Healthy school meals and educational outcomes

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Non-technical summary

In many developed countries, children's diet has deteriorated tremendously over the last decades; resulting in significant increases in child obesity, but also in important deficiencies in those nutrients playing an essential role in cognitive development. In 2004, the Celebrity Chef Jamie Oliver embarked on a large campaign aiming at improving school meals in the UK. This paper uses the unique features of the "Jamie Oliver Feed Me Better" campaign to study the effects of healthy school meals on educational achievements of children in primary school. The Jamie Oliver campaign introduced drastic changes in the meals offered in the schools of one borough (Greenwich), shifting from low-budget processed meals, high in saturated fat, salt, and sugar towards healthier options.

Since school meals were changed 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. More precisely, using pupil and school-level data from the National Pupil Database (NPD) and from the School census, we can 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 substantial: Our estimates show that the campaign increased the percentage of pupils reaching level 4 by 3 to 6 percentage points in English, and the percentage of pupils reaching level 5 by 3 to 8 percentage points in Science. Moreover, we find that a substantial decrease in absenteeism in Greenwich schools after the campaign, in particular in "authorised absences", which are more likely to be due to sickness (and therefore health). The rate of absenteeism falls by about .80 percentage points, which is about 15% of the average absenteeism rate in our sample, thus a notable effect.

These effects are particularly noteworthy because they measure direct and immediate effects of improvement in children's diet on educational achievements only. There could be additional benefits (in particular in terms of health), beyond the improvements in educational achievements, which we are unable to measure because of lack of data. Nevertheless, even if we only take these short-term benefits into account, we find that the campaign was very cost-effective, with costs and benefits similar to other policies (such as the "literacy hour") implemented in the UK in the nineties.

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Abstract

This paper uses the "Jamie Oliver Feed Me Better" campaign to evaluate the impact of healthy school meals on educational outcomes. The campaign introduced drastic changes in the meals offered in the schools of one Borough, shifting from low-budget processed meals towards healthier options. We evaluate the effect of the campaign on educational outcomes using a difference in differences approach; comparing key stage 2 outcomes in primary schools before and after the reform, using the neighbouring Local Education Authorities as a control group. We find evidence that healthy school meals did improve educational outcomes, in particular in English and Science.

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

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

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"Mens Sana in Corpore Sano"

(A Sound Mind in a Sound Body)

Juvenal (Satire 10.356)

Introduction

Economists have recently pointed at the importance of early interventions to affect later educational outcomes and reduce disparities in society (e.g. Heckman (2006)). One crucial determinant of child development is nutrition and diet. In many developed countries, children's diet has deteriorated tremendously over the last decades, with direct consequences on child obesity rates and child health. In 2006, 15% of children aged 2 to 10 in the UK were classified as "obese", compared to 10% only 10 years ago[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. blood pressure, cholesterol, overweight (obesity), low fruit and vegetable intake, and iron deficiency. Importantly, poor diet does not only have direct negative effects on child weight and child health, but also results in significant deficiencies in those nutrients playing an essential role in cognitive development (see Lambert et al. (2004)). Indeed, the evidence shows a significant and *immediate* effect of diet on behaviour, concentration and cognitive ability (see Sorhaindo and Feinstein (2006) for a review). For example, deficiencies in zinc, iodine, iron and folate have been found to significantly impair the cognitive development of school-aged children (Delange, 2000; Bryan et al. (2004), Pollitt and Gorman (1994)).

Very little is known on the effect of poor diet on academic achievements in developed countries. There are a number of studies documenting correlations between *malnutrition* and educational outcomes (see Pollitt (1990), Behrman (1996), Alderman et al. (2006)), but most of this literature concentrates on developing

[1] Source: Health Survey for England, Obesity is defined by a body mass index (weight in kg / (height in m)^2) higher than 30.)

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. This paper uses the unique features of the "Jamie Oliver Feed Me Better" campaign, lead in the UK in 2004 by the celebrity chef Jamie Oliver. The campaign introduced drastic changes in the meals offered in the schools of one Borough – Greenwich, shifting from low-budget processed meals, high in saturated fat, salt, and sugar towards healthier options. Using pupil and school-level data from the National Pupil Database (NPD) and from the School census, we evaluate the effect of the campaign on educational outcomes in primary schools using a difference in differences approach; comparing educational outcomes (key stage 2 outcomes more specifically) before and after the reform, using the neighbouring Local Education Authorities as a control group.

School meals are important because they are one of the most obvious instruments for policy intervention in children's diet. In the UK, all public schools offer school meals (about 45% of school kids in primary and secondary schools eat school lunches every day). In addition, school meals are part of a means-tested program, such that children from less privileged backgrounds receive school meals for free. In 2006, around 18% of the pupil population was eligible for the free school meal program.[2] 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. Furthermore, school meals are now more important than in the past, since children seem to 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". Finally, because children are not "economic agents" as such – they are usually not the ones taking the decisions on the food they purchase - the possible relevance of policy intervention is greater than for adults.

[2] See appendix for details of eligibility criteria

We find that the campaign had a positive and significant effect on educational achievements. Our estimates show that the campaign increased the percentage of pupils reaching level 4 by 3 to 6 percentage points in English, and the percentage of pupils reaching level 5 by 3 to 8 percentage points in Science. We also find that authorised absences (which are likely to be linked to sickness) drop by 15% on average. These effects are particularly noteworthy since they only capture direct and immediate 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. The fact that we do find short-term effects directly on educational achievements shows that improving school meals can make an immediate difference to educational achievements.

The campaign also provides an interesting and unique opportunity to shed some light on a possible *placebo* effect, which is usually hard to assess in social sciences. We investigate how test scores changed in the schools that were mentioned explicitly in the television program, with the hypothesis that maybe these schools were more vulnerable to a possible placebo effect than other schools. We actually find a negative effect for those schools. That is, rather than a positive placebo effect, it seems that these schools rather experienced some disruption.

The paper is structured as follows. Section 1 describes the background of the "Feed me Better Campaign". Section 2 discusses the existing evidence in the literature on the effects of nutrition on health and educational outcomes. Section 3 describes the sample and data we use in our empirical analysis. Section 4 presents our identification strategy and the results. Section 5 concludes.

1. Background: School Meals and the Jamie Oliver Campaign

The celebrity chef Jamie Oliver started the campaign "Feed me Better" in 2004, drawing the attention of the media to the poor quality of meals offered in schools. His campaign was documented in a TV programme which was broadcast in prime time in

February 2005 on one of the major UK channels (Channel 4). The program featured mainly one school in Greenwich (Kidbrooke secondary school), which then served as pilot for the Jamie Oliver "experiment". The idea was to drastically change the school meal menus in schools, starting with this pilot school in the borough of Greenwich, and then extending the changes to all schools in the borough. Figure 1 shows an example of a weekly menu introduced by Oliver.

The campaign was successful in its implementation since the Council of Greenwich, in charge of setting the menus for all schools of the county, agreed to adopt the new "Jamie Oliver" menus and most schools switched from their old menus to the new menus in the school year 2004-2005. 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 the initial stages, in the pilot school of Kidbrooke, the healthy meals were being put along side 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. In September 2004 at the start of the autumn term Jamie hosted an evening for all the head teachers in which they were invited to take part in the experiment. In the TV programme we are not told how many schools sign up, they are all offered the opportunity but some do not choose to participate. The aim was then to roll the scheme, which completely replaced the junk food with healthy alternatives, out in 6 weeks, so it commenced just after the half term-October 2004. 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. The roll out had taken place fully by September 2005 with 81 of the 88 schools taking part in the scheme.

As part of the experiment the council has increased the investment 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 in

preparation of the meal, equipment costs and promotion to the parents. By September 2007 a total £1.2 million had been invested in school meals[3].

The dinner ladies were trained over the half-term break in a so-called boot camp. The scheme was temporarily halted in December 2004 for budgetary concerns, although this was eventually resolved, the schools had to find the money themselves if they went over budget. Greenwich council also agreed to put more funding into school meals. After the filming of Jamie's School dinners the School Food Trust was established in September 2005 with the remit of improving school dinners across the board. Greenwich had the advantage of being one of the first areas to improve their meals and the standards introduced by the Schools Food Trust would have taken time to take effect.

Despite the initial difficulties of implementation, the evaluation of the campaign has been quite positive. The website of the "Heath Education Trust" 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."

Nutritional analysis

We do have some information on the nutritional content of the meals offered to the children before the changes, although only through the TV programme. The Jamie Oliver team hired nutritionists to analyse the meals and found that the meals contained no vitamin C at all and contained between 1/3 to a ½ of iron of what is typically recommended in a meal. There is a large body of evidence in the medical literature showing the importance of vitamin C for immunity, from the common cold (Sasazuki et al (2006), Hemila (1992)) to lung function, Schwartz and Weiss(1992)) and on the absorption of iron (Cook et al (1982)). Iron, on the other hand, has been

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

found to influence cognition and concentration. We discuss in more detail the findings of the medical literature in the next section.

2. Related literature

Despite the importance of the subject in the public and policy arenas, there is only a limited number of studies on the causal effect of children's diet on health on the one hand, and educational outcomes on the other.

The medical literature has carried out a number of studies on the relationship between diet and behaviour, concentration and educational outcomes. Sorhaindo and Feinstein (2006) provide a literature review of this literature. They mention four different channels through which nutrition may affect educational outcomes. The first channel is through physical development. A poor diet leaves children susceptible to illness through a poor immune system. Greater illness results in more days absent and further a decrease in teacher contact hours which may result in a decrease in performance. The second channel is through cognition and ability to concentrate. Numerous studies have found that there is a link between diet on 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 two crucial findings in the existing studies. Firstly, good nutrition in early childhood is important in the cognitive development for both school-aged and adolescent children. Secondly, children's academic performance is altered by diet on an *instant* basis. The third channel mentioned in their review is behaviour. There is a causal link between a deficiency in vitamin B and behavioural problems; particularly this is related to aggressive behaviour and changes in personality. The research in this area is more limited. There could also be social interaction effects through peer effects within the classroom if it is the case that healthy food has an impact on behaviour. Healthy school meals could generate positive externalities on all children, through their positive effect on behaviour in the classroom. Finally, the last channel mentioned is though school life and in particular difficult school inclusion due to obesity.

Economists have recently devoted more attention to the determinants and effects of obesity, and child obesity in particular. Anderson and Butcher (2006) 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 (2005)) link school financial pressures to availability of junk food in middle and high schools, and estimate that a 10 percentage point increase in the availability of junk food 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 individual 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 – to compare children just above and just below the eligibility cut-off. She finds that students who eat school lunch 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 is a limited number of studies studying the effect of diet on educational performance, based on 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) find 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 in mathematics and to a lesser extent in History/Social Sciences. 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. Data, sample and descriptive statistics

3.1 Data and Sample

We investigate the effect of the campaign on three outcome variables: Educational outcomes, take-up rates and sickness absenteeism.

For educational outcomes, we chose to concentrate on performance in primary schools for two main reasons: 1) The recent economic literature has pointed to the importance of interventions in early childhood, 2) 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). 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.

The NPD contains information on key pupil characteristics. These include several variables such as ethnicity, a low-income marker and information on Special Education Needs (SEN), that we have matched with Keystage 2 attainment records. Key Stage 2 corresponds to the years 3-7 in England; and all pupils take a standardized test at the end of the Key Stage (in year 7, typically at the age of 11). The Key Stage 2 test has three main components: English, Maths and Sciences. We will consider these three components separately. In addition, we use data at the school level from the School Census provided by the Department for Children, School and Families (DCFS).

Second, 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.

We concentrate the analysis on the school years from 2002 to 2007, and exclude the year 2005 to avoid misclassification problems (since menus were effectively changed in the course of the school year 2004-2005)

We use seven neighbouring Local Education Countries as controls for the analysis. These LEAs were chosen because of their resemblance to Greenwich, on a number of aggregate statistics on socio-economic characteristics, such as the proportion of whites, proportion of households living in social housing and the unemployment rate. Figure 2 shows the geographical location of these LEAs and Table 1 presents summary neighbourhood statistics of these LEAs.

3.2 Descriptive statistics

Table 2 compares control and treatment schools on a number of observable characteristics, as well as educational outcomes, before and after the campaign. Although we have chosen the control LEAs for their similarities with Greenwich, there are a number of notable differences worth pointing out. The percentage of non white pupils is substantially higher in Greenwich than in the control areas. The reverse is true for the percentage of pupils speaking English as their first language. On the other hand, indicators of social deprivation, such as the Income Deprivation Affecting Children Index and the percentage of pupils eligible for free school meals are comparable in the treatment and control groups. Importantly for our analysis, these indicators are quite similar before and after the campaign.

Turning to educational outcomes, we find that most indicators do increase between 2004 and 2006, both in the treatment schools and in Greenwich. There is a slight relative improvement in performance in Greenwich in comparison to other LEAs.

We now turn to a more detailed empirical analysis.

4. Analysis

4.1 Empirical strategy

We follow closely Machin and McNally (2008) in the structure of the empirical analysis. We consider two different specifications, a first specification based on a difference-in-differences approach and a second specification using propensity matching techniques.

For the difference-in-differences approach, we estimate the following model:

$$Y_{islt} = \alpha + \beta\ \text{Greenwich}_l + \gamma\ \text{Greenwich}_l\text{*}\ \text{Post-2005}_t + \delta X_{ist} + \lambda Z_{st} + \pi_t\ T_t + \rho_l t + \varepsilon_{ist}$$

Where Y_{ist} denotes the outcome variable for pupil *i* in school *s* in LEA *l* in year *t*; Greenwich is a dummy variable equal to 1 for the LEA of Greenwich and 0 for the seven 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 2002-03, 2003-04; *X* is a vector of pupil characteristics, *Z* is a vector of school characteristics; 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 coefficient 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.

As in Machin and McNally (2008), we also estimate an equation including school fixed effects. The effect of Greenwich is captured by these school fixed effects, but we still can estimate the effect of the campaign (γ)

For the matched difference-in-difference approach we follow the basic method of Heckman, Ichimura and Todd (1997), where we estimate the propensity scores and then trim the sample based on the common support to exclude poorly matched schools. We use a sample of selected matched schools using propensity score

matching techniques on the 2003/2004, pre-policy data,. The propensity score distribution and probit model used to generate them are in the appendix.

4.2 Results

a) Effect on educational outcomes

We first study the effect of the campaign on school-level outcomes, more precisely, on the percentage of pupils reaching (1) level 3 or more, (2) level 4 or more or (3) level 5 in english, maths and science respectively.

We present two sets of results. First, we present results based on school-level data, that is, where we aggregated test scores at the school level, and introduce controls for school characteristics and school fixed effects. Second, we present results using individual pupil data, controlling for individual pupil characteristics and school characteristics.

The results for the different specifications are presented in Tables 4-7.

We find that Key stage 2 results are significantly improved, specifically in English and Science. We find a significant effect of the interaction dummy on the percentage of pupils reaching level 4 in English and on the percentage of people reaching level 5 in Science. The effects are quite substantial: In English, our estimates vary between 3 and 6 percentage points; and for science, our estimates vary between 3 and 8 percentage points.

Free school meal status

So far we have included all pupils in the analysis. However, only part of them has been truly treated, those who actually eat school meals. We do not have individual information about who is eating school meals and who is not. The only information we have is whether the pupil is eligible for free school meals. One could argue that "free school meals" pupils are more likely to have been treated than the other pupils. However, we cannot be sure that the change in diet has been most significant for these pupils in comparison to others. Thus, we should be careful with the interpretation of

the results. Table 7 reports regression results based on the sample of free school meal children only. We find that most of the positive significant effects decrease or disappear entirely. Thus, we fail to find evidence that the campaign specifically helped those children who benefit from free school meals. This result may seem counter-intuitive, as the FSM pupils should presumably be the most likely pupils in the school to be eating the meals. One possible story is that FSM pupils are those for which the change has been to most difficult to implement, since these pupils were probably eating the "unhealthy" meals on a daily basis and would therefore maybe be the most put off by the change in menus. Anecdotal evidence (from the TV programme) suggests that some children refused to eat the healthy meals, which would probably have harmed cognitive performance more than eating anything albeit something of little nutritional value.

Placebo effect

One concern is that the campaign affected educational outcomes not through the improvement in diet, but simply through a "placebo-effect". Indeed, the schools were very well aware they were part of a "pilot experiment". It could be that the effect we measure is a placebo effect rather than an actual effect of the reform.

We should note that any reform of this kind, that is, where one group of people is treated and another is not, is potentially subject to this placebo effect. In contrast to experiments in pure sciences, it is virtually impossible to think of a way of administering a placebo treatment to a control group. Any change in policy could affect outcomes simply because those who are treated know they are treated. There is usually no way researchers can be sure that the effect they estimate is truly due to the change in policy rather than a placebo effect.

Our setting, nonetheless, provides us scope to investigate the placebo effect to some extent. As the campaign was part of a program broadcast on one of the major channels in the UK, we have good reasons to believe that some schools were probably more subject to a possible placebo effect than others. Some of the treated schools were explicitly mentioned in the program, such that one could expect that for those schools, the "placebo-effect" could be stronger than others. We have extended the empirical

analysis to allow for this possibility. We added an interaction term for those schools that were explicitly mentioned during the program (note that some of them were just very briefly mentioned, there was no filming on location).

We present the results in Table 8 for English, Maths and Science respectively. The results are quite striking. The evidence points in the direction of a "disruption effect" rather than a positive placebo effect. In the case of maths, we find that the interaction coefficient is significant and negative, while we find no positive effect of the campaign overall. For English and Science, the interaction dummy is in most cases negative but is not significant. We conclude that the positive effects we have reported earlier are unlikely to be due to a placebo effect.

Additional evidence on this disruption is that there were many initial problems in the schools that took on the scheme early on. Further, as the programme was rolled out a food week was introduced, hence those later schools would have had this and the early schools were treated with just a change in the menus with little additional support. Further, there were tasting sessions for the parents that did not occur in the earlier schools.

The TV schools were among the earliest to change their menus. These schools also changed their menus before the additional funding of approximately £600,000 was agreed in the budget, hence they would have had to cover the cost of the changes, for example the additional kitchen staff hours needed to prepare the new menus, especially in the beginning from their existing budgets which would have resulted in less inputs in other areas, i.e. books and other equipment. This could also explain why those TV schools seem to perform so badly.

Heterogenous effects

We also investigated whether the reform affected pupils differently according to gender, race and statement of special educational need. The results are presented in Table 9. We find no clear evidence of heterogeneous effects. Girls seem to have been more affected, but we cannot reject that the effect of the reform was identical across

gender. Thus, we cannot conclude that the reform affected some students more than others, except according to their free school meal status (cfr. discussion above).

b) Effect on take-up rates

We now examine the effect of the campaign on the take-up rates of free school meals. We do not have information on whether children did indeed eat the food or not (the anecdotal information we have points that, indeed, 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 (conditional on eligibility).

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, which is known to be relatively low in the UK.[4]

We report the results in Table 12. We find no evidence of a change in take-up rates. Figures 5 and 6 show the evolution of eligibility and take-up rates of free school meals in each LEA. There is no obvious difference between Greenwich and the other LEAs. Hence, we conclude that the campaign has not affected take-up rates of free school meals. Obviously, this does not mean that there has been no change in the actual consumption of school meals. As we discussed earlier, the change in menus had not been implemented easily and some children were reluctant to accept the new menus. If that is the case, that means that the effects we have identified are a lower bound on the long-term effect of healthy meals.

[4] A related literature (references…) points at possible stigma effects associated with the take-up of free school meals. It is for example common practice to give free school meal children special tokens or allocate a separate cashier for them.

c) Effects on absenteeism

We now turn to the effects of campaign on absenteeism. We have information at the school level on the percentage of authorised and unauthorised absences. Authorised absences are those that are formally pre-authorised by the school, thus likely to be linked with sickness. Table 11 shows the results of the DD analysis, both on authorised an unauthorised absences. We find a substantial negative effect on authorised absences; the rate of absenteeism drops by about .80 percentage points, which corresponds to 15% of the average rate of absenteeism. On the other hand, we do not find a significant effect on unauthorised absences.

The 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. In Table 12, we compare the results we have presented earlier (in column 4 of Tables 4, 5 and 6) with results controlling for authorised absenteeism at the school level. We find that the coefficients reported earlier remain very similar. Thus, the effects on educational achievements are not driven by the change in absenteeism. However, 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.

d) Costs and benefits

Unfortunately we do not have individual or school-level information about health outcomes, so our estimates probably provide only a lower bound on the overall benefits of the program. 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 £2103 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 by the celebrity chef Jamie Oliver in the UK, to evaluate the impact of healthy school meals on educational outcomes.

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 substantial: our estimates show that the campaign increased the percentage of pupils reaching level 4 by 3 to 6 percentage points in English, and the percentage of pupils reaching level 5 by 3 to 8 percentage points in Science. Also, we find that the rate of absenteeism falls by about .80 percentage point, which is about 15% of the average rate of absenteeism.

One drawback of our analysis is that we have little information on the health outcomes of children, as well as whether children actually ate the meals or not. The anecdotal evidence suggests that some children found it hard to adjust to the new healthy menus. Our results show that test scores did *not* improve for children eligible for free school meals (and therefore from relatively less privileged socio-economic backgrounds), which were probably the ones who were the most used to the previous processed food and for whom it was the most difficult to adjust. In this light, the positive results we identify could be a lower bound on the long-term effects of a change in school meals.

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Appendix

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.

TABLES AND FIGURES

Figure 1: Sample of Jamie Oliver menus

* = 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

Figure 2: Local education authorities in the London area

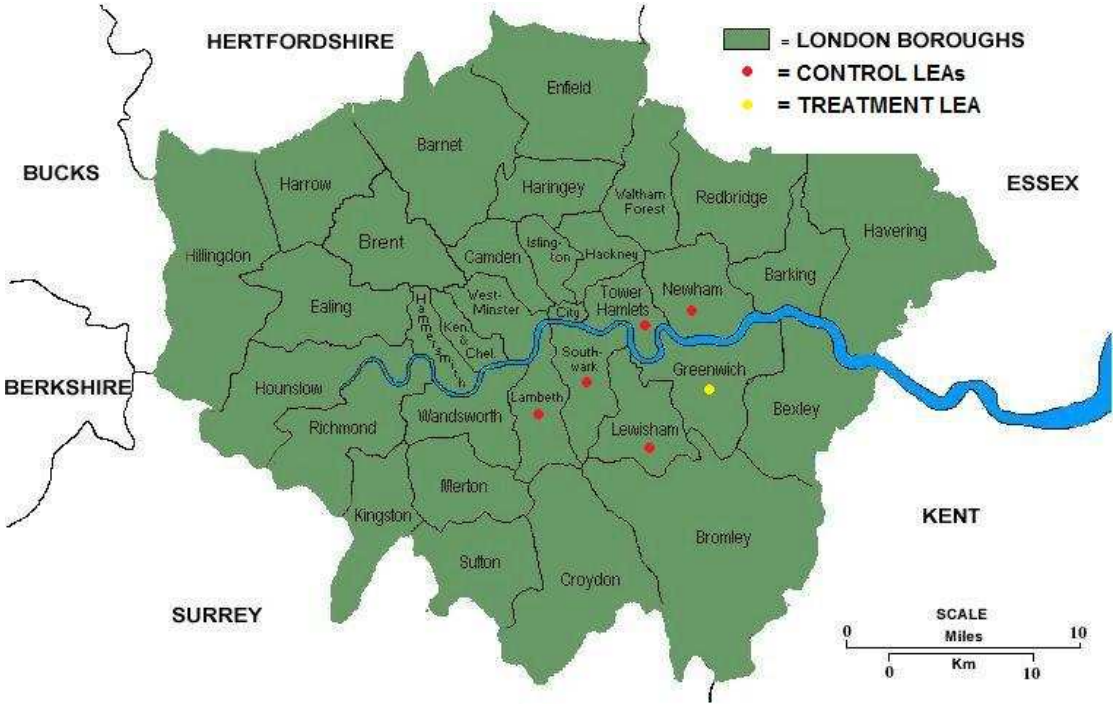

Figure 3 :Propensity scores for Greenwich (1) and Non-Greenwich (0) Schools

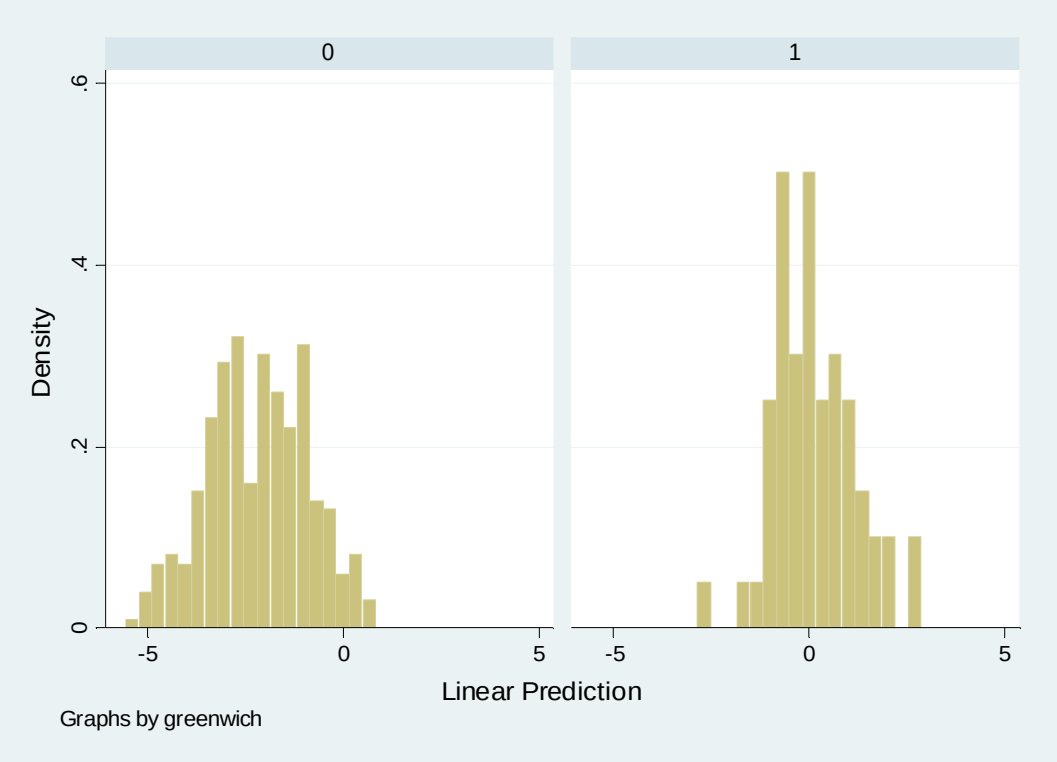

Figure 4: Free School Meal Eligibility (by LEA)

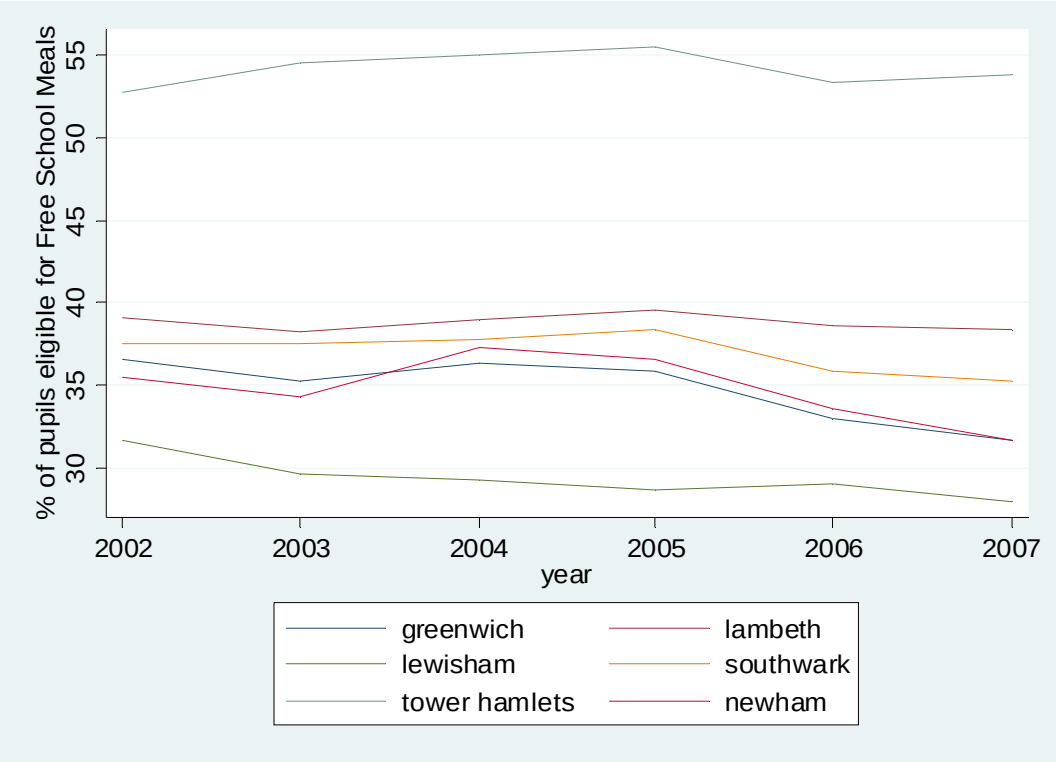

Figure 5: Free School Meal Take Up

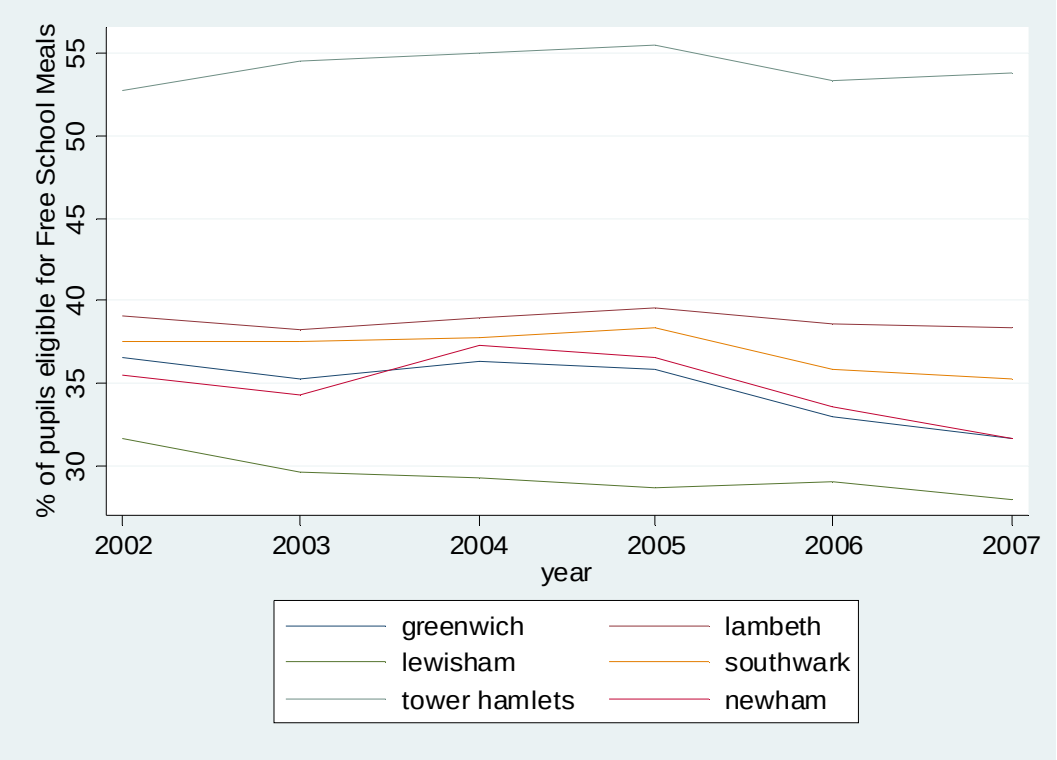

Table 1: Neighbourhood statistics

	Greenwich	Barking and Dagenham	Lambeth	Wandsworth	Southwark	Lewisham	Newham	Tower Hamlets
Proportion of whites	77.1%	85.2%	62.4%	78.0%	63.0%	65.9%	39.4%	51.4%
Long-term unemployment rate[1]	1.9%	1.4%	2.0%	1.1%	2.1%	1.9%	2.1%	2.2%
Social housing[2]	39.5%	37.1%	41.4%	23.0%	53.4%	35.6%	36.5%	52.5%
Rate of obesity[3]	20.2%	23.9%	16.8%	13.9%	19.7%	19.2%	21.2%	11.9%
Free School meals Eligility[4]	36.4%	25.3%	39.0%	32.4%	37.8%	29.2%	37.9%	55.0%

Source: Office for National Statistics (Neighbourhood statistics) [1] Obesity rates among adults (obesity is such that body mass index > 20), survey from 2003-2005;, [3] People aged 16-74: Economically active: Unemployed (Persons, census April 2001), [4] Percentage of households living in housing rented to the Local area council (Census 2001), [4] Percentage of pupils eligible for free school meals (School Census 2004)

Table 2: Control and treatment schools – Summary statistics
(Standard deviations in parentheses)

	Non-Greenwich		Greenwich	
	2004	2006	2004	2006
Average no. of pupils	341.43	302.6	308.4	278.74
	(156.75)	(134.51)	(115.65)	(107.33)
% of pupils eligible for Free School Meals	39.84	40.44	36.44	35.59
	(15.54)	(15.58)	(16.5)	(15.66)
% of pupils female	48.2	47.95	47.56	47.25
	(7.14)	(7.72)	(9.4)	(9.29)
% of pupils with some special need	25.42	27.92	27.88	30.93
	(20.13)	(19.81)	(20.02)	(20.02)
% of pupils with statement of special need	7.4	7.36	6.16	6.88
	(22.48)	(22.18)	(20.34)	(20.45)
% of pupils non-white	68.74	70.66	40.07	44.08
	(18.23)	(17.75)	(19.48)	(20.71)
& of pupils who have English as a first Language	51.11	49.42	75.21	70.42
	(26.56)	(26.46)	(16.74)	(18.31)

Average IDACI[5] score	45.15	45	39.67	38.94
	(10.65)	(10.67)	(10.49)	(9.92)
% Faith School	26.21	26.21	23.94	23.94
	(44.04)	(44.04)	(42.98)	(42.98)
English: Proportion attaining level 3 and above	87.11	89.43	86.93	89.71
	(18.09)	(17.58)	(18.13)	(15.12)
English: Proportion attaining level 4 and above	70.48	73.88	68.72	73.61
	(20.16)	(19.85)	(19.76)	(16.64)
English: Proportion attaining level 5 and above	21.71	26.16	20.88	26.51
	(14.94)	(16.41)	(15.1)	(14.24)
Maths: Proportion attaining level 3 and above	87.3	89.33	87.39	89.75
	(18.16)	(17.47)	(17.76)	(15.17)
Maths: Proportion attaining level 4 and above	68.53	71.06	68.3	72.13
	(19.16)	(19.2)	(17.83)	(17.83)
Maths: Proportion attaining level 5 and above	26.44	27.59	25.88	29.59
	(13.43)	(13.76)	(13.73)	(14.2)
Science: Proportion attaining level 3 and above	87.83	89.76	88.24	90.64
	(18.22)	(17.56)	(17.7)	(14.98)
Science: Proportion attaining level 4 and above	77.18	78.93	76.54	80
	(19.83)	(19.89)	(19.33)	(17.16)
Science: Proportion attaining level 5 and above	32.99	35.5	31.63	37.86
	(18.53)	(17.98)	(17.63)	(18.91)
Pupil Teacher Ratio	21.87	20.38	21.43	20.5
	(6.05)	(5.26)	(5.44)	(4.98)
Pupil Staff Ratio	10.83	9.81	12.29	11
	(3.03)	(2.68)	(3.34)	(2.92)
Authorised Absence (% half days missed)	4.79	5.06	5.42	5.31
	(1.13)	(1.13)	(1.08)	(1.15)
Unauthorised Absence (% half days missed)	1.05	1.08	1.24	1.27
	(1.04)	(0.92)	(1.13)	(0.96)

[5] **Income Deprivation Affecting Children Index shows the percentage of children in each SOA (Super Output Area) that live in families that are income deprived(ie, in receipt of Income Support, Income based Jobseeker's Allowance, Working Families' Tax Credit or Disabled Person's Tax Credit below a given threshold), DCSF)**

Table 3: Probability of Treatment (Greenwich=1)

	Coefficient	s.e.
English: Proportion attaining level 4 and above	-0.309	(2.478)
Maths: Proportion attaining level 4 and above	0.617	(2.419)
Science: Proportion attaining level 4 and above	-0.878	(2.442)
English: Proportion with no level due to absence/disapplication	-6.794	(12.53)
Science: Proportion with no level due to absence/disapplication	16.91	(9.425)
Maths: Proportion with no level due to absence/disapplication	-21.79	(12.43)
Percentile English score: 1st quartile	-0.0477	(0.0411)
Percentile Maths score: 1st quartile	-0.0118	(0.0279)
Percentile Science score: 1st quartile	0.0144	(0.0476)
Percentile English score: 2nd quartile	0.0296	(0.0486)
Percentile Maths score: 2nd quartile	0.0255	(0.0359)
Percentile Science score: 2nd quartile	0.00924	(0.0566)
Percentile English score: 3rd quartile	-0.0364	(0.0397)
Percentile Maths score: 3rd quartile	0.0656	(0.0310)
Percentile Science score: 3rd quartile	-0.102	(0.0585)
% of pupils eligible for Free School Meals	1.486	(1.499)
% of pupils female	5.033	(3.767)
Average idaci score	-1.014	(1.785)
% of pupils with English as a first language	-0.515	(0.884)
% of pupils non-white	-5.361	(0.986)
% of pupils with Special Educational Needs, no statement	1.435	(1.785)
% of pupils with Special Educational Needs, with statement	7.605	(7.583)
Faith School	0.607	(0.333)
Pupil Teacher Ratio	-0.0467	(0.0349)
Pupils Staff Ratio	0.243	(0.0682)
Authorised Absence	0.280	(0.122)
Unauthorised Absence	0.247	(0.137)
Observations	354	

Notes: Probit model; Coefficients and Standard errors reported, weighted by number of pupils in each school. All explanatory variables are 2003/2004 school level variables

Table 4 : Effect on educational outcomes – English Key Stage 2 results

	(1)	(2)	(3)	(4)	(5)
% Level 3 and above					
Greenwich*Post 2005	2.749	2.042	-0.327	0.350	0.479
	(3.385)	(1.905)	(1.682)	(1.659)	(2.024)
% Level 4 and above					
Greenwich*Post 2005	5.974	5.895**	3.805	4.533*	5.535*
	(3.670)	(2.574)	(2.517)	(2.541)	(3.236)
% Level 5 and above					
Greenwich*Post 2005	4.132	3.804	3.431	2.717	3.326
	(3.305)	(3.289)	(3.207)	(3.288)	(4.422)
Observations	1994	1991	1994	1991	1188
Number of Schools			416	415	239
School Controls	No	Yes	No	Yes	Yes
School Fixed Effects	No	No	Yes	Yes	Yes
Matching	No	No	No	No	Yes

Note: Standard errors in parentheses (clustered by school). *** p<0.01, ** p<0.05, * p<0.1. 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. All regressions contain specific LEA trends and year dummies. Control LEAs include: Southwark, Lewisham, Tower Hamlets, Newham and Lambeth.

Table 5: Effect on educational outcomes – Maths Key Stage 2 results

	(1)	(2)	(3)	(4)	(5)
% Level 3 and above					
Greenwich*Post 2005	2.369	1.756	-0.710	0.325	0.303
	(3.348)	(1.806)	(1.767)	(1.725)	(2.033)
% Level 4 and above					
Greenwich*Post 2005	4.278	4.028	2.467	2.467	3.227
	(3.764)	(2.986)	(2.905)	(2.926)	(3.480)
% Level 5 and above					
Greenwich*Post 2005	2.924	3.173	2.281	2.196	2.905
	(2.931)	(2.908)	(2.775)	(2.826)	(3.258)
Observations	1994	1991	1994	1991	1188
Number of Schools			416	415	239
School Controls	No	Yes	No	Yes	Yes
School Fixed Effects	No	No	Yes	Yes	Yes
Matching	No	No	No	No	Yes

See notes for table 4.

Table 6: Effect on educational outcomes – Science Key Stage 2 results

	(1)	(2)	(3)	(4)	(5)
% Level 3 and above					
Greenwich*Post 2005	1.997	1.389	-1.100	-0.197	-0.222
	(3.289)	(1.686)	(1.606)	(1.580)	(1.887)
% Level 4 and above					
Greenwich*Post 2005	4.769	4.360	2.435	3.000	4.564
	(3.973)	(2.959)	(2.841)	(2.852)	(3.549)
% Level 5 and above					
Greenwich*Post 2005	7.578**	7.534**	6.737*	6.067*	3.143
	(3.779)	(3.791)	(3.605)	(3.666)	(4.212)
Observations	1994	1991	1994	1991	1188
Number of Schools			416	415	239
School Controls	No	Yes	No	Yes	Yes
School Fixed Effects	No	No	Yes	Yes	Yes
Matching	No	No	No	No	Yes

See notes to table 4.

Table 7 : Effect on educational outcomes – Pupil Level Data

	All pupils		Free school meals pupils	
Percentile Score	(1)	(2)	(3)	(4)
English				
Greenwich*Post 2005	4.667**	2.844	1.080	-4.028
	(2.301)	(2.767)	(3.209)	(3.873)
Observations	62771	50091	25379	19838
Number of Schools	402	310	402	310
Maths				
Greenwich*Post 2005	1.713	2.038	-1.689	-3.931
	(2.249)	(2.847)	(3.088)	(3.863)
Observations	63804	50889	25968	20271
Number of Schools	403	310	402	310
Science				
Greenwich*Post 2005	3.917	2.353	0.489	-2.418
	(2.635)	(3.158)	(3.317)	(3.873)
Observations	64587	51512	26430	20649
Number of Schools	404	310	404	310
Individual & School Controls	Yes	Yes	Yes	Yes
School Fixed Effects	Yes	Yes	Yes	Yes
Matching	No	Yes	No	Yes

Note: Standard errors in parentheses (clustered by school). *** 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. All regressions contain specific LEA trends and year dummies. Control LEAs include: Southwark, Lewisham, Tower Hamlets, Newham and Lambeth.

Table 8: Effect on educational outcomes –Key Stage 2 results

School-level data

	English		Math		Science	
	(1)	(2)	(3)	(4)	(5)	(6)
% Level 3 and above						
Greenwich*Post 2005	0.277	0.0219	0.300	0.262	-0.205	-0.0262
	(1.686)	(1.925)	(1.752)	(2.059)	(1.607)	(1.824)
TV*Post 2005	0.733	0.564	0.250	0.371	0.0810	0.586
	(1.806)	(1.519)	(1.826)	(1.862)	(1.420)	(1.392)
% Level 4 and above						
Greenwich*Post 2005	4.636*	3.440	3.109	1.804	3.085	1.513
	(2.603)	(2.973)	(3.014)	(3.694)	(2.939)	(3.444)
TV*Post 2005	-1.038	-2.438	-6.440*	-7.036*	-0.843	1.031
	(3.093)	(3.295)	(3.854)	(4.050)	(2.606)	(2.999)
% Level 5 and above						
Greenwich*Post 2005	2.651	1.279	3.293	4.324	6.615*	2.581
	(3.331)	(4.125)	(2.845)	(3.293)	(3.864)	(4.383)
TV*Post 2005	0.659	-1.665	-11.00***	-17.41***	-5.502	-5.649
	(2.135)	(2.605)	(3.841)	(3.165)	(5.772)	(7.226)
Observations	1991	1594	1991	1594	1991	1594
Number of Schools	415	321	415	321	415	321
School Controls	Yes	Yes	Yes	Yes	Yes	Yes
School Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes
Matching	No	Yes	No	Yes	No	Yes

See notes to table 4.

Table 9: Effect on educational outcomes – Differences across gender, race and special educational need

	English		Maths		Science	
	(1)	(2)	(3)	(4)	(5)	(6)
Gender						
Greenwich*Post 2005*Boys	3.416	1.617	0.338	0.00622	2.244	0.448
	(2.909)	(3.612)	(2.628)	(3.338)	(3.116)	(3.834)
Greenwich*Post 2005*Girls	5.733**	3.643	2.981	3.986	5.520*	4.090
	(2.415)	(2.819)	(2.568)	(3.164)	(2.878)	(3.331)
P Value of test of no difference	0.1621	0.1630	0.6835	0.8026	0.2501	0.5596
Race						
Greenwich*Post 2005*white	3.729	3.832	3.871	5.348*	6.270**	4.903
	(2.603)	(3.301)	(2.560)	(3.181)	(2.660)	(3.183)
Greenwich*Post 2005*non-white	5.663*	2.386	-0.631	-0.691	2.093	1.045
	(2.906)	(3.130)	(3.043)	(3.455)	(3.776)	(4.299)
P Value of test of no difference	0.1169	0.0411	0.3535	0.5895	0.3497	0.2240
Special educational need						
Greenwich*Post 2005*no statement	4.837**	2.907	1.897	2.124	3.732	2.033
	(2.319)	(2.796)	(2.275)	(2.884)	(2.665)	(3.215)
Greenwich*Post 2005*statement	-7.419	4.155	-5.722	6.451	12.17	21.06**
	(10.58)	(12.08)	(9.257)	(10.35)	(8.758)	(9.225)
P Value of test of no difference	0.5277	0.6081	0.5910	0.7163	0.6659	0.8537
Individual & School Controls	Yes	Yes	Yes	Yes	Yes	Yes
School Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes
Matching	No	Yes	No	Yes	No	Yes

Table 10: Effect on educational outcomes – Free School Meal Take up Rates

	(1)	(2)	(3)	(4)	(5)
% FSM Take up rate					
Greenwich*Post 2005	0.470	0.614	-0.210	-0.379	0.129
	(1.553)	(1.331)	(1.249)	(1.146)	(1.251)
Observations	2034	2033	2034	2033	1456
Schools			421	421	292
% FSM Eligibility					
Greenwich*Post 2005	-1.100	0.182	-1.305	-0.217	-1.068***
	(1.537)	(0.460)	(1.328)	(0.436)	(0.381)
Observations	2040	2039	2040	2039	1456
Schools			421	421	292
School Controls	No	Yes	No	Yes	Yes
School Fixed Effects	No	No	Yes	Yes	Yes
Matching	No	No	No	No	Yes

See notes to table 4.

Table 11: Effect on Absenteeism

	(1)	(2)	(3)	(4)	(5)
Authorised Absenteeism					
Greenwich*Post 2005	-0.821***	-0.867***	-0.852***	-0.782***	-0.409
	(0.260)	(0.275)	(0.260)	(0.273)	(0.339)
Observations	1859	1853	1859	1853	1184
Schools			381	380	239
Unauthorised Absenteeism					
Greenwich*Post 2005	-0.299	-0.434*	-0.299	-0.404	-0.0485
	(0.256)	(0.250)	(0.250)	(0.261)	(0.289)
Observations	1783	1777	1783	1777	1157
Schools			380	379	239
Total Absenteeism					
Greenwich*Post 2005	-1.101***	-1.254***	-1.149***	-1.201***	-0.484
	(0.347)	(0.357)	(0.341)	(0.365)	(0.399)
Observations	1783	1777	1783	1777	1157
Schools			380	379	239
School Controls	No	Yes	No	Yes	Yes
School Fixed Effects	No	No	Yes	Yes	Yes
Matching	No	No	No	No	Yes

Table 12 – Effect on Educational Outcomes controlling for absenteeism

	English		Maths		Science	
	No controls for absenteeism rate	Controlling for authorised absenteeism	No controls for absenteeism rate	Controlling for authorised absenteeism	No controls for absenteeism rate	Controlling for authorised absenteeism
% Level 3 and above	0.350	0.369	0.325	0.432	-0.197	-0.174
Greenwich*Post 2005	(1.659)	(1.693)	(1.725)	(1.640)	(1.580)	(1.524)
% Level 4 and above	4.533*	4.597*	2.467	3.247	3.000	4.135
Greenwich*Post 2005	(2.541)	(2.706)	(2.926)	(2.953)	(2.852)	(2.964)
% Level 5 and above	2.717	2.722	2.196	2.715	6.067*	6.881*
Greenwich*Post 2005	(3.288)	(3.566)	(2.826)	(3.062)	(3.666)	(3.950)
Observations	1991	1848	1991	1848	1991	1848
Number of Schools	415	380	415	380	415	380
School Controls	Yes	Yes	Yes	Yes	Yes	Yes
School Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes
Matching	No	No	No	No	No	No