** p<0.01, ** p<0.05, * p<0.1, robust standard errors in parentheses, see also notes Table 3 for description of year group controls.

Table C3 – Extended control group – Difference in differences			
	(1)	(2)	(3)
Authorised			
Greenwich × Post 2005	-0.172**	-0.662***	-0.549***
	(0.0762)	(0.126)	(0.163)
Observations			
	3735	3735	3639
Unauthorised			
Greenwich × Post 2005	-0.0775	0.0562	0.162
	(0.0616)	(0.109)	(0.129)
Observations	3736	3736	3640
LEA Fixed Effects	No	Yes	Yes
LEA Trend	No	Yes	Yes
Year Dummies	No	Yes	Yes
Year Group Controls	No	No	Yes

Note: *** p<0.01, ** p<0.05, * p<0.1, robust standard errors in parentheses, see also notes Table 3 for description of year group controls.