The Effect of Fast Food Restaurants on Obesity

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Abstract. We investigate the health consequences of the supply of fast food restaurants in an area. Specifically, using a detailed dataset on the exact geographical location and date of opening of new restaurant establishments, we estimate how the supply of fast food restaurants in an area affects obesity rates of 3 million school children and weight gain of over 1 million pregnant women. To address the concerns about the endogenous location of fast-food restaurants, we document that the presence of a fast-food at very close distance from a school appears largely idiosyncratic. In addition, the net openings of fast-foods near the mother's residence are not positively related to increases in the demographic predictors of obesity. We find that among 9th grade children, the opening of a new fast food restaurant within a tenth of a mile of a school is associated with a 11 percent increase in the obesity rate in that school. There is no discernable effect at .25 miles and at .5 miles. Among pregnant mothers, using models with mother fixed effects we find that the opening of a new fast food restaurant within a tenth of a mile of a residence result in a 4.4 percent increase in the probability of gaining over 20 kilos. The effect is smaller but also discernable at .25 miles and at .5 miles. In both samples, the opening of non-fast food restaurants has no correlation with obesity and weight gain. Moreover, the opening of a fast food restaurant in the future has no correlation with current obesity and weight gain, conditional on current fast food supply. The results are consistent with a model in which access to fast-foods increases obesity by lowering food prices or by tempting consumers with self-control problems. The difference in travel costs between students and mothers can explain the different effects of proximity.

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1. Introduction

The prevalence of obesity and obesity related diseases has increased rapidly in the U.S. since the mid 1970s. At the same time, the number of fast food restaurants has also increased rapidly. According to the Census of Retail Trade, the number of fast food restaurants more than doubled over the same time period, while the number of other restaurants grew at a much slower pace (Chou, Grossman, and Saffer, 2004). In the public debate over obesity it is often assumed that the widespread availability of fast food restaurants is an important determinant of the dramatic increases in obesity rates. Policy makers in several cities have responded by restricting the availability or content of fast food, or by requiring posting of the caloric content of the meals (Mcbride, 2008; Mair et al. 2005). But the evidence linking fast food and obesity is not strong. Much of it is based on correlational studies in small data sets.

In this paper we seek to identify the causal effect of increases in the supply of fast food restaurants in an area on obesity rates in that area. Specifically, using a detailed dataset on the exact geographical location and date of opening of new restaurant establishments, we estimate how the supply of fast food restaurants in an area affects the obesity rates of 3 million school children and the weight gain of over 1 million pregnant women.

For school children, we observe obesity rates for 9th graders in California over several years, and we are therefore able to estimate cross-sectional as well fixed effects models that control for characteristics of schools and neighborhoods. In the fixed effect specifications, the identification of the effect of fast food on student obesity rates arises from relating changes in the obesity rates of students in a given grade and schools to *changes* in the number of fast food restaurants near that school. For mothers, we employ the information on weight gain during pregnancy reported in the Vital Statistics data for Michigan, New Jersey, and Texas covering fifteen years.[1] We focus on women who have at least two children so that we can follow a given woman across two pregnancies and estimate models that include mother fixed effects. Identification arises from relating the change in weight gain for a given mother between her first and second pregnancy to the change in the number of fast food restaurants in the immediate vicinity of her residence.

The design employed in this study allows for a more precise identification of the effect of fast-food on obesity compared to the previous literature (summarized in Section 2) along two key dimensions. First, we observe information on weight for millions of individuals compared to at most tens of thousand in the standard data sets with weight information such as the NHANES and the BRFSS. This increases substantially the power of our estimates. Second, we exploit very detailed geographical location information, including distances of only one tenth of a mile. By comparing groups of individuals that are only at slightly different distances to a restaurant, we can arguably diminish the impact of unobservable differences in characteristics between the two groups.

While it is clear that fast food is generally unhealthy, it is a priori not obvious whether changes in the availability of fast food restaurants should necessarily be expected to have an impact on health. On one hand, it is possible that the opening of a new fast food restaurant may simply lead local consumers to substitute away from unhealthy food

[1] The Vital Statistics data reports only the weight gain and not the weight at the beginning (or end) of the pregnancy. While the weight gain during pregnancy could in principle respond differently to fast-food exposure than weight gain in other periods, there is no evidence that this is the case. One advantage of focusing on a longitudinal measure of weight gain instead of a measure of weight in levels is that only the recent exposure to fast-food should matter.

prepared at home or consumed in existing restaurants, without significant changes in the overall amount of unhealthy food consumed. On the other hand, the opening of a fast food restaurant is likely to affect the intake of unhealthy food if it significantly lowers the monetary and non-monetary costs of accessing unhealthy food. This may happen if the opening of a new fast food restaurant results in more competition and therefore a lower monetary price for unhealthy food in that area; or if the opening of a new fast food restaurant significantly lowers the travel cost to access unhealthy food. In addition, the opening of a fast food restaurant may increase consumption of unhealthy food even in the absence of any cost advantage if some individuals have self-control problems.

Ultimately, the effect of changes in the supply of fast food on obesity is an empirical question. We find that among 9th grade children, the presence of a fast-food restaurant within a tenth of a mile of a school is associated with an increase of about 1 percentage points in the fraction of students in a class who are obese. In the school fixed effect specification, the opening of a new fast food restaurant within a tenth of a mile of a school is associated with an increase of 3.7-4.6 percentage points. Compared to the overall obesity rate, this effect amounts to a 11 percent increase in the incidence of obesity. Consistent with highly non–linear transportation costs, we find no discernable effect at .25 miles and at .5 miles. The obesity effect varies across genders and racial groups. Specifically, the effect is largest for Hispanic students and female students.

Among pregnant mothers, we find that the opening of a new fast food restaurant within a tenth of a mile of a residence results in 0.56 percentage points higher probability of gaining over 20kg. This amounts to a 4.4 percent increase in the probability of gaining over 20 kilos. The effect declines with distance, but, unlike for 9th graders, it is still discernable at .25 miles and at .5 miles. The effect varies across races and is largest for African American mothers.

Overall, our findings suggest that increases in the supply of fast food restaurants have a significant effect on obesity, especially among adolescent children. An important question for interpreting our results is to what extent our estimates only measure the effect of increases in the supply of fast food restaurants. It is in principle possible that our estimates reflect, at least in part, unmeasured shifts in the demand for fast food. This is a concern, because fast food chains are likely to open new restaurants where they expect demand to be strong, and higher demand for unhealthy food is almost certainly correlated with higher risk of obesity. The presence of unobserved determinants of obesity that may be correlated with increases in the number of fast food restaurants would lead us to overestimate the importance of fast food restaurants for obesity.

We can not fully rule out this possibility. However, three pieces of evidence lend some credibility to our interpretation. First, we find that observable characteristics of the schools are not associated with changes in the availability of a fast food in the immediate vicinity of a school. We also find that, conditioning on mother fixed effects, the observable characteristics of mothers that predict high weight gain are negatively (not positively) related to the presence of a fast-food chain, suggesting that any bias in our estimates may be downward, not upward. While these findings do not necessarily imply that changes in the supply of fast food restaurants are also orthogonal to unobserved determinants of obesity, they are at least consistent with our identifying assumption.

Second, while we find that the opening of a new fast food restaurant is associated with increases in obesity rates and weight gains, the opening of a new non-fast food restaurant has no discernible effect on obesity rates or weight gains. This suggests that our estimates are not just capturing increases in the local demand for restaurant establishments.

Third, if fast food restaurants open in areas that experience unobserved upward trends in demand for fast food, it is possible that current obesity rates may be correlated with future fast food restaurants openings. However, we find that while the opening of a new fast food restaurant affects current obesity rates, future opening of fast food restaurants have no effect on current obesity rates and weight gains. Taken together, the weight of the evidence is at least consistent with a causal effect of fast food restaurants on obesity rates among 9^{th} graders and weight gains among pregnant women.

The results on the impact of fast-food on obesity are consistent with a model in which access to fast-foods increases obesity by lowering food prices or by tempting consumers with self-control problems. The differences in travel costs between students and mothers explain the different effects of proximity: 9^{th} graders have much higher travel costs and hence are only affected by fast-food adjacent to the school. Women, instead, can travel more easily and hence are affected also by the availability of fast-food further away.

While the main motivation for focusing on school children and pregnant women is the availability of geographically detailed data on weight measures for a very large sample, they are important groups to study in their own right. Among school aged children 6-19 rates of overweight have soared from about 5% in the early 1970s to 16% in 1999-2002 (Hedley et al. 2004). These rates are of particular concern given that children who are overweight are more likely to be overweight as adults, and are increasingly suffering from diseases associated with obesity while still in childhood (Krebs and Jacobson, 2003). At the same time, the fraction of women gaining over 60 pounds during pregnancy doubled between 1989 and 2000 (Lin, forthcoming). Excessive weight gain during pregnancy is often associated with higher rates of hypertension, C-section, and large-for-gestational age infants, as well as with a higher incidence of later maternal obesity (Gunderson and Abrams, 2000; Rooney and Schauberger, 2002; Thorsdottir et al., 2002; Wanjiku and Raynor, 2004).[2] Moreover, Figure 1 shows that the incidence of low birth weight, an indicator of poor fetal health, increases sharply with weight gain above 20 kilograms.

The remainder of the paper is organized as follows. In Section 2 we review the existing literature. In Section 3 we describe our data sources. In Section 4, we present our econometric models and our empirical findings. Section 5 concludes.

2. Background

Critics of the fast food industry point to several features that may make fast food less healthy than other types of restaurant food (Spurlock, 2004; Schlosser, 2002). These include low monetary and time costs, large portions, and high calorie density of signature menu items. Indeed, energy densities for individual food items are often so high that it would be difficult for individuals consuming them not to exceed their average recommended dietary intakes (Prentice and Jebb, 2003). Some consumers may be particularly vulnerable. In two randomized experimental trials involving 26 obese and 28

[2] Birth certificates, our source of data for pregnant women, report weight gain but not pre-pregnancy weight. Obesity and high weight gain appear to be independently associated with poor pregnancy outcomes. Weight gain tends to be less in the obese than in other women.

lean adolescents, Ebbeling et al. (2004) compared caloric intakes on “unlimited fast food days” and “no fast food days”. They found that obese adolescents had higher caloric intakes on the fast food days, but not on the no fast food days.

The largest fast food chains are also characterized by aggressive marketing to children. One experimental study of young children 3 to 5 offered them identical pairs of foods and beverages, the only difference being that some of the foods were in McDonald’s packaging. Children were significantly more likely to choose items perceived to be from McDonald’s (Robinson et al. 2007). Chou, Grossman, and Rashad (forthcoming) use data from the National Longitudinal Surveys (NLS) 1979 and 1997 cohorts to examine the effect of exposure to fast food advertising on overweight among children and adolescents. In ordinary least squares (OLS) specifications, they find significant effects in most specifications.[3] This works suggest that close proximity to fast food restaurants might matter.

Still, a recent review of the considerable epidemiological literature about the relationship between fast food and obesity (Rosenheck, 2008) concluded that “Findings from observational studies as yet are unable to demonstrate a causal link between fast food consumption and weight gain or obesity”. Most epidemiological studies have longitudinal designs in which large groups of participants are tracked over a period of time and changes in their body mass index (BMI) are correlated with baseline measures of fast food consumption. These studies typically find a positive link between obesity and fast food consumption. However, observational studies cannot rule out potential

[3] They also estimate instrumental variables (IV) models using the price of advertising as an instrument. However, while they find a significant “first stage”, they do not report the IV estimates because tests suggest that advertising exposure is not endogenous. They also estimate, but do not report individual fixed effects models, because these models have much larger standard errors than the ones reported.

confounders such as lack of physical activity, consumption of sugary beverages, and so on. Moreover, all of these studies rely on self-reported consumption of fast food. A typical question is of the form "How often do you eat food from a place like McDonald's, Kentucky Fried Chicken, Pizza Hut, Burger King or some other fast food restaurant?"

There is also a rapidly growing economics literature on obesity, reviewed in Philipson and Posner (2008). Economic studies place varying amounts of emphasis on increased caloric consumption as a primary determinant of obesity (a trend that is consistent with the increased availability of fast food). Using data from the NLSY, Lakdawalla and Philipson (2002) conclude that about 40% of the increase in obesity from 1976 to 1994 is attributable to lower food prices (and increased consumption) while the remaining is due to reduced physical activity in market and home production. Bleich et al. (2007) examine data from several developed countries and conclude that increased caloric intake is the main contributor to obesity.

Cutler et al. (2003) examine food diaries as well as time use data from the last few decades and conclude that rising obesity is linked to increased caloric intake and not to reduced energy expenditure. They suggest that the increased caloric intake is from greater frequency of snacking, and not from increased portion sizes at restaurants or fattening meals at fast food restaurants. They further suggest that technological change has lowered the time cost of food preparation which in turn has lead to more frequent consumption of food. Finally, they speculate that people with self control problems are over-consuming in response to the fall in the time cost of food preparation. Cawley (1999) discusses a similar behavioral theory of obesity as a consequence of addiction.

Courtemanche and Carden examine the impact on obesity of Wal-Mart and warehouse club retailers such as Sam's club, Costco and BJ's wholesale club which compete on price. They link store location data to individual data from the Behavioral Risk Factor Surveillance System (BRFSS.) They find that non-grocery selling Wal-Mart stores reduce weight while non-grocery selling stores and warehouse clubs either reduce weight or have no effect. Their explanation is that reduced prices for everyday purchases expand real incomes, enabling households to substitute away from cheap unhealthy foods to more expensive but healthier alternatives.

A few papers explicitly focus on fast food restaurants as potential contributors to obesity. Chou et al. (2004) estimate models combining state-level price data with individual demographic and weight data from the Behavioral Risk Factor Surveillance surveys. They find a positive association between obesity and the per capita number of restaurants (fast food and others), and a negative association between obesity and real fast-food restaurant price. Rashad, Grossman, and Chou (2005) present similar findings using data from the National Health and Nutrition Examination Surveys. But it is possible that underlying preferences for greater and more convenient food consumption drive both increased obesity and more fast food availability.

Anderson and Butcher (2005) investigate the effect of school food policies on the BMI of adolescent students using data from the NLSY97. The key identification assumption is that variation in financial pressure on schools across counties provides exogenous variation in availability of junk food in the schools. They find that a 10 percentage point increase in the probability of access to junk food at school can lead to about 1 percent increase in students' BMI. Anderson, Butcher and Schanzenbach (2007) examine the elasticity of children's BMI with respect to mother's BMI and find that it has increased over time, suggesting an increased role for environmental factors in child obesity. Anderson, Butcher, and Levine (2003) find that maternal employment is related to childhood obesity, and speculate that employed mothers might spend more on fast food. Cawley and Liu (2007) use time use data and find that employed women spend less time cooking and are more likely to purchase prepared foods.

Anderson and Matsa (2007) examine the link between eating out and obesity using the presence of Interstate highways in rural areas as an instrument for restaurant density. Interstate highways provide a plausibly exogenous boost to restaurant density for communities adjacent to highways, reducing the travel costs of eating out for people in these communities. Anderson and Matsa find no evidence of a causal link between restaurants and obesity – the distributions of BMI in highway and non-highway rural areas are almost identical. Using food intake data from the US Department of Agriculture, Anderson and Matsa suggest two reasons for why restaurants may not be contributing to obesity. First, there is selection bias in restaurant patrons – people who eat out also consume more calories when they eat at home. Second, relatively large portions at restaurants are partly offset by lower caloric intake at other times of the day.

This paper differs from Anderson and Matsa (2007) in three main dimension: (i) we estimate separately the impact of fast-foods and of other restaurants, while Anderson and Matsa (2007) estimates jointly the effect of all restaurants; (ii) we take advantage of a very large sample that allows us to identify even small effects, such as increases by 50 grams in the weight gain of mothers during pregnancy; (iii) we do not have an instrument for fast-food availability and focus the analysis on availability of fast-foods at very close distances, which is less likely to be endogenous. In light of these differences, our results are consistent with theirs. Our findings of a net impact of restaurants on mother weight gain are limited to top-10 fast-food restaurants, which are a small minority of the restaurants that will be attended because of proximity to the highway. In addition, the small (but statistically significant) point estimates of weight gain for mothers are plausibly within the confidence interval of their estimates.

In summary, there is strong evidence of correlations between fast food consumption and obesity. It has been more difficult to demonstrate a *causal* role for fast food. In this paper we tap new data in an attempt to test the causal connection between fast food and obesity.

3. Data Sources and Summary Statistics

Data for this project comes from three sources.

(a) School Data. Data on children comes from a class-year level data set on 5th, 7th, and 9th graders in California public schools for the years 1999 and 2001 to 2007. The observations for 9th graders, which we focus on in this paper, represent 3.06 million student-year observations. In California, students in these grades are given a fitness assessment, the FITNESSGRAM®, developed by The Cooper Institute. The test is administered in the Spring of each year. Data is reported at the class level in the form of the percentage of students who are obese, and who have acceptable levels of abdominal strength, aerobic capacity, flexibility, trunk strength, and upper body strength. Obesity is measured using actual body fat measures, which are considerably more accurate than the usual BMI measure (Cawley and Burkhauser, 2006). Data is also reported for sub-groups within the school (e.g. by race and gender) provided the cells have 10 students.

This administrative data set is merged to information about schools (including the percent black, white, Hispanic, and Asian, percent immigrant, pupil/teacher ratios, fraction eligible for free lunch etc.) from the National Center for Education Statistics Common Core of Data. The location of the school was also geocoded using ArcView. Finally, we merged in information about the location of the school from the 2000 Census including the median earnings, percent high-school degree, percent unemployed, and percent urban in the closest Census block group.

(b) **Mothers Data.** Data on mothers come from Vital Statistics Natality data from Michigan, New Jersey, and Texas. These data are from birth certificates, and cover all births in these states from 1989 to 2003 (from 1990 in Michigan). For these three states, we were able to gain access to confidential data including mothers names, birth dates, and addresses, which enabled us both to construct a panel data set linking births to the same mother over time, and to geocode her location (again using ArcView). The Natality data are very rich, and include information about the mother's age, education, race and ethnicity; whether she smoked during pregnancy; the child's gender, birth order, and gestation; whether it was a multiple birth; and maternal weight gain. We restrict the sample to singleton births and to mothers with at least two births in the sample, for a total of over 3.5 million births.

(c) **Restaurant Data.** Restaurant data with geo-coding information come from the National Establishment Time Series Database (Dun and Bradstreet). We obtained a panel of virtually all firms in Standard Industrial Classification 58 from 1990 to 2006, with names and addresses. Using this data, we constructed several different measures of "fast food" and "other restaurants," as discussed further in Appendix 1. In this paper, the benchmark definition of fast-food restaurants includes only the top-10 fast-food chains, namely, Mc Donalds, Subway, Burger King, Taco Bell, Pizza Hut, Little Caesars, Kfc, Wendys, Dominos Pizza, and Jack In The Box. We also show estimates using a broader definition that includes both chain restaurants and independent burger and pizza restaurants. Finally, we also measure the supply of non-fast food restaurants. The definition of "other restaurants" changes with the definition of fast food. Appendix Table 1 lists the top 10 fast food chains in California, New Jersey and Michigan, as well as examples of restaurants that we did not classify as fast food.

(d) **Matching.** Matching was performed using information on latitude and longitude of restaurant location. Specifically, we match the schools and mother's residence to the closest restaurant establishments using the ArcView software. For the school data, we match the results on testing for the spring of year *t* with restaurant availability in year *t-1*. For a subset of existing restaurants, we manually double checked their exact location using web search and found that the reported location is generally correct. For the mother data, we match the data on weight gain during pregnancy with the restaurant availability in the year that overlaps the most with the pregnancy.

Summary Statistics. Using the data on restaurant, school, and mother's locations, we constructed indicators for whether there are fast food or other restaurant within .1, .25, and .5 miles of either the school or the mother's residence. Table 1a shows summary characteristics of the schools data set by distance to a fast food restaurants. Here as in most of the paper we use the narrow definition of fast-food, including the top-10 fast-food chains. Relatively few schools are within .1 miles of a fast food restaurant, and the characteristics of these schools are somewhat different than those of the average California school. Only 7% of schools has a fast food restaurant within .1 miles, 65% of all schools has a fast food restaurant within 1/2 of a mile.[4] Schools within .1 miles of a fast food restaurant have more Hispanic students, a slightly higher fraction of students eligible for free lunch, and lower test scores. They are also located in poorer and more urban areas. The last row indicates that schools near a fast food restaurant have a higher incidence of obese students than the average California school due to either a causal effect or to selection.

Table 1b shows a similar summary for the mother data. Again, mothers who live near fast food restaurants have different characteristics than average mother. They are younger, less educated, more likely to be black or Hispanic, and less likely to be married.

4. Empirical Analysis

We begin in Section 4.1 by describing our econometric models and our identifying assumptions. In Section 4.2 we show the correlation between restaurant location and student characteristics for the school sample, and the correlation between restaurant location and mother characteristics for the mother sample. Our empirical estimates for students and mothers are in Section 4.3 and 4.4, respectively.

4.1 Econometric Specifications

[4] The average school in our sample had 4 fast foods within 1 mile and 24 other restaurants within the same radius.

Our empirical specification for schools is

$$(1) \quad Y_{st} = \alpha\, F1_{st} + \beta\, F25_{st} + \gamma\, F50_{st} + \alpha'\, N1_{st} + \beta'\, N25_{st} + \gamma'\, N50_{st} + \delta\, X_{st} + \theta\, Z_{st} + d_s + e_{st}$$

where Y_{st} is the fraction of students in school *s* in a given grade who are obese in year *t*; $F1_{st}$ is an indicator equal to 1 if there is a fast food restaurant within .1 mile from the school in year *t*; $F25_{st}$ is an indicator equal to 1 if there is a fast food restaurant within .25 miles from the school in year *t*; $F50_{st}$ is an indicator equal to 1 if there is a fast food restaurant within .5 mile from the school in year *t*; $N1_{st,}$ $N25_{st}$ and $N50_{st}$ are similar indicators for the presence of non-fast food restaurants within .1, .25 and .5 miles from the school; d_s is a fixed effect for the school.

The vectors X_{st} and Z_{st} include school and neighborhood *time-varying* characteristics that can potentially affect obesity rates. Specifically, X_{st} is a vector of school-grade specific characteristics including fraction blacks, fraction native Americans, fraction Hispanic, fraction immigrants, fraction female, fraction eligible for free lunch, whether the school is qualified for Title I funding, pupil/teacher ratio, and 9th grade tests scores, as well as school-district characteristics such as fraction immigrants, fraction of non-English speaking students (LEP/ELL), share of IEP students. The controls Z_{st} is a vector of characteristics of the Census block closest to the school including median income, median earnings, average household size, median rent, median housing value, percent white, percent black, percent Asian, percent male, percent unmarried, percent divorced, percent with a high school degree, percent with an associate degree, percent with college degree, percent with a post-graduate degree, percent in the labor force, percent employed, percent with household income under \$10,000, percent with household income above \$200,000, percent urban, percent of the housing stock that is owner occupied.

We estimate this regression separately for each grade, although we mainly focus on 9th graders, since they are old enough to have more discretion on where to eat. To account for heteroskedasticity caused by the fact that cells vary in size, we weight all our models by the number of students in each cell. To account for the possible correlation of the residual e_s within a school, we report standard errors clustered by school.

In the cross-sectional specification without school fixed effects *d,* the identification of the effect of fast food on student obesity rates arises from relating obesity rates for 9th grade students in a given school to the number of fast food restaurants near that school, holding constant all the controls. In the specification with school fixed effects, the identification depends on changes in obesity rates for schools that experience a change in the fast-food presence in the vicinity of the school. In this latter specification, while the sample includes all schools, only schools that experience a change in the number of fast food restaurants effectively contribute to the estimation of the parameters α, β and γ. In either specification, the key identifying assumption is that after conditioning on the vectors X and Z, and on the number of non-fast food restaurants (as well as on the school effects in the fixed effect specification), the determinants of obesity other than fast food restaurants rates are not systematically correlated with the number of fast food restaurants. In sub-section 4.2 below we report some evidence intended to probe the validity of this assumption.

When estimating equation 1, we define the fast food indicators $F1_{st,}$ $F25_{st}$ and $F50_{st}$ as not mutually exclusive. Similarly, we define the non-fast food indicators $N1_{st,}$ $N25_{st}$ and $N50_{st}$ as not mutually exclusive. For example, the coefficient α is the difference in the effect of opening a fast food restaurant within .1 mile and the effect of opening a fast food restaurant within .25. This implies that to compute the effect of opening a fast food restaurant within .1 mile one needs to sum the three coefficients α+β+γ. In some models, we report a more parsimonious specification where only dummies for fast food closer than .1 miles are included:

$$Y_{st} = \alpha\, F1_{st} + \alpha'\, N1_{st} + \delta\, X_{st} + \theta\, Z_{st} + d_s + e_{st} \qquad (2)$$

Of course, estimates of this specification are easier to read than estimates of equation 1, since the coefficient α represents the effect of opening a fast food restaurant within .1 mile.

When we use our sample of mothers, our econometric specification is

$$Y_{it} = \alpha\, F1_{it} + \beta\, F25_{it} + \gamma\, F50_{it} + \alpha'\, N1_{it} + \beta'\, N25_{it} + \gamma'\, N50_{it} + \delta\, X_{it} + d_i + e_{it} \qquad (3)$$

where Y_{it} is either an indicator equal 1 if mother *i* gains more than 20Kg during her *t*th pregnancy or mother *i*'s weight gain during her *t*th pregnancy; X_{it} is a vector of time-varying mother characteristics that may affect weight gain including age dummies, four dummies for education, dummies for race, Hispanic status, an indicator equal to 1 if the mother smokes during pregnancy, and indicator for male child, dummies for parity, marital status and year dummies;[5] and d_i is either a mother fixed effect or, in some models, a zip code fixed effect. To account for the possible correlation of the residual e_{it} for the same individual over time, we report standard errors clustered by mother or zip code.

In one set of specifications we include zip-code fixed effects for the residence of the mother. In this specification, similarly to the fixed effect specification for the schools, identification of the effect of fast food arises from *changes over time* in the number of fast food restaurants near the relevant mother's residence. In models that include mother fixed effects, estimates of the effect come from relating the *change in weight gain* for a given mother between her first and second pregnancy to the *change in the number of fast food restaurant*s in the immediate vicinity of her residence. In the latter case, only mothers who experience changes in the number of fast food restaurants between their first and second pregnancy effectively contribute to the estimation of the parameters α, β, and γ. Variation in weight gain of mothers for whom the number of fast food restaurant is fixed is fully absorbed by the fixed effect and therefore does not contribute to the identification of the effect. In models that include zip code fixed effects, identification of the parameters α, β, and γ arise from the comparison of the average weight gain of all mothers in a given zip code before and after the change in the number of fast food restaurant in the zip code, after conditioning on the vector X.

The key identifying assumption is that after conditioning on individual (or zip code) fixed effects, the vector X, and the number of non-fast food restaurants, changes in other determinants of obesity rates are not systematically correlated with changes the

[5] Also included are indicators for missing education, race, Hispanic status, smoking and marital status.

number of fast food restaurants. Below we report some evidence that is consistent with this assumption.

Like for the school models, when we estimate equation 3, we define the fast food indicators $F1_{i,}$ $F25_i$ and $F50_i$ and the non-fast food indicators $N1_{i,}$ $N25_i$ and $N50_i$ as not mutually exclusive. In some models, we also report a more parsimonious specification where only dummies for fast food closer than a given distance are included:

$$(4) \qquad Y_i = \alpha\, F1_i + \alpha'\, NX_i + \delta\, X_i + d_i + e_i$$

Where NX_I is an indicator for availability of a fast food restaurant <.1 miles; <.25 miles or <.50 miles.

4.2 Correlates of Obesity and Opening of Fast Food Restaurants

To investigate the plausibility of our identifying assumptions, in this sub-section we test whether observable characteristics of students (mothers) are associated with levels of (and changes in) the availability of a fast food near a school (her residence), after conditioning on our controls. Finding that, after conditioning on our controls, the location of fast food restaurants remains correlated with observable student (mother) demographic or socio-economic characteristics may indicate that the location of fast food restaurants are also correlated with unobservable determinants of obesity and therefore may cast doubt on our identifying assumptions.

We begin in column 1 and 2 of Table 2A, Panel A by showing what observable characteristics of students are associated with higher risk of obesity. Entries are estimates of models where the dependent variable is the percentage of students in the 9th grade who are classified as obese. The unit of observation is a school-grade-year for schools in California in the years 1999 and 2001-2007. Standard errors clustered by school are shown in parenthesis.

Column 1 indicates that the share of African American students and Hispanic students is associated with higher obesity rates, after conditioning on a vector of school-level controls from the Common-Core data and a vector of demographic controls that measure socio-economic characteristics of the block that is closest to the relevant school. Notably, average test scores are strongly negatively associated with obesity. Column 2 indicates that conditioning on school fixed effects, the correlations between obesity and race, and between obesity and test scores remain largely significant.

Columns 3 to 8 explore the correlation between observable student characteristics and availability of fast food restaurants near the school. Specifically, the dependent variables in columns 3-8 are indicator variables for the presence of at least one fast-food restaurant within a given distance from the school. Models in columns 3 to 5 control for school characteristics and Census block characteristics. Models in columns 6 to 8 also include school fixed effects. In both cases, we include a control for availability of non-fast-food restaurants at the same distance.

In the cross-sectional specifications (columns 3 to 5) the most important determinant of fast-food availability is the presence of a non-fast-food restaurant. Beyond this variable, the only variable that predicts (positively) the availability of fast-food restaurants is the urban status. Indeed, when we consider jointly all the demographic controls (excluding the presence of other restaurants), these controls are not jointly significant predictors of the availability of fast-food at the .25 miles or 1. mile distance (although they are at the .5 mile distance). This stands in stark contrast to the strong effect that the demographic controls have on the obesity measure. The presence of a fast-food restaurant at very close distance from the school, hence, is not systematically correlated with demographic factors, including the ones (like share African American and share Hispanic) that predict obesity. If selection on observable variables is similar to selection on unobservable variables (as in Altonji, Elder and Taber, 2005), this finding indicates that cross-sectional models that condition on our controls should yield consistent estimates.

To elaborate on this idea, in Panel B we generate the best linear predictor of the share of obese students using the full set of controls X and Z, including the ones shown in Column 1 of Table 2A, Panel A. We then regress the indicator variables for the availability of a fast-food restaurant on this predicted share of obese students and on a control for the availability of other restaurants. The coefficient on the predicted variable indicates how much fast-food availability loads on the same observables that predict obesity. If this variable loads positively, it indicates that the same variables that predict obesity also predict fast-food availability, indicating the potential for a spurious positive correlation between fast-food and obesity. We find that, while this obesity predictor is significantly correlated with availability of fast-food within .5 miles of a school, it is not correlated with the availability of fast-food at closer distances (.25 miles or .1 mile). This indicates that the selection on unobservables may not be as important a concern at short distances.

We perform a similar analysis for the fixed effect specifications (columns 6 to 8). We find that no variable systematically predicts the entry (or exit) of fast-foods near schools. As in the cross-sectional evidence, we cannot reject the joint hypothesis that all the demographic controls do not affect the presence of fast-food within .25 miles or within .1 miles of a school. In addition, we also find no evidence that the predicted share of obese kids correlates with the availability of fast-food. These results suggest that in the fixed effect specification the observables that determine obesity rates are not significant determinants of fast-food availability, allaying some of the concerns about endogeneity of the fast-food measure.

Overall, we find no systematic evidence of an effect of demographic controls on fast-food availability at very close distance from a school. While this finding does not necessarily imply that changes in the supply of fast food restaurants are also orthogonal to unobserved determinants of obesity, it is at least consistent with our identifying assumption.

Table 2B reports similar OLS correlations for the mother sample. Here we report standard errors clustered by zip code or by mother in parenthesis. Column 1 and Columns 3 to 5 in Panel A report the estimate of a model with zip code fixed effects. African American and Hispanic mothers are less likely to gain over 20kg during pregnancy, but more likely to have a fast-food establishment present near them. These variables suggest a negative correlation between the determinants of fast-food availability and high weight gain. The pattern differs for smoking and marriage status. Smoking is positively related to both high weight gain and fast-food availability, while the opposite is true for marriage status. These variables suggest a positive correlation between the determinants of fast-food availability and high weight gain. In Panel B, we present the results of the summary measure of the observable constructed running a probit regression of high weight gain on the observables[6] Column 3 indicates that mothers who, based on their observable characteristics, have a high probability of gaining more than are also more likely to be located near a fast food restaurant, after conditioning on the number of non fast food restaurant within .5 miles and zip code fixed effects. The coefficient on the predicted probability of gaining more than 20kg declines substantially when we condition on the number of non-fast food restaurant within .25 miles and zip code fixed effects (column 4). It declines even further when we condition on the number of non fast food restaurant within .1 miles and zip code fixed effect (column 5), although it remains statistically significant. This indicates that better controls for availability of other restaurants reduce but do not fully eliminate the amount of selection on observables.

In Columns 2 and 6 to 8 we consider the same patterns for models with mother fixed effects. The coefficient on the predicted probability of weight gain above 20kg is negative for fast-food availability at .5 miles (column 6), but it declines to zero when we condition on the number of non fast food restaurant within .1 miles and mother fixed effect (column 8). This is reassuring, because it implies that after controlling for mother fixed effects and availability of non-fast food restaurants, the observable characteristics of the mothers in our sample would predict an average or lower than average probability of weight gain > 20Kg. While we can not rule out the possibility that selection on unobservables is completely different from selection on observables, Table 2B is

[6] We estimate the predicted probability of weight gain > 20Kg by taking the predicted values from a probit model where the covariates are age dummies, four dummies for education, race, Hispanic status, an indicator equal to 1 if the mother smokes during pregnancy, and indicator for male child, parity, marital status and year dummies.

consistent with our identifying assumption that location of fast food restaurants is not associated with other unobserved determinants of obesity, after conditioning on mother fixed effects.

4.3 Empirical Results for Schools

In this sub-section we present estimates of the effect of fast food on obesity based on the sample of California schools. In the next sub-section, we present estimates of the effect of fast food on obesity based on the mother sample.

(a) Baseline Estimates. Table 3 shows our baseline empirical estimates of the effect of changes in the supply of fast food restaurants on obesity rates. Entries are estimates of the model specified in equation 1. The unit of observation is a school-grade-year for schools in California in the years 1999 and 2001-2007. We focus on 9th graders. The dependent variable is the percentage of students in the 9th grade who are classified as obese based on their BMI. Each column is a different regression. Entries in rows 1, 3 and 5 are the coefficient on a dummy for the existence of a fast food restaurant at a given distance from the school. These entries are estimates of coefficients α, β and γ in equation 1. Entries in rows 2, 4 and 6 are coefficient on dummy for the existence of a non-fast food restaurant at a given distance from the school. These entries are estimates of coefficients α', β' and γ' in equation 1.

For completeness, in column 1 we report unconditional estimates. There is a positive association between availability of a fast food within .5 miles and obesity rates, but the coefficient is not statistically significant. Recall that the fast food and non-fast food indicators are not mutually exclusive, so that to obtain the effect of availability of a fast food within .25 miles one needs to add the coefficients on $F50_s$ and $F25_s$: 1.3903-2.4859= -1.0956. Similarly, the effect of availability of a fast food within .1 miles is the sum of three coefficients 1.3903-2.4859 +3.0807 = 1.9851.

Estimates in column 2 condition on school level controls, census block controls and years effects. Since school fixed effects are not included, these estimates use cross-sectional variation as well as variation over time. As before, the school-level controls are from the Common Core of Data, with the addition of Star test scores for the 9th grade, while the Census block controls are from the closest block to the address of the school. Here the only statistically significant effect seems to be associated with the difference in availability of fast food restaurant within .1 miles and .25 miles. The coefficients on the other indicators are insignificant. It is important to highlight that the coefficient on availability of a fast food within .25 miles and availability of a fast food within .50 miles become insignificant because their point estimates decline, not because standard errors increase. If anything, standard errors are smaller in column 2 than in column 1, indicating that our controls do a good job in absorbing other determinants of obesity but leave enough variation for the identification of the effect of interest.

Finally, in column 3 we present estimates with school fixed effects. By including indicators for each school, we completely absorb any time-invariant determinant of obesity. The estimates are identified only by schools where the fast-food availability varies over time. At the .1 mile distance, for example, there are 13 schools that add a fast-food, 8 that lose a fast-food, and 1 school that does both. The estimates with school fixed effects point to a statistically significant effect of the availability of a fast food within .1

miles, as in the cross-sectional specification of column 2, but with a larger point estimate. There is no evidence of a positive additional effect of the availability of a fast food within .25 miles or .5 miles.[7] Notably, while increases in the number of fast food restaurants within .1 mile result in increases in obesity rates, increases in the number of non-fast food restaurants have no effect on obesity. This is reassuring, since it suggests that the increases in obesity rates are no driven by unobserved shifters in the overall demand for restaurants in an area.

How large is the estimated effect? Column 3 indicates that the opening of a fast food within .1 miles from a school results in a 3.7 percentage point increase in the incidence of obesity for 9th graders in that school. This estimate---obtained by summing entries for the three fast food indicators (6.3337-1.7947-.8311=3.7)----is both statistically significant and economically important. In particular, since the mean of the dependent variable is 32.9, our estimate implies that the opening of a fast food within .1 miles from a school results in a 11.2 percent increase in the incidence of obesity. This large finding is consistent with a very non linear increase of transportation costs with distance, and/or with strong psychological effects of the availability of fast food restaurants (for example: temptation effects).

(b) Additional Specifications. In Table 4 we present estimates from a variety of alternative specifications. Column 1 and 2 show estimates of equation 2. Unlike estimates of equation 1 shown in Table 5, here we do not control for availability of restaurants more than .1 miles away. The point estimate in the model that includes school

[7] The point estimates, although not all statistically significant, point to an effect that is non-linear in distance. Indeed, if one were to take the point estimates at face value, the effect would appear to be U-shaped.

fixed effects (column 2) indicates that the opening of a as food restaurant within .1 miles from a school results in an increase in the obesity rate by 4.6 percentage points. This estimate is larger than the corresponding estimate in column 3 of Table 5 (3.7 percentage points) and amounts to a 14 percent increase.

For the remaining specifications in Table 4, we focus on the benchmark cross-sectional specification of Table 3, Column 2. We report only the coefficient on the availability of fast-food and other restaurants at a .1 mile distance. The coefficients on the other distances are not significantly different from zero. Column 3 of Table 4 investigates whether the availability of 2 or more fast foods within .1 miles has a greater impact than the availability of one fast food within .1 miles. Unfortunately, the number of schools where 2 or more fast food restaurants open within .1 miles is so limited that it is difficult to estimate this model with schools fixed effects. Estimates of the cross-sectional specification fail to find an additional effect of 2 or more restaurant over and above the effect of the first restaurant. Turning to column 4, controlling for the continuous variable indicating the number of non-fast food restaurants within .1 from the school does not affect the estimates on the fast-food variable.

Column 5 investigates whether a broader definition of fast food restaurant changes our main results. The broad definition includes all restaurants classified as fast-foods by Wikipedia. In particular, the entry in row 5 is the coefficient on a dummy for whether there is a fast food restaurant according to the broader definition less than .1 miles from the school. We expect our measure of fast food, based on the top 10 fast food chains, to be a better and more precise measure (see the Appendix). Consistent with this notion, column 5 indicates that the Wikipedia measure does not have any additional impact over and above our baseline definition, at least in the cross-section. Column 6 shows unweighted results.

Finally, columns 7 to 9 show estimates based on models that use a different identification strategy. Column 7 reports results from an optimal trimming model, where we include only schools that have a propensity score between .1 and .9. This specification effectively drops observations that are unlikely to be a good control. Column 8 reports estimates of treatment on the treated based on a matching estimator model based on nearest neighborhood matching, where we match on all the school level and block level covariates. Finally, column 9 reports estimates of a model only based on schools that are .25 miles from the closest fast food restaurant. In this proximity regression, the schools with a fast-food within .1 mile are compared to schools with a fast-food within .25 miles, which are likely to be a very comparable group. Across these three specifications, we find similar estimates of the impact of fast-food on the share of obese kids, indicating an increase of about 2 percentage points.

Based on Table 4, we conclude that our results are generally robust to changes in the sample, definition of the key independent variable and changes in the identification strategy.

(c) Placebo Analysis. One concern with estimates in Table 3 and 4 is that even after conditioning on school fixed effects and time varying student and neighborhood characteristics, the location of fast food restaurant is still associated with other determinants of obesity that we can not control for. After all, fast food chains do not open restaurant randomly. Presumably, they open new restaurants in areas where they expect demand for fast food to be strong.

In Table 5, we exploit the exact timing of the restaurant opening and test whether we see any evidence of changes in obesity rates as a function of *future* fast food restaurant openings. If fast food restaurants open in areas that experience unobserved upward trends in demand for fast food, it is possible that current obesity rates may be correlated with future fast food restaurants openings. Based on the finding in Table 5 that distances above .1 mile do not seem to matter, in here we focus on the more parsimonious specification that includes only indicators for restaurants within .1 miles.

Our findings in column 1 indicate that conditioning on availability of fast food restaurants in year *t*, availability in year *t+3* does not appear to be positively correlated with obesity rates. If anything, the coefficient on availability of fast food restaurants 3 years later is *negative*, although not statistically significant at conventional levels. Of course, since availability of fast food restaurant now and in 3 years is highly correlated, standard errors are fairly large.

In column 2 we restrict the sample to schools that currently do not have a fast food restaurant within .1 miles. For these schools, the opening of a fast food restaurant 3 years later has virtually no correlation with current obesity rates.

(d) Racial and Gender Differences in the Obesity Effect. The data on body mass index are available by race and gender group for 9^{th} graders in each reporting school in California as long as the relevant group is larger than 10 students in the grade-school-year cell. In Table 6, we split the sample by race and gender. One limitation is that the sample of schools varies across the different racial and gender groups as a function of the number of schools with at least 10 students in 9th grade in that demographic group. This is particularly a concern for the group of African American students, since the number of African American residents in California is limited. We report estimates of models similar to equation 2, without school fixed effects (upper panel) and with school fixed effects (lower panel).

Column 1 indicates that estimates for whites are not very different from estimates based on the entire sample, although they are slightly less precise. Point estimates are largest for Hispanic students in the fixed effects estimates. Looking at the fixed effects models, our estimates indicate that the opening of a new fast food restaurant increases the probability of obesity for Hispanic students by 5.4 percentage points and for white students only by 3.7 percentage points. In percent terms, however, the effect appears to be similar across races. For example, relative to the average obesity rate, the effect for Hispanics is 14.6 percent, while the effect for whites is 13.1 percent.

When we turn to gender differences, we find that the effect is substantially larger for female students than for male students. This gender difference is particularly large for fixed effects models in the lower panel. Estimates indicate that the opening of a new fast food restaurant increases the probability of obesity by 8.5 percentage points for females and only 3.9 percentage points for males.

An important question is whether the obesity effect is larger for students with low family income. While we do not have a direct measure of income, we tested for differences in the obesity effect by free lunch status. Students who receive free lunch have lower family income than students who do not receive free lunch. In results not shown in the table, we find that the difference in the effect for the two groups is small and not statistically significant at conventional levels.

(e) Detailed Fitness Measures. For completeness, in Appendix Table A2, we report the effect of fast food restaurant opening on more detailed measures of fitness. We estimate empirical models similar to equation 2, without school fixed effects (upper panel) and with school fixed effects (lower panel). For convenience, column 1 reproduces our baseline obesity estimates from column 2 and 3 of Table 5. The remaining columns report estimates of models where the dependent variable is abdominal strength (column 2), aerobic capacity (column 3), flexibility (column 4), trunk strength (column 5) and upper body strength (column 6). Cross-sectional estimates in the upper panel point to a negative effect of fast food restaurant on flexibility. However, estimates that condition on fixed effects are generally insignificant.

4.4 Empirical Results for Mothers

(a) Baseline Estimates. We now turn to estimates based on our birth certificates data. Table 7 presents our estimates of equation 3. The dependent variable in columns 1 and 2 is an indicator equal to 1 if weight gain is above 20Kg. The dependent variable in columns 3 and 4 is weight gain in kilograms.

Models that condition on mother fixed effects (columns 2 and 4) point to a positive effect of opening of a new fast food restaurant on weight gain and the probability of weight gain above 20 kg. The coefficient on the indicator for a fast food restaurant within .5 miles points to an increase of .19 percentage points in the probability of weight gain larger than 20kg (column 2), and an increase of 0.049kg in weight gain (column 4). These effects are small when compared with the sample averages. They correspond to a 1.5 percent and a 0.3 percent increase in probability of weight gain above 20 kg and weight gain, respectively.

The effect seems to decrease somewhat with distance. However, the marginal increments from .50 to .25 and from .25 to .1 are not very precisely estimated.[8] Interestingly, we find no evidence that non-fast food restaurants are associated with positive effects on weight gain. If anything column 3 reports somewhat negative effects.

Compared with our results for students, the effect of fast food availability for mothers seems to differ in two dimensions. First, it is smaller in magnitude. Second, it is more linear in distance. For 9th graders the effect of distance is highly non-linear. Only availability of fast food within .1 miles seems to matter, but fast food restaurants further away seem to have no discernible impact. For mothers, distance appears to matter, but less discontinuously. Only based on the point estimates, availability of a fast food at .1 mile has a larger impact on mothers than availability at .25, and even larger than availability at .50. This is consistent with 9th graders having higher transportation costs than mothers or less self-control.

(b) Additional Specifications. Table 8 shows estimates from a number of additional specifications. This Table generally follows the structure of Table 4.

Columns 1 to 3 present estimates of variants of equation 4, where only one measure of restaurant availability is included in each regression. These models are easier to read than the corresponding models in Table 9. Column 1 indicates that conditioning

[8] This is in part due to the fact that the restaurant indicators are all highly correlated.

on mother fixed effects, the probability of weight gain > 20Kg increases by 0.56 percentage points when a new fast food restaurant opens within .1 from the mother residence. Relative to the baseline probability (reported in Table 1) this amounts to a 4.4 percent effect. Importantly, there is no effect of opening of non fast food restaurants.

Consistent with Table 9, the effect of fast food restaurants declines with distance. Column 2 indicates that the effect is only 0.24 percentage points, or 2 percent, for restaurant openings that are within .25 miles of the mother residence. The effect for openings within .50 miles is 0.23 percentage points (column 3).

In the remaining Columns for brevity we focus on the specification in Column 3 which examines the impact of restaurant availability at .5 miles with mother fixed effects. The results for availability at closer distances are similar, with larger point estimates and larger standard errors. In Column 4 we do not find any additional impact of the availability of 2 fast-food restaurants. Column 5 indicates that controlling for the number of non-fast food restaurants within .50 miles does not change the estimates. Column 6 investigates the robustness of our estimates to a broader definition of fast food. Using a broader definition of fast food does not seem to change our results either. For example, in column 5 we include among the regressors both an indicator for a top 10 fast food restaurant and the number of all restaurants classified as fast-foods by Wikipedia. Like for Table 6, the broader definition does not have any additional impact over and above the baseline definition.

Column 7 reports results from an optimal trimming model, where we include only schools that have a propensity score between .1 and .9. As explained above, this specification drops observations that are unlikely to be a good control. Finally, column 8 uses only the sample of mothers who live within 1 mile of a fast food restaurant. The results of these specifications are very consistent with the benchmark results in Column 3.

(c) Placebo Analysis. In Table 9 we test whether there is evidence of changes in obesity rates as a function of *future* fast food restaurant openings. Column 1 reports estimates for models that include zip code fixed effects, while Columns 2 reports estimates that have mother fixed effects. While *current* fast food restaurants with 0.5 miles appears to increase current probability of weight gain above 20Kg, there is little evidence that *future* fast food restaurants increase weight gains. This is consistent with our identifying assumption.

(d) Racial and Age Differences in the Obesity Effect. Finally, in Table 10 we investigate whether the obesity effect varies by age group and racial group. Column 1 reproduces for convenience our preferred estimate from column 3 of Table 8.

Columns 2 to 4 report estimates for specific racial and ethnic groups for models that condition on mother fixed effects. A comparison of the estimated coefficients indicates that the effect of a new fast food restaurant is largest for African American mothers and next for Hispanic mothers, with no effect for White mothers. In particular, the coefficient for African American mothers, .0065, is almost three times the coefficient for the average mother. Relative to the average of the dependent variable for blacks this amounts to a 5 percent effect.

We also consider differences on the basis of education. In Columns 5 and 6 we separate the mothers into mother with high school or less (column 5) and mothers with a higher eduction (column 6). We find that the impact is larger in the less educated group. The effect of non-fast-food restaurants is reliably zero across the different racial and educational categories

5. Conclusions

Obesity has increased rapidly in the U.S. since the 1970s. At the same time, the number of fast food restaurants more than doubled over the same time period. Exposes such as "Fast Food Nation" (Schlosser, 2001) and "Supersize Me" (Spurlock, 2004) highlight the popular perception that these two trends may be related—the availability of fast food may have caused at least some of the increase in obesity. Obesity has been linked to hypertension, cardiovascular disease, diabetes, and certain cancers so that the rise in obesity has become a serious public concern.

Yet, most of the existing evidence on the causal link between supply of fast food and incidence of obesity is difficult to interpret, because it is mostly based on correlations. The concern is that fast food restaurants open in areas where the demand for fast food is strong. Since consumers have access to unhealthy food from many sources, it is possible that obesity rates would be higher in these areas even in the absence of increases in fast food restaurants.

This paper investigates the health consequences of increases in the supply of fast food restaurants in an area. We focus on the effect of changes in the supply of fast food in an area on obesity rates of school children and weight gains of pregnant women. The focus on very close distance and the presence of a large array of controls alleviates issues of endogenous fast-food placement.

Our results point to a significant effect of increases in the supply of fast food restaurants on risk of obesity, especially among adolescent children. Specifically, we document that the opening of a fast food restaurant within a tenth of a mile of a school is associated with a 11 percent increase in the obesity rate in that school. Consistent with highly non-linear transportation costs, we do not find evidence of an effect at .25 miles and at .5 miles. The effect varies significantly across races and genders, with the largest effect for Hispanic students and female students.

The effect for pregnant mothers is smaller, although it declines less with distance. We find that the opening of a new fast food restaurant within a tenth of a mile of a residence result in a 4.4 percent increase in the probability of gaining over 20 kilos. The effect at .25 miles and at .5 miles is smaller, but still discernable. We also find that the effect differ for different racial and ethnic groups, with the largest effects for African American mothers.

The significant effect of fast-food establishments within one tenth of a mile of a school is consistent with high travel costs for students. In light of this result, policies aimed at lowering childhood obesity could include limiting the presence of fast-foods in the immediate vicinity of a school.

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Appendix 1: Definition of Fast Food Restaurant

There is little consensus about the definition of fast food in the literature. For example, the American Heritage Dictionary definies fast food as “Inexpensive food, such as hamburgers and fried chicken, prepared and served quickly.” While everyone agrees that prominent chains such as McDonald’s serve fast food, there is less agreement about whether smaller, independent restaurants are also “fast food.”

The Census of Retail trade defines a fast food establishment as one that does not offer table service. Legislation recently passed in Los Angeles imposing a moratorium on new fast food restaurants in south central L.A. defined fast food establishments as those that have a limited menu, items prepared in advance or heated quickly, no table service, and disposable wrappings or containers (Abdollah, 2007). However, these definitions do not get at one aspect of concern about fast food restaurants, which is their heavy reliance on advertising, and easy brand recognition.

We constructed several different measures of fast food. Our benchmark definition of fast-food restaurants focuses on the top 10 chains, which are McDonald’s, Subway, Burger King, Pizza Hut, Jack in the Box, Kentucky Fried Chicken, Taco Bell, Domino’s Pizza, Wendy’s, and Little Ceasar’s. We have also constructed a broader definition using Wikipedia’s list of national fast food chains (en.wikipedia.org/wiki/Fast_food). Wikipedia considers fast food to be “Food cooked in bulk and in advance and kept warm, or reheated to order.” Our broadest definition starts with this list, excludes ice cream, donut, and coffee shops, and adds in all independent restaurants from our Dun and Bradstreet list that have the words “pizza” or “burger” in their names. The definition of “other restaurant” depends on the definition of fast food.

As discussed in the paper, we find a larger impact of the top 10 fast-food chains than for the broader definition of fast-foods. To conserve space, we show estimates for the broad definition excluding ice cream, donuts, and coffee shops, and for the top 10 chains.

Figure 1. Incidence of low birth weight and Weight Gain During Pregnancy (in pounds)

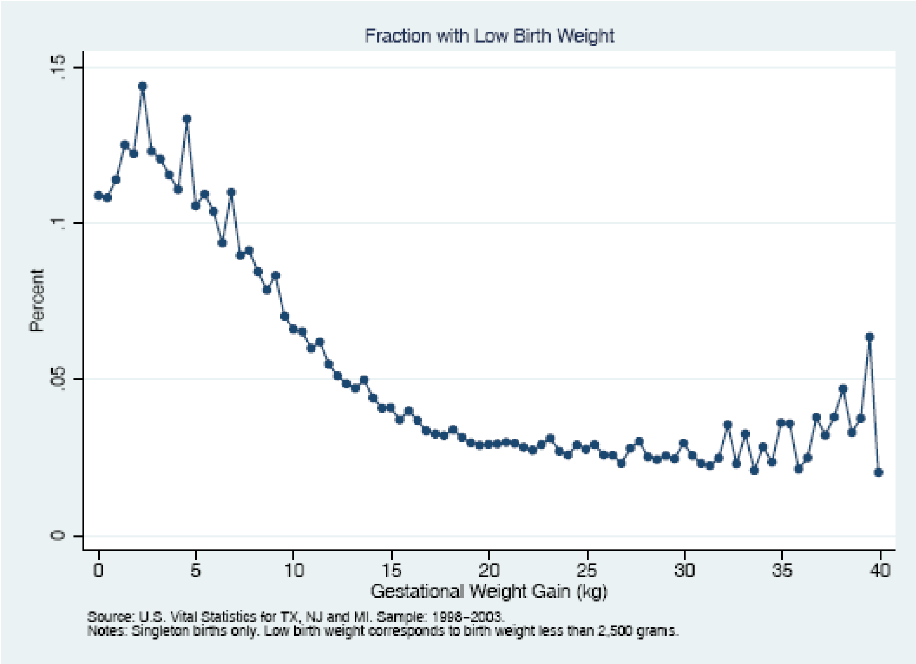

TABLE 1A

SUMMARY STATISTICS FOR SCHOOL DATA

	CA All	CA <.5 miles FF	CA <.25 miles FF	CA <.1 miles FF
# School-Year Observations	8373	5188	2321	559
No. Students per grade	366.27	384.30	383.05	400.74
School Characteristics				
% Black students	0.084	0.093	0.093	0.086
% Asian students	0.107	0.117	0.118	0.116
% Hispanic students	0.380	0.409	0.416	0.436
% immigrant students	0.034	0.029	0.030	0.033
% eligible for free lunch	0.290	0.306	0.313	0.311
Average Test Scores 9th grade	56.255	54.964	54.737	52.291
Census Demographics of nearest block				
Median earnings	25674	24668	24271	23942
% High-School degree	0.220	0.219	0.219	0.220
% unemployed	0.083	0.085	0.088	0.079
% Urban	0.912	0.974	0.971	0.987
Outcomes				
Share obese students	32.949	33.772	33.724	35.733

TABLE 1B

SUMMARY STATISTICS FOR BIRTH DATA

	All Births	Siblings Only	Siblings <=.5 mi	Siblings <=.25 mi	Siblings <=.1 mi
# Mother-Year Observations	6732916	3531160	979792	303901	52953
Demographic Characteristics					
Mean age of mother	26.892	26.639	26.325	26.133	25.834
% age 15-24	0.289	0.298	0.319	0.333	0.356
% age 25-34	0.495	0.504	0.489	0.478	0.462
% 35+	0.118	0.099	0.090	0.085	0.078
% high school	0.314	0.306	0.306	0.309	0.308
% some college	0.317	0.321	0.289	0.275	0.254
% college or more	0.075	0.074	0.062	0.056	0.047
% black	0.160	0.170	0.199	0.198	0.203
% hispanic	0.299	0.281	0.331	0.348	0.372
% smoking	0.112	0.111	0.110	0.111	0.112
% child is male	0.512	0.512	0.511	0.511	0.508
Parity	0.914	1.060	1.087	1.083	1.076
% married	0.682	0.689	0.645	0.633	0.616
Outcomes					
% weight gain greater than 20kg	0.126	0.118	0.120	0.121	0.123
Mean weight gain	13.664	13.491	13.410	13.412	13.400

TABLE 2A

PREDICTORS OF OBESITY AND FAST-FOOD PRESENCE NEAR SCHOOLS: CROSS-SECTION AND PANEL

Dep. Var.:	% Obese 9th graders		Availability of fast-food within distance from school: .5 miles	.25 miles	.1 miles	.5 miles	.25 miles	.1 miles
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Panel A. All Controls								
Share African American students in school	13.8132	3.852	0.3224	0.0395	-0.0422	-0.3886	0.009	-0.0877
	(2.7498)***	(10.8709)	(0.2217)	(0.1934)	(0.0715)	(0.2539)	(0.1636)	(0.0895)
Share Asian students in school	-3.5712	-28.3859	-0.0071	0.1433	-0.0407	0.2402	0.3009	0.0026
	(2.4789)	(8.8319)***	(0.1712)	(0.1495)	(0.0755)	(0.2313)	(0.1552)*	(0.0567)
Share Hispanic students in school	7.176	19.9484	-0.0582	0.155	0.0381	-0.1575	-0.0102	-0.0369
	(1.9494)***	(6.8332)***	(0.1432)	(0.1190)	(0.0524)	(0.2026)	(0.1146)	(0.0555)
Share of closest Census block that is urban	1.0413	-	0.1005	-0.0189	0.0431	-	-	-
	(0.9509)		(0.0475)**	(0.0360)	(0.0185)**			
Test Scores in 9th grade	-0.1953	-0.0441	0.0014	0.0013	-0.0004	-0.0016	-0.0002	-0.0001
	(0.0182)***	(0.0190)**	(0.0010)	(0.0009)	(0.0004)	(0.0005)***	(0.0003)	(0.0001)
Availability of Other Restaurants within same distance			0.4206	0.3218	0.1684	0.0116	0.0057	0.0328
			(0.0319)***	(0.0276)***	(0.0383)***	(0.0276)	(0.0196)	(0.0247)
F-Test Controls = 0	F=52.20***	F=4.72***	F=4.43***	F=1.16	F=0.99	F=1.55**	F=0.76	F=0.94
R^2	0.4284	0.6503	0.2836	0.228	0.133	0.926	0.9385	0.9287
Panel B. Single Predictor of Obesity								
Predicted Share of Obese 9th Graders (Based on Controls)			0.0051	-0.0009	0.0008	-0.0048	-0.0015	-0.0004
			(0.0021)**	(0.0017)	(0.0007)	(0.0026)*	(0.0024)	(0.0009)
Availability of Other Restaurants within same distance			0.5431	0.3485	0.1681	0.0124	0.0047	0.0332
			(0.0243)***	(0.0265)***	(0.0377)***	(0.0280)	(0.0195)	(0.0245)
R^2	0.4284	0.6503	0.2836	0.228	0.133	0.926	0.9385	0.9287
Specification:	Cross-Sect. Regression	School f.e. Panel	Cross-Sectional Regression			School Fixed-Effect Panel Regression		
Average of Dep. Var.	32.9494	32.9494	0.4696	0.1775	0.0397	0.4696	0.1775	0.0397
N	8373	8373	8373	8373	8373	8373	8373	8373

Notes: Each column is a different OLS regression. The regressions are weighted by the number of students. The dependent variable in Column 1 is the percentage of students in the 9th grade who are classified as obese. The dependent variables in columns 3-8 are indicator variables for the presence of at least one fast-food restaurant within the prescribed distance from the school. The unit of observation is a school-grade-year for schools in California in the years 1999 and 2001-2007. The school-level controls are from the Common-Core data, with the addition of Star test scores for the 9th grade. The Census block controls are from the closest block to the address of the school. Standard errors clustered by school in parenthesis.

* significant at 10 percent; ** significant at 5 percent; *** significant at 1 percent

TABLE 2B

PREDICTORS OF FAST-FOOD PRESENCE NEAR MATERNAL RESIDENCE: PANEL

			Availability of fast-food within distance from mother's residence					
Dep. Var.:	Weight Gain Larger than 20kg		.5 miles	.25 miles	.1 miles	.5 miles	.25 miles	.1 miles
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Panel A. All Controls								
African American mother	-0.0055	.	0.0011	-0.0004	0.0021	.	.	.
	(0.0013)***		(0.0058)	(0.0025)	(0.0007)***			
Hispanic mother	-0.0277	.	0.0109	0.0038	0.0019	.	.	.
	(0.0010)***		(0.0032)***	(0.0018)**	(0.0006)***			
Mother smokes	0.0134	-0.0055	0.0024	0.0004	0.0000	0.0027	0.0009	0.0002
	(0.0009)***	(0.0013)***	(0.0012)*	(0.0007)	(0.0002)	(0.0011)**	(0.0007)	(0.0003)
Mother is married	-0.0132	-0.0063	-0.0040	-0.0019	-0.0008	0.0018	0.0007	0.0000
	(0.0007)***	(0.0009)***	(0.00133)***	(0.0007)***	(0.0002)***	(0.0009)*	(0.0007)	(0.0003)
Availability other restaurants within			0.2630	0.1540	0.0811	0.2810	0.1530	0.0791
same distance			(0.0048)***	(0.0033)***	(0.0031)***	(0.0007)***	(0.0005)***	(0.0006)***
F-Test Controls=0	F=972.07***	F=82.01***	F=2928.96***	F=18547.05***	F=20.26***	F=29.53***	F=7.426***	F=2.957***
R^2	0.008	0.006	0.072	0.068	0.043	0.073	0.063	0.039
Panel B. Single Predictor of Weight Gain								
Predicted probability of weight gain			0.191	0.0863	0.0247	-0.312	-0.056	-0.0012
> 20 kg (probit, based on controls)			(0.0244)***	(0.0122)***	(0.0040)***	(0.0137)***	(0.0090)***	(0.0041)
Availability other restaurants within			0.2720	0.157	0.082	0.282	0.153	0.0792
same distance			(0.0048)***	(0.0034)***	(0.0031)***	(0.0008)***	(0.0006)***	(0.0006)***
R2			0.066	0.066	0.042	0.069	0.062	0.039
Specification:	Zip-Code f.e.	Mother f.e.	Zip-Code Fixed Effects Panel Regression			Mother Fixed Effects Panel Regression		
N	3019200	3019262	3531059	3531059	3531059	3531126	3531126	3531126

Notes: Each column is a different OLS regression. The unit of observation is a pregnancy for mothers with at least two births in the sample. All the regressions in Panel A include a full set of demographic controls listed in the text. Standard errors clustered by zip code (columns 1 and 3-5) or by mother (columns 2 and 6-8) in parenthesis.

* significant at 10 percent; ** significant at 5 percent; *** significant at 1 percent

TABLE 3
IMPACT OF FAST-FOOD ON OBESITY IN SCHOOLS: BENCHMARK RESULTS

Dep. Var.:	Percent of 9th graders that are obese		
	(1)	(2)	(3)
Availability of Fast Food Rest. Within .1 miles	3.0807 (1.6072)*	1.7385 (0.8740)**	6.3337 (2.5986)**
Availability of Other Restaurant Within .1 miles	0.6817 (1.0308)	-0.6162 (0.5704)	1.0026 (1.6483)
Availability of Fast Food Rest. Within .25 miles	-2.4859 (1.1112)**	-0.891 (0.5452)	-1.7947 (1.0932)
Availability of Other Restaurant Within .25 miles	2.1416 (0.8757)**	0.0505 (0.4895)	0.0375 (0.8521)
Availability of Fast Food Rest. Within .5 miles	1.3903 (0.8219)*	-0.0391 (0.4475)	-0.8311 (0.9826)
Availability of Other Restaurant Within .5 miles	1.2266 (0.8407)	0.4638 (0.4881)	-0.4151 (0.7376)
Specification:	Cross-Sect. Regression No Controls	Cross-Sect. Regression Controls	School f.e. Panel Controls
R^2	0.0209	0.4296	0.6512
N	8373	8373	8373

Notes: Each column is a different OLS regression. The regressions are weighted by the number of students. The dependent variable is the percentage of students in the 9th grade who are classified as obese. The mean of the dependent variable is 32.9494. The unit of observation is a school-grade-year for schools in California in the years 1999 and 2001-2007. Entries in rows 1, 3 and 5 are the coefficient on a dummy for the existence of a fast food restaurant at a given distance from the school. Entries in rows 2, 4 and 6 are coefficient on dummy for the existence of a non-fast food restaurant at a given distance from the school. The school-level controls are from the Common Core of Data, with the addition of Star test scores for the 9th grade. The Census block controls are from the closest block to the address of the school. Standard errors clustered by school in parenthesis.

* significant at 10 percent; ** significant at 5 percent; *** significant at

TABLE 4
IMPACT OF FAST-FOOD ON OBESITY IN SCHOOLS: ROBUSTNESS

Dep. Var.:	Percent of 9th graders that are obese								
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Availability of Fast Food Rest.	1.1025	4.618	1.668	2.0754	3.015	2.6593	2.0234	1.7916	2.0046
Within .1 miles	(0.8059)	(2.7405)*	(0.9080)*	(0.9415)**	(1.6378)*	(1.1722)**	(1.2898)	(.9361)*	(0.9658)**
Availability of Other Rest.	-0.6725	0.9707	-0.6205			0.2406	1.7044		-1.0868
Within .1 miles	(0.5226)	(1.6460)	(0.5702)			(0.6002)	(2.0437)		(0.8638)
Avail. of >=2 Fast Food Rest.			0.415						
Within .1 miles			(2.0676)						
No. of Other Rest.				-0.4091					
Within .1 miles				(0.2196)*					
Availability of Fast Food (Broad Def.)					0.0887				
Restaurant Within .1 miles					(1.7305)				
Availability of Non-Fast Food Rest.					0.3447				
Within .1 miles					(1.0437)				
Specification:	Cross-Section OLS	Panel OLS	Cross-Section OLS	Cross-Section OLS	Cross-Section OLS	Unweighted OLS	Optimal Trimming	Matching Estimator	Proximity Regression
Includes Controls for Restaurants at .25 and .5 miles	No	No	Yes	Yes	Yes	Yes	Yes	No	No
Sample:	All Schools	All Schools	All Schools	All Schools	All Schools	All Schools	Schools with Prop. Score >=.1 and <=.9	All Schools	Schools with Fast Food Within .25 m.
R^2	0.4289	0.6507	0.4296	0.4309	0.0219	0.3117	0.5116	.	0.4519
N	8373	8373	8373	8373	8373	8373	992	8373	1486

Notes: Each column is a different OLS regression. The regressions are weighted by the number of students. The dependent variable is the percentage of students in the 9th grade who are classified as obese. The mean of the dependent variable is 32.9494. The unit of observation is a school-grade-year for schools in California in the years 1999 and 2001-2007. Entries in row 1 and 2 are the coefficient on a dummy for the existence of a fast fast food restaurant and a non-fast food restaurant closer than .1 miles from the school. The entry in row 3 is the coefficient on a dummy for whether there are 2+ fast food restaurants less than .1 miles from the school. The entry in row 4 is the coefficient on the number of non-fast food restaurants within .1 from the school. The entry in row 5 is the coefficient on a dummy for whether there is a fast food restaurant according to a broader definition (and not included in the benchmark definition) less than .1 miles from the school. The broad definition includes all restaurants classified as fast-foods by Wikipedia.
The school-level controls are from the Common Core of Data, with the addition of Star test scores for the 9th grade. The Census block controls are from the closest block to the address of the school. Standard errors clustered by school in parenthesis.

* significant at 10 percent; ** significant at 5 percent; *** significant at 1 percent

TABLE 5
IMPACT OF FAST-FOOD ON OBESITY IN SCHOOLS: PLACEBOS

Dep. Var.:	Placebos based on leads % of obese 9th graders	
	(1)	(2)
Availability of Fast Food Rest.	5.9191	-
Within .1 miles	(2.3877)**	-
Availability of Other Restaurant	0.414	0.2828
Within .1 miles	(1.6475)	(1.7644)
Availability of Fast Food Rest.	-4.0011	-1.1628
Within .1 miles 3 Years Later	(2.1361)*	(1.9063)
Availability of Other Restaurant	-0.5785	-0.6153
Within .1 miles 3 Years Later	(1.6646)	(1.7710)
Specification:		
Sample:	All Schools	Schools with no Fast-Food at .1 miles
Average of Dep. Var.		
R^2	0.3877	0.3869
N	4734	4551

Notes: The regressions are weighted by the number of students. The dependent variable is the percentage of students in the relevant grade who are classified as obese. The unit of observation is a school-grade-year for schools in California in the years 1999 and 2001-2005. The sample in columns 2, 4 and 6 includes only schools located within .25 mile from a fast food. Entries in row 1 are the coefficient on a dummy for the existence of a fast food restaurant less than .1 miles from the school. Entries in row 2 are the coefficient on a dummy for the existence of a non-fast food restaurant less than .1 miles from the school. The entry in row 3 is the coefficient on a dummy for the existence of a fast food restaurant less than .1 miles from the school 3 years after obesity is measured. The entry in row 4 is the coefficient on a dummy for the existence of a non-fast food restaurant less than .1 miles from the school 3 years after obesity is measured. The school-level controls are from the Common Core of Data. The Census block controls are from the closest block to the address of the school. Standard errors clustered by school in parenthesis.

* significant at 10 percent; ** significant at 5 percent; *** significant at 1 percent

TABLE 6

HETEROGENEITY IN IMPACT OF FAST-FOOD ON OBESITY IN SCHOOLS

	% of obese 9th graders in demographic group				
Dep. Var.:	Whites	Hispanics	African American	Males	Females
	(1)	(2)	(3)	(4)	(5)
Panel A. Cross-Sectional Regression					
Availability of Fast Food Rest.	2.8149	2.0067	-1.5417	1.3833	1.9248
Within .1 miles	(1.0163)***	(1.0135)**	(1.2056)	(0.8002)*	(1.0002)*
Availability of Other Rest.	-0.8204	-0.3049	-0.4451	-0.5993	-0.6006
Within .1 miles	(0.7328)	(0.6169)	(0.8610)	(0.5425)	(0.6526)
R^2	0.284	0.2215	0.2516	0.401	0.4246
Panel B. Fixed-Effect Regression					
Availability of Fast Food Rest.	3.7168	5.4225	3.2754	3.9964	8.554
Within .1 miles	(2.5520)	(1.7801)***	(4.4318)	(2.3144)*	(2.6775)***
Availability of Other Rest.	0.7213	1.599	-4.0106	0.2259	1.5046
Within .1 miles	(1.4140)	(1.9890)	(2.2747)*	(1.7925)	(1.6370)
R^2	0.5482	0.5027	0.5716	0.6209	0.6469
Average of Dep. Var.	28.2286	36.9517	35.4517	33.7454	30.7471
N	6513	6946	2851	7780	7502

Notes: Each column is a different regression. The unit of observation is a school-grade-race-(or gender-)year in the years 1999 and 2001-2007.. The sample varies across racial groups (across genders) because race-specific (gender-specific) obesity is reported only for races (genders) that have at least 10 students in a given grade-school-year. Panel A presents the results of a cross-sectional regression which includes the full set of school-level and Census-block controls employed in Tables II and III, including controls for the availability of fast-food restaurants and other restaurants within .25 and .5 miles. Panel B presents the results of a fixed-effect regression which includes, in addition to the controls listed in Panel A, school fixed effects. Standard errors clustered by school in parenthesis.

* significant at 10 percent; ** significant at 5 percent; *** significant at 1 percent

TABLE 7

IMPACT OF FAST-FOOD ON WEIGHT GAIN FOR MOTHERS: BENCHMARK RESULTS

Dep. Var.:	Weight Gain During Pregnancy Larger than 20kg		Weight Gain During Pregnancy in kilograms	
	(1)	(2)	(3)	(4)
Availability of Fast Food Rest. Within .1 miles	0.0007 (0.0018)	0.0039 (0.0025)	0.0006 (0.0338)	0.0735 (0.0432)*
Availability of Other Restaurant Within .1 miles	-0.0004 (0.0007)	-0.0012 (0.0010)	-0.0425 (0.0140)***	-0.0058 (0.0169)
Availability of Fast Food Rest. Within .25 miles	0.0013 (0.0009)	0.0006 (0.0013)	0.0201 (0.0179)	0.0231 (0.0215)
Availability of Other Restaurant Within .25 miles	0.0001 (0.0005)	0.0009 (0.0008)	-0.0224 (0.0103)**	0.0193 (0.0129)
Availability of Fast Food Rest. Within .5 miles	0.001 (0.0006)*	0.0019 (0.0008)**	0.0156 (0.0124)	0.049 (0.0135)***
Availability of Other Restaurant Within .5 miles	0.0001 (0.0006)	-0.0002 (0.0008)	-0.0377 (0.0113)***	-0.0186 (0.0137)
Specification:	Zip-Code Fixed Effects Panel	Mother Fixed Effects Panel	Zip-Code Fixed Effects Panel	Mother Fixed Effects Panel
R^2	0.008	0.006	0.018	0.023
N	3019200	3019262	3019200	3019262

Notes: Each column is a different OLS regression. The unit of observation is a pregnancy for mothers with at least two births in the sample. All the regressions include a full set of demographic controls listed in the text. Standard errors clustered by zip code (columns 1 and 3) or by mother (columns 2 and 4) in parenthesis.

* significant at 10 percent; ** significant at 5 percent; *** significant at

TABLE 8

IMPACT OF FAST-FOOD ON WEIGHT GAIN LARGER THAN 20KG: ROBUSTNESS WITH MOTHER FIXED EFFECT MODELS

Dep. Var.:	Weight Gain During Pregnancy Larger Than 20kg							
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Availability of Fast Food Rest. Within .1 miles	0.0056 (0.0024)**							
Availability of Other Rest. Within .1 miles	-0.0006 (0.0009)							
Availability of Fast Food Rest. Within .25 miles		0.0024 (0.0011)**						
Availability of Other Rest. Within .25 miles		0.0008 (0.0007)						
Availability of Fast Food Rest. Within .5 miles			0.0023 (0.0007)***	0.0029 (0.0008)***	0.0025 (0.0007)***	0.0017 (0.000914)*	0.0018 (0.0008)**	0.0018 (0.0009)**
Availability of Other Rest. Within .5 miles			0.0001 (0.0008)	0.0002 (0.0008)			-0.0340 (0.0075)***	0.0000 (0.0015)
Avail. of >=2 Fast Food Rest. Within .1 miles				-0.00123 (0.0011)				
No. of Other Rest. Within .5 miles					0.0000 0.0000			
Availability of Fast Food (Broad Def.) Restaurant Within .5 miles						0.0010 (0.0009)		
Availability of Non-Fast Food Rest. Within .5 miles						-0.0003 (0.0008)		
Specification:	Mother Fixed Effects	Mother Fixed Effects	Mother Fixed Effects	Mother Fixed Effects	Mother Fixed Effects	Mother Fixed Effects	Optimal Trimming	Proximity Regression
Sample:	All Births	All Births	All Births	All Births	All Births	All Births	Births with Prop. Score >=.1 and <=.9	Mothers with Fast Food Within 1 mile
R^2	0.006	0.006	0.006	0.006	0.006	0.006	0.005	0.005
N	3019262	3019262	3019262	3019262	3019262	3019262	2189311	1842736

.Notes: Each column is a different OLS regression. The unit of observation is a pregnancy for mothers with at least two births in the sample. All the regressions include a full set of demographic controls listed in the text. Standard errors clustered by mother in parenthesis.

* significant at 10 percent; ** significant at 5 percent; *** significant at 1 percent

TABLE 9
IMPACT OF FAST-FOOD ON WEIGHT GAIN: PLACEBOS

Dep. Var.:	Placebos based on leads Weight Gain Larger than 20kg	
	(1)	(2)
Availability of Fast Food Rest. Within .5 miles	0.0022 (0.0010)**	0.0033 (0.0012)***
Availability of Other Restaurant Within .5 miles	0 (0.0009)	-0.0007 (0.0012)
Availability of Fast Food Rest. Within .5 miles 3 Years Later	-0.0008 (0.0010)	-0.0012 (0.0012)
Availability of Other Restaurant Within .5 miles 3 Years Later	0.0002 (0.0009)	0.0011 (0.0012)
Specification:	Zip-Code Fixed Effects	Mother Fixed Effects
R^2	0.006	0.006
N	3019262	3019262

Notes: Each column is a different OLS regression. The unit of observation is a pregnancy for mothers with at least two births in the sample. All the regressions include a full set of demographic controls listed in the text. Standard errors clustered by mother in parenthesis.

* significant at 10 percent; ** significant at 5 percent; *** significant at 1 percent

TABLE 10

HETEROGENEITY IN IMPACT OF FAST-FOOD ON WEIGHT GAIN LARGER THAN 20KG

	Weight Gain During Pregnancy Larger than 20kg						
Dep. Var.:	All	White	African American	Hispanic		High School or Less	Some College or More
	(1)	(2)	(3)	(4)		(5)	(6)
Availability of Fast Food Rest.	0.0023	-0.0011	0.0066	0.0022		0.0033	0.0002
Within .5 miles	(0.0007)***	(0.0011)	(0.0016)***	(0.0013)*		(0.0009)***	(0.0012)
Availability of Other Rest.	0.0001	0.001	-0.0032	-0.0015		0.0000	0.0004
Within .5 miles	(0.0008)	(0.0010)	(0.0021)	(0.0015)		(0.0010)	(0.0011)
Specification:	Mother Fixed Effects	Mother Fixed Effects	Mother Fixed Effects	Mother Fixed Effects		Mother Fixed Effects	Mother Fixed Effects
Average of Dep. Var.	0.126	0.122	0.131	0.101	#	0.126	0.106
R^2	0.006	0.01	0.002	0.011		0.007	0.007
N	3019262	1720325	495045	794535		1779895	1236989

Notes: Each column is a different OLS regression. The unit of observation is a pregnancy for mothers with at least two births in the sample. All the regressions include a full set of demographic controls listed in the text. Standard errors clustered by mother in parenthesis.

* significant at 10 percent; ** significant at 5 percent; *** significant at 1 percent

APPENDIX TABLE 1
FAST-FOOD RESTAURANTS AND OTHER RESTAURANTS

Top-10 Fast-Food Restaurants		Other Restaurants: Examples
Rank	Name	Name
(1)	(2)	(3)
1	Mc Donalds	Cafe Zingaro
2	Subway	El Macho Cafe
3	Burger King	El Paseo Restaurant
4	Taco Bell	Le Croissant Coffee Shop
5	Pizza Hut	Shakeys Pizza Parlor
6	Little Caesars	Subway
7	Kfc	Tanpopo Japanese Country Inn
8	Wendys	Thai Gulf Restaurant
9	Dominos Pizza	Tonys Submarine Sandwiches
10	Jack In The Box	Yogurt Delite

Notes: Data on restaurant establishments from Dun & Bradstreet. The Fast-Food establishments are organized by identifying the top-20 most common chains. The other restaurants are the remaning restaurant establishments, with the exception of "Subway", which is categorized as a non-fast-food chain.

APPENDIX TABLE 2
IMPACT OF FAST-FOOD ON OBESITY IN SCHOOLS: ALL FITNESS MEASURES

Dep. Var.:	Percent of 9th graders not fit in test					
Test:	Obesity (Low Fat Content)	Abdominal Strength	Aerobic Capacity	Flexibility	Trunk Strength	Upper Body Strength
	(1)	(2)	(3)	(4)	(5)	(6)
Panel A. Cross-Sectional Regression						
Availability of Fast Food Rest.	1.7385	-0.2462	-1.4257	-2.9971	1.102	-2.951
Within .1 miles	(0.8740)**	(1.5579)	(1.8154)	(1.4496)**	(1.3752)	(1.7414)*
Availability of Other Rest.	-0.6162	1.0758	-1.1739	0.8341	-0.7435	-0.5001
Within .1 miles	(0.5704)	(0.8870)	(1.1195)	(0.8794)	(0.8451)	(1.1778)
R^2	0.4296	0.3618	0.4946	0.217	0.2117	0.2786
Panel B. Fixed-Effect Regression						
Availability of Fast Food Rest.	6.3337	2.8514	0.822	0.1704	6.0512	1.9535
Within .1 miles	(2.5986)**	(2.1178)	(2.3191)	(2.9216)	(3.2289)*	(3.3450)
Availability of Other Rest.	1.0026	0.5629	-0.2362	0.4003	3.0409	-0.382
Within .1 miles	(1.6483)	(1.7773)	(1.6372)	(2.2357)	(1.9444)	(1.9984)
R^2	0.6512	0.6863	0.8	0.5466	0.5467	0.6623
Average of Dep. Var.	32.9591	21.2723	51.0022	31.4660	17.3974	34.9211
N	8373	8260	8172	8227	8028	8363

Notes: Each column is a different OLS regression with a different measure of lack of fitness as dependent variable. The regressions are weighted by the number of students. The unit of observation is a school-grade-year for schools in California in the years 1999 and 2001-2007. Panel A presents the results of a cross-sectional regression which includes the full set of school-level and Census-block controls employed in Tables II and III, including controls for the availability of fast-food restaurants and other restaurants within .25 and .5 miles. Panel B presents the results of a fixed-effect regression which includes, in addition to the controls listed in Panel A, school fixed effects. Standard errors clustered by school in parenthesis.

* significant at 10 percent; ** significant at 5 percent; *** significant at 1 percent