The Effect of Fast-Food Restaurants on Obesity and Weight Gain

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Abstract. We investigate how changes in the supply of fast-food restaurants affect weight outcomes of 3 million children and 3 million pregnant women. Among 9th graders, a fast-food restaurant within .1 mile of a school results in a 5.2% increase in obesity rates. Among pregnant women, fast-food restaurant within .5 mile of residence results in a 1.6% increase in the probability of gaining over 20 kilos. The implied effects on caloric intake are one order of magnitude larger for children than for mothers, consistent with smaller travel cost for adults. Non-fast-food restaurants and future fast-food restaurants are uncorrelated with weight outcomes.

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1. Introduction

In the public debate over obesity it is often assumed the widespread availability of fast-food restaurants is an important determinant of 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 (Mair et al. 2005.)[1] 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 effect of increases in the local supply of fast-food restaurants on obesity rates. Using a new dataset on the exact geographical location of restaurants, we ask how proximity to fast-food restaurants affects the obesity rates of over 3 million school children and the weight gain of 3 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 models with and without school fixed effects. 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. We focus on women who have at least two children so that we can follow a given woman across two pregnancies.

The design employed in this study allows for a more precise identification of the effect of fast-food restaurants on obesity than the previous literature. First, we observe information on weight for millions of individuals compared to at most tens of thousand in the standard data sets used previously. This large sample size substantially increases 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 who are at only slightly different distances to a restaurant, we can arguably diminish the impact of unobservable differences in characteristics between the groups. Since a fast-food restaurant's location might reflect characteristics of the area, we test whether there are any observable patterns in restaurant location within the very small areas we focus on. Third, we have a more precise idea of the timing of exposure than

[1] Abdollah, Tami. "A Strict Order for Fast Food," Los Angeles Times, A-1, Sept. 10, 2007, http://articles.latimes.com/2007/sep/10/local/me-fastfood10. See also Mcbride, Sarah. "Exiling the Happy Meal," Wall Street Journal, July 22, 2008, http://online.wsj.com/article/SB121668254978871827.html Accessed on Nov 9, 2009.

many previous studies: The 9th graders are exposed to fast-food restaurants near their new school from September until the time of a spring fitness test, while weight gain during pregnancy pertains to the 9 months of pregnancy.

While it is clear that fast food is often unhealthy, it is not obvious a priori that changes in the proximity of fast-food restaurants should be expected to have an impact on health. On the one hand, it is possible that proximity to a fast-food restaurant simply leads to substitution away from unhealthy food prepared at home or consumed in existing restaurants, without significant changes in the overall amount of unhealthy food consumed. On the other hand, proximity to a fast-food restaurant could lower the monetary and non-monetary costs of accessing unhealthy food.[2]

Ultimately, the effect of changes in the proximity of fast-food restaurants 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 1.7 percentage points in the fraction of students in a class who are obese relative to the presence of a fast-food restaurant at .25 miles. This effect amounts to a 5.2 percent increase in the incidence of obesity among the affected children. Since grade 9 is the first year of high school and the fitness tests take place in the spring, the period of fast-food exposure that we measure is approximately 30 weeks, implying an increased caloric intake of 30 to 100 calories per school-day. We view this as a plausible magnitude. The effect is larger in models that include school fixed effects. Consistent with highly non–linear transportation costs, we find no discernable effect at .25 miles and at .5 miles.

Among pregnant women, we find that a fast-food restaurant within a half mile of a residence results in a 0.19 percentage points higher probability of gaining over 20 kilograms (kg). This amounts to a 1.6 percent increase in the probability of gaining over 20 kilos. The effect increases monotonically and is larger at .25 and larger still at .1 miles. The increase in weight gain implies an increased caloric intake of 1 to 4 calories per day in the pregnancy period. The effect varies across races and educational levels. It is largest for African American mothers and for mothers with a high school education or less. It is zero for mothers with a college degree or an associate's degree.

[2] In addition, proximity to fast food may increase consumption of unhealthy food even in the absence of any decrease in cost if individuals have self-control problems.

Our findings suggest that increases in the supply of fast-food restaurants have a significant effect on obesity, at least for some groups. On the other hand, our estimates do not suggest that proximity to fast-food restaurants is a major determinant of obesity: Calibrations based on our estimates indicate that increases in the proximity of fast-food restaurants can account for 0.5 percent of the increase in obesity among 9th graders over the past 30 years, and for at most 2.7 percent of the increase in obesity over the past 10 years for all women under 34. This estimate for mothers assumes other women in that age range react similarly to pregnant women; if they react less, then it is an upper bound.

Our estimates seek to identify the health effect of changes in the supply of fast food restaurants. However, it is in principle possible that our estimates reflect unmeasured shifts in the demand for fast food. 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 role of fast-food restaurants.

We can not entirely rule out this possibility. However, four points lend credibility to our interpretation. First, our key identifying assumption for mothers is that, in the absence of a change in the local supply of fast food, mothers would gain a similar amount of weight in each pregnancy. Given that we are looking at the *change* in weight *gain* for the same mother, this assumption seems credible. Our key identifying assumption for schools is that, in the absence of a fast-food restaurant, schools that are .1 miles from a fast food and schools that are .25 miles from a fast food would have similar obesity rates.[3]

Second, while current proximity to a fast-food restaurant affects current obesity rates, proximity to *future* fast-food restaurants, controlling for current proximity, has no effect on current obesity rates and weight gains.

Third, while proximity to a fast-food restaurant is associated with increases in obesity rates and weight gains, proximity to non fast-food restaurants has no discernible

[3] This assumption may appear problematic given previous research (Austin et al., 2005) which suggests that fast-food restaurants are more prevalent within 1.5 miles of a school. However, we only require that, *within a quarter of a mile from a school,* the exact location of a new restaurant opening is determined by idiosyncratic factors such as where suitable locations become available.

effect on obesity rates or weight gains. This suggests that our estimates are not just capturing increases in the local demand for restaurant establishments, or other characteristics of the neighborhood that might be correlated with a high density of restaurants.

Finally, we directly investigate the extent of selection on observables. We find that observable characteristics of schools are not associated with changes in the availability of a fast food restaurant in the immediate vicinity of a school. Fast-food restaurants are equally likely to be located within .1, .25, and .5 miles of a school. Also, the observable characteristics of mothers that predict large weight gains are negatively--not positively--related to the presence of a fast-food chain, suggesting that any bias in our estimates for mothers may be downward, not upward. Taken together, the weight of the evidence is consistent with a causal effect of fast-food restaurants on obesity rates among 9th graders and on weight gains among pregnant women.

The estimated effects of proximity to fast-food restaurants on obesity are consistent with a model in which access to fast-foods restaurants increases obesity by lowering food prices or by tempting consumers with self-control problems.[4] Differences in travel costs between students and mothers could explain the different effects of proximity. Ninth graders have higher travel costs in the sense that they are constrained to stay near the school during the school day, and hence are more affected by fast-food restaurants that are very close to the school. For this group, proximity to a fast-food restaurant has a quite sizeable effect on obesity. In contrast, for pregnant women, proximity to a fast-food restaurant has a quantitatively small (albeit statistically significant) impact on weight gain. Our results suggest that concerns about the effects of fast-food restaurants in the immediate proximity of schools are well-founded. Although relatively few students are affected, these restaurants have a sizeable effect on obesity rates among those who are affected.

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 the

[4] See DellaVigna (2009). A model of cues in consumption (Laibson, 2001) has similar implications: a fast-food restaurant that is in immediate proximity from the school is more likely to trigger a cue that leads to over-consumption.

econometric models. In Sections 5 and 6 we present the empirical findings for students and mothers, respectively. In Section 7 we discuss policy implications and conclude.

2. Background

While there is considerable evidence in the epidemiological literature of correlation between fast food consumption and obesity, it has been more difficult to demonstrate a causal role for fast food. A recent review about the relationship between fast food and obesity (Rosenheck, 2008) concludes that "Findings from observational studies as yet are unable to demonstrate a causal link between fast food consumption and weight gain or obesity."

A rapidly growing economics literature has focused on the link between declining food prices and obesity (see Philipson and Posner, 2008 for a review).[5] A series of recent papers explicitly focus on fast-food restaurants as potential contributors to obesity.[6] The two papers closest to ours are Anderson and Matsa (2009) and Brennan and Carpenter (2009). Anderson and Matsa focus on the link between eating out and obesity using the presence of Interstate highways in rural areas as an instrument for restaurant density. They find no evidence of a causal link between restaurants and obesity.

Our paper differs from Anderson and Matsa (2009) in three important dimensions, and these differences are likely to explain the discrepancy in our findings. First, we have a very large sample that allows us to identify even small effects. Our estimates of weight gain for mothers are within the confidence interval of Anderson and Matsa's two stage least squares estimates. Second, we have the <u>exact</u> location of each restaurant, school and mother. In contrast, Anderson and Matsa use telephone exchanges as the level of

[5] For example, Lakdawalla and Philipson (2002) argue that about 40% of the increase in obesity from 1976 to 1994 is attributable to lower food prices. 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.

[6] Chou et al. (2004) estimate models combining state-level price data with individual demographic and weight data from the Behavioral Risk Factor Surveillance surveys and find a positive association between obesity and the per capita number of restaurants (fast food and others) in the state. Rashad, Grossman, and Chou (2005) present similar findings using data from the National Health and Nutrition Examination Surveys. Anderson and Butcher (2005) investigate the effect of school food policies on the BMI of adolescent students. 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 Lui (2007) show that employed mothers spend less time cooking. Thomadsen (2001) estimate a discrete choice model of supply and demand that links prices to market structure and geographical dispersion of fast food outlets in California.

geographical analysis. Given our findings, it is not surprising that at their level of aggregation the estimated effect is zero. Third, the populations under consideration are different. Anderson and Matsa focus on predominantly white rural communities, while the bulk of both the 9th graders and the mothers we examine are urban and many of them are minorities. We show that the effects vary considerable depending on race. Indeed, when Dunn (2008) uses an instrumental variables approach similar to the one used by Anderson and Matsa, he finds no effect for rural areas or for whites in suburban areas, but strong effects for blacks and Hispanics. As we show below, we also find stronger effects for minorities.

Brennan and Carpenter (2009) use individual-level student data from the California Healthy Kids Survey. In contrast to our study, Brennan and Carpenter present only cross-sectional estimates, and pool data from grades 7-12. They focus on fast-food restaurants within .5 miles of a school, although they also present results for within .25 miles of a school. Their main outcome measure is BMI, which is computed from self-reported data on height and weight. Relative to their study, our study adds longitudinal estimates, the focus on 9th graders, a better obesity measure, estimates for pregnant mothers, and checks for possible unobserved differences between people and schools located near fast-food restaurants and others.

3. Data and Summary Statistics

Data for this project comes from three sources.

(a) School Data. Data on children comes from the 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 the spring, California 9th graders are given a fitness assessment, the FITNESSGRAM®. Data is reported at the class level in the form of the percentage of students who are in the "healthy fitness zone" with regard to body fat, and who have acceptable levels of abdominal strength, aerobic capacity, flexibility, trunk strength, and upper body strength. Data are available only for cell sizes with greater than 10 students, so that for some of the sub-group analyses we report below, there are some cells with data that are surpressed. What we will call obesity is the fraction of students whose body fat measures are outside the healthy fitness zone. For boys this means that they have body fat measures greater than 25% while for girls, it means that they have body fat measures greater than 32%. Body fat is measured using skin-fold calipers and two skinfolds (calf and triceps). This way of measuring body fat is considerably more accurate than the usual BMI measure (Cawley and Burkhauser, 2006). Since grade 9 is the first year of high school and the fitness tests take place in the Spring, this impact corresponds to approximately 30 weeks of fast-food exposure.[7] [8]

(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). Confidential data including mothers names, birth dates, and addresses, were used to construct a panel data set linking births to the same mother over time, and then to geocode her location (again using ArcView).[9] 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-coded information come from the National Establishment Time Series Database (Dun and Bradstreet). These data are used by all major banks, lending institutions, insurance and finance companies as the primary system for creditworthiness assessment of firms. As such, it is arguably more precise and comprehensive than yellow pages and business directories.[10] We obtained a panel of virtually all firms in Standard Industrial Classification 58 ("Eating and Drinking Places") from 1990 to 2006, with names and addresses. Using this data, we constructed several

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[7] In very few cases, a high school is in the same location as a middle school, in which case the estimates reflect a longer-term impact of fast-food.

[8] 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 Statistic's Common Core of Data, as well as to the Start test scores for the 9th grade. The location of the school was geocoded using ArcView. Finally, we merged in information about the nearest Census block group of the school from the 2000 Census including the median earnings, percent high-school degree, percent unemployed, and percent urban.

[9] In Michigan, the state created the panel and gave us de-identified data with latitude and longitude. In New Jersey, the matching was done at the state offices and then we used de-identified data. The importance of maintaining confidentiality of the data is one reason we do not use continuous distance measures in the paper.

[10] The yellow pages are not intended to be a comprehensive listing of businesses - they are a paid advertisement. Companies that do not pay are not listed.

different measures of fast-food restaurants 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 in the country, namely, McDonalds, Subway, Burger King, Taco Bell, Pizza Hut, Little Caesars, KFC, Wendy's, 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 these "other restaurants" changes with the definition of fast food. Appendix Table 1 lists the top 10 fast food chains as well as examples of restaurants that we did not classify as fast food.

Matching was performed using information on latitude and longitude of restaurant location. Specifically, we match the schools and mother's residence to the closest restaurants using 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 the mother data, we match the data on weight gain during pregnancy with 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 was a fast-food restaurant or other restaurant within .1, .25, and .5 miles of either the school or the mother's residence. Table 1A shows summary characteristics of all the controls variables in the schools data set by distance to a fast-food restaurant, where distances are overlapping. Here, as in most of the paper, we use the narrow definition of fast-food, including the top-10 fast-food chains. Only 7% of schools have a fast-food restaurant within .1 miles, while 65% of all schools have a fast-food restaurant within 1/2 of a mile.[11] Schools within .1 miles of a fast-food restaurant have more Hispanic students 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. Table 1B shows a similar summary of the mother data, indicating all the control variables. Again, mothers who live very near fast-food restaurants have different

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

characteristics than the average mother. They are younger, less educated, more likely to be black or Hispanic, and less likely to be married.

4 Econometric Specifications

Our baseline 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 miles of the school in year *t*; $F25_{st}$ is an indicator equal to 1 if there is a fast-food restaurant within .25 miles of the school in year *t*; $F50_{st}$ is an indicator equal to 1 if there is a fast-food restaurant within .5 mile of 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 of the school; d_s is a fixed effect for the school.

We include the controls $N1_{st,}$ $N25_{st}$ and $N50_{st,}$ because the presence of other restaurants in a neighborhood is likely to be a good proxy for characteristics of a neighborhood that may be correlated both with the presence of a fast-food restaurant and with factors that may contribute to obesity in school children such as urbanicity and lack of space to play. Moreover, some of the hypotheses about how fast food contributes to obesity (such as through marketing to children) may be unique to fast food. Hence, it is important to distinguish between the effects of fast-food restaurants per se and those of other restaurants.

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 African-American, fraction native American, fraction Hispanic, fraction immigrant, 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 (Limited English Proficiency/English Language Learner), share of special education (Individual Educational Plan) students (see Table 1A for a full list). 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, racial composition, educational composition, and labor force participation. (Table 1A again provides the full list). 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.

Other things being equal, the school fixed effects specification would be our preferred specification in the schools data. However, we also emphasize models without school fixed effects because there are many schools in our data that do not experience a change in the proximity of fast-food restaurants over our sample period (and hence do not contribute to identification in the models with school fixed effects) as discussed above. Moreover, we find little evidence that the placement of fast food restaurants is related to student characteristics within the small areas that we focus on. Finally because we focus on 9th graders, who are generally new to their high schools, the estimates without school fixed effects may closely resemble those with fixed effects since both capture the influence of new proximity to a fast-food restaurant. Given that the previous literature focuses largely on cross-sectional estimates, it is of interest to compare models with and without school fixed effects in order to determine the possible magnitude of biases due to omitted variables bias. We find significant effects of close proximity to a fast-food restaurant in models with and without school fixed effects.

The key identifying assumption is that after conditioning on the vector X and Z, the proximity of non-fast-food restaurants and, in the panel specifications, also school fixed effects, changes in other determinants of obesity rates are not systematically correlated with changes in the proximity of fast-food restaurants. In other words, in the absence of a fast-food restaurant, schools that are .1 miles from a fast-food restaurant and schools that are .25 miles from a fast-food restaurant are assumed to have similar changes in obesity rates. This assumption is not incompatible with fast-food restaurants targeting schools when opening new locations. It only requires that, *within a quarter of a mile from a school,* the exact location of a new restaurant opening is determined by idiosyncratic factors. Since the exact location of new retail establishments is determined by many factors, including the timing of when suitable locations become available, this assumption does not appear unrealistic. Below we report a number of empirical tests of this assumption.

It is important to note that the fast-food restaurant indicators $F1_{st,}$ $F25_{st}$ and $F50_{st}$ are not mutually exclusive. Similarly, we define the non-fast-food restaurant indicators $N1_{st,}$ $N25_{st}$ and $N50_{st}$ as not mutually exclusive. This means that the coefficient α, for example, is the *difference* in the effect of having a fast-food restaurant within .1 mile and the effect of having a fast-food restaurant within .25 miles. To compute the effect of having a fast-food restaurant within .1 mile (relative to the case where there is no fast-food restaurant within at least .5 miles) one needs to sum the three coefficients $\alpha+\beta+\gamma$.

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

$$(2)\quad Y_{it} = \alpha\, F1_{it} + \beta\, F25_{it} + \gamma\, F50_{it} + \alpha'\, N1_{it} + \beta'\, N25_{it} + \gamma'\, N50_{it} + \delta\, X_{it} + d_i + e_{it},$$

where Y_{it} is either an indicator equal 1 if mother *i* gains more than 20Kg (or 15Kg) 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 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,[12] and d_i is a mother 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. In an alternative set of specifications we include fixed effects for the zip code of residence of the mother rather than mother fixed effects. This specification is similar to the fixed effect specification for the schools.

Finally, there are two reasons for proximity to a fast-food restaurant to change for mothers. They could stay in the same place and have a restaurant open (or close) near them. Or, they could move closer or further away from a fast-food restaurant between pregnancies. In order to determine which of these two effects dominate, we also estimate models using only women who stayed in the same place between pregnancies

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

(These women are designated stayers). In these models, the estimates reflect the estimated effects of having a restaurant open (or close) nearby between pregnancies.

One concern is the possible presence of measurement error. While our information about restaurants comes from one of the most reliable existing data sources on the location of retailers[13], it is probably not immune from measurement error. Our empirical findings point to an effect of fast-food restaurants on obesity that declines with distance. It is unlikely that measurement error alone is responsible for our empirical finding. First, measurement error is likely to induce some attenuation bias in our estimates (i.e. a downward bias). Second, even if measurement error did not induce downward bias, it would have to vary systematically with distance, and there is no obvious reason why this would be the case.[14]

5. Empirical Findings: School Sample

(**a) Benchmark Estimates.** Table 2 shows our baseline empirical estimates of the effect of changes in the supply of fast-food restaurants on obesity rates (see equation 1 above). The dependent variable is the percentage of students in the 9th grade who are classified as obese. Each column is from a different regression. Entries are the coefficient on a dummy for the existence of a fast-food restaurant at a given distance from the school (coefficients α, β, and γ in equation 1) and coefficients on dummies for the existence of a non-fast-food restaurant at a given distance from the school (α', β' and γ' in equation 1). Recall that the fast-food restaurant indicators are not mutually exclusive. Thus, the coefficient on the .1 miles dummy is to be interpreted as the *additional* effect of having a

[13] Our data on restaurant are considered by some as the "best data source for studying business location" (Kolko and Neumark, 2008).

[14] As an additional check, we used Google Map to check the distance between schools and restaurants for a random sample of our schools. This comparison is complicated by three problems. First, Google Map data are not immune from measurement error. In our search, we found some instances in which Google Map significantly misreported or missed the location of a business. Second, our data end in mid-2006, while current Google Maps reflect restaurant location at the end of 2008. There is considerable churning in this industry, so even if our data and Google data were perfectly correct, we could find some discrepancies. Third, our measure of distance is "as the crow flies", while Google Map only provides driving distance. This latter issue is a problem because the key variable of interest for us is a dummy equal to 1 if the distance between the school and the restaurant is <.1 miles. Even small differences between distance measured "as the crow flies" and driving distance may lead us to incorrectly label our indicator as incorrect, when in fact it is correct. In the sub-sample of 30 schools that we checked by hand, we estimate a reliability ratio of .75. Given the three limitations described above, we consider this evidence as quite encouraging.

fast-food restaurant within .1 mile over and above the effect of having a fast-food restaurant within .25 miles.

In column 1 we report unconditional estimates. There is generally a positive association between availability of a fast-food restaurant and obesity rates. Estimates in column 2 condition on school level controls, census block controls and year effects. We note that standard errors are smaller in column 2 than in column 1, indicating that our controls do a good job absorbing other determinants of obesity but leave enough variation for the identification of the effect of interest. With controls, the only statistically significant effect is associated with the availability of a fast-food restaurant within .1 miles. To illustrate the interpretation of this coefficient, compare two schools that are identical, but one is located .09 miles from a fast-food restaurant while the other one is located .24 miles from a fast-food restaurant. The estimate of α in Column 2 indicates that in the former the obesity rate is 1.7 percentage points higher than in the latter. This estimate is both statistically significant and economically important: compared to a mean obesity rate of 32.9, a fast-food restaurant within .1 miles from a school results in a 5.2 percent increase in the incidence of obesity. The coefficients on availability of a fast-food restaurant within .25 miles (β) and on availability of a fast-food restaurant within .50 miles (γ) are statistically insignificant. Figure 1a plots these estimates together with confidence intervals. The presence of non-fast-food restaurants has no effect on obesity, indicating that the effect of fast-food restaurants is specific and does not generalize to any food establishment. This pattern of effects – only fast-food restaurants that are very close have an effect -- is consistent with a non linear increase in transportation costs with distance, and/or with strong psychological effects of the availability of fast-food restaurants, such as temptation for consumers with self-control problems.

We can also use the estimates in Table 2 to compare the effect of having a fast-food restaurant at distance of .1 miles, compared to not having a fast-food restaurant (within .5 miles). The sum of coefficients $\alpha+\beta+\gamma$ (reported at the bottom of the Table), which captures the effect of exposure to a fast-food restaurant within .1 miles compared to no fast-food restaurant within .5 miles, is sizeable and positive (.81 = 1.7385-.891-.0391), though not significant.

In columns 3 and 4 we present estimates with school fixed effects. By including indicators for each school, we absorb any time-invariant determinant of obesity. The estimates are identified only by schools where fast-food restaurant availability varies over time. At the .1 mile distance, for example, there are 13 schools that add a fast-food restaurant, 8 that lose a fast-food restaurant, and 1 school that does both. At the .25 (respectively, .5) mile distance, 63 (respectively, 117) schools switch fast-food restaurant availability in the sample. The estimates with school fixed effects point to a statistically significant effect of the availability of a fast-food restaurant within .1 miles of 6.33 percentage points, which is larger than in the cross-sectional estimates of columns 1 and 2. This fast-food restaurant effect is the same in the specification without controls (Column 3) and with controls (Column 4, and also Figure 1a), indicating that once we condition on school fixed effects there is very limited selection on the other observables. There is no evidence of a positive additional effect of the availability of a fast-food restaurant within .25 miles or .5 miles. The pattern is similar to what we see in models without school fixed effects: there is no significant effect of fast-food restaurant at .5 or .25 miles, and a large positive effect at .1 miles.

Next, we present estimates based on an event study methodology. We examine how the past, current and future existence of a fast food restaurant in a given location affects the current obesity rates of students at that location. Estimates are from a single regression where we include indicators for availability of fast food in years *t-3, t-2, t-1, t, t+1, t+2* and *t+3* for a distance of .1 mile, .25 miles, and.5 miles. [15] Figure 2 presents estimates of the impact of fast-food availability within .1 miles for specifications both without and with school fixed effects. The vertical bars denote 95% confidence intervals. If fast-food restaurants open in areas that experience unobserved upward trends in the demand for fast food, it is possible that current obesity rates may be correlated with future (or lagged) fast-food restaurant availability. Otherwise, we expect that future fast-food restaurant exposure should not affect obesity rates. Similarly, lagged fast-food restaurant presence near the school should not affect obesity rates since students in 9th

[15] We also include (but do not show) seven indicators for non-fast food restaurants.

grade are typically starting high-school in a different location from where they attended middle school.

While the estimates are necessarily imprecise given the high degree of multicollinearity, the qualitative picture that emerges from Figure 2 is striking. Both cross-sectional estimates and panel estimates indicate that the effect of exposure occurs at time *t*, which is exactly the time when it is expected to occur. Estimates for the three lags and the three leads are all much closer to zero. We conclude that, conditional on current availability of a fast food restaurant, past or future availability has no discernible effect on obesity. This lends considerable credibility to our design.

(b) Magnitude of the Estimated Effect. Are the estimated effects plausible? To investigate this question, we compute how many calories it would take per school day to move a 14-year old boy of median height across the cut-offs for overweight status (the 85 percentile of BMI) and obesity (the 95 percentile of BMI). Based on CDC (2000) growth charts, it only takes a weight gain of 3.6 pounds to move from the 80^{th} to the 85^{th} percentile of the BMI distribution. Over a period of 30 weeks[16], this corresponds to a gain of about 80 additional calories per school day. It would take 300 additional calories to move from the 90^{th} to the 95^{th} percentile of BMI, where the later is the cutoff for obesity.

Based on these calibrations, the cross-sectional estimate of a 1.7 percentage point increase in the obesity rate due to the immediate proximity of a fast-food restaurant (column 2 in Table 2) corresponds to about 30 additional calories per day according to the first calculation and 100 calories per day according to the second. These amounts can be compared with the calories from a typical meal at a fast-food restaurant, such as 540 calories for McDonald's Big Mac, 990 calories for Burger King's Double Whopper, 570 for McDonald's regular fries, and 200 calories for a 16 ounce regular Coke.[17] Even assuming that a large portion of the calories consumed in fast-food restaurants are offset

[16] 30 weeks is the average length of time that the 9^{th} graders are exposed to a nearby restaurant between the beginning of high school in Sept. and the fitness test. BMI percentiles and median height for 14 year old boys are taken from the CDC(2000) growth charts available from www.cdc.gov/nchs/data/nhanes/growthcharts/set1/all.pdf.

[17] The fast food calories are from http://www.acaloriecounter.com/fast-food.php The estimate that it takes 3500 extra calories per week to gain a pound is from the CDC and is available from http://www.cdc.gov/nccdphp/dnpa/healthyweight/index.htm

by lower consumption at other meals, it is easy to obtain caloric intake increases that are consistent with the observed effects.[18]

Ebbeling et al. (2004) report on a controlled experiment of energy intake among overweight and non-overweight adolescents that involved offering them a fast food meal during the day and found that energy intake from the meal among all participants was extremely large (1652 kcal). What is more striking is that overweight participants consumed approximately 400 more total calories on fast food days than non–fast food days while lean participants were able to offset their fast food intakes. Thus, there appears to be at least a subset of children who do not offset fast food calories effectively. The estimates in Table 2 appear therefore to be quite plausible.

(c) Additional Specifications. In Table 3 we present estimates from a variety of alternative specifications. In column 1 we test how sensitive our results are to our definition of a fast-food restaurant. Our estimates so far are based on our benchmark definition of fast-food restaurants, which includes the top 10 chains (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). As Appendix Table 1 shows, the top 10 restaurants account for 43 percent of all fast-food restaurants in the four states we study. In column 1 we add an indicator based on a broader definition of fast-food restaurants based on the Wikipedia list of fast food chains. Our broad definition starts with this list, excludes ice cream, donut, and coffee shops, and adds in all independent restaurants that have the words "pizza" or "burger" in their names. This allows us to capture some of the effect of small independent restaurants. The model indicates that this measure does not have any additional impact over and above our baseline definition of a fast-food restaurant, suggesting that the top 10 fast-food restaurants are qualitatively different from other fast food establishments. In column 2 we show estimates using another alternative measure of fast food that excludes Subway restaurants, which are arguably healthier than

[18] The calorie intake from the typical fast food meal is an order of magnitude larger than any plausible caloric expenditure in a round trip to a fast-food restaurant. It would take at most 4 minutes to stroll the distance of 1-2 blocks to a fast-food restaurant that is 0.1 miles away and a 14 year old boy of median weight (about 120 lbs) would expend about 30 calories on the trip. The weight for age charts for boys is available at http://www.cdc.gov/growthcharts/data/set1clinical/cj41c021.pdf while the calorie burn rate for walking at 3.5 mph can be computed at http://www.healthdiscovery.net/links/calculators/calorie_calculator.htm.

the other chains, from our list of top 10 fast-food restaurants. The results are essentially the same as using the benchmark definition.[19]

Column 3 shows estimates of a model in which we do not distinguish between fast food and non-fast-food restaurants. The key independent variable here is an indicator equal to 1 for any restaurant. This specification is similar to the one emphasized by Anderson and Matsa (2009). Consistent with their findings, we find no evidence that the presence of any restaurant affects obesity.

In columns 4 and 5 we test for racial differences. The point estimates for Hispanic students (larger in the fixed effect estimates) are similar to the ones in the whole sample. Point estimates for African-Americans are smaller and not significant. This may be due to a limitation of our data which is that reporting is restricted to groups with at least 10 students. Since there are relatively few African Americans in California, this restriction induces more censoring for them than for other groups. The point estimates for Whites (Web Appendix Table 1) are similar to those in the whole sample. When we split the sample by gender (Web Appendix Table 1), the effect is substantially larger for female students than for male students. We also attempted to consider variation in effects by family income, using whether children were eligible for free school lunch as an income proxy. The difference in the effects for the groups with and without free lunch status is small and not statistically significant at conventional levels (not shown).

We have also considered a number of alternative specifications (Web Appendix Table 2): (i) an optimal trimming model, where we include only schools that have a propensity score between .1 and .9; (ii) a nearest neighborhood matching specification, where we match on all the school level and block level covariates; and a (iii) a proximity regression where we use only the subsample of schools that are within .25 miles of a fast-food restaurant and examine the effect of being within .1 miles. All of these specifications yield estimates similar to those described above.[20]

[19] We also asked whether the availability of two or more fast food restaurants within .1 miles had a greater impact than the availability of one fast food restaurant within .1 miles, but did not find any difference. This is not surprising, given the small number of cases with two or more fast-food restaurants within .1 miles. See the web appendix Table 2 for details.

[20] We also present results on the effect of fast-food restaurants on alternative measures of fitness in Web Appendix Table 3 including: abdominal strength, aerobic capacity, flexibility, trunk strength and upper body strength. Our hypothesis is that consumption of fast food should have a larger effect on obesity than on say, strength. Models without school fixed effects point to a negative effect of fast-food restaurant on

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

We now turn to a discussion of the plausibility of our identifying assumptions. We begin by asking whether observable characteristics of students are associated with levels of (and changes in) the availability of a fast-food restaurant near a school. In Table 4 we replicate the main regressions of Table 2 but use as dependent variables six characteristics of the school, such as the fraction of the students in the school who are Black (column 1), Hispanic (column 2), Asian (column 3), the share of Title 1 students (column 4) share with free lunch (column 5), and average test scores (column 6). These models exclude the school level characteristics from the regressions (i.e. the X variables), but include the Census controls and the year fixed effects (the Z variables). Panel A reports estimates from models without school fixed effects, while panel B reports estimates from school fixed effects models. Of the 36 estimated coefficients, only one is statistically significant at conventional levels, and there is no systematic pattern to the coefficients. Student characteristics do not appear to be systematically associated with the presence of fast-food restaurants.

To implement a further placebo test, we generate the best linear predictor of the share of obese students using the full set of controls X and Z. Then in Column 7 we regress this variable on the variables for fast-food availability, as in Table 2, including again only the controls Z. The regression coefficients indicate how much fast-food availability loads on the same observables that predict obesity. We find that this obesity predictor is not significantly correlated with availability of fast-food at any distance,

flexibility. However, estimates from models with school fixed effects are generally insignificant for these measures. This finding is consistent with Cutler et al.'s (2003), and Bleich et al.'s (2007) argument that rising obesity is linked to increased caloric intake and not to reduced energy expenditure.

either in the cross-section or in the panel specification. This indicates that selection on unobservables is not likely to be an important concern at close distances.[21]

In panel C of Table 4 we present a geographic placebo: we test for whether fast-food restaurant are geographically uniformly distributed in the area around schools. If they are, we expect the number of fast-food restaurants within .25 (respectively, .5) miles of a school to be 2.5^2 (respectively, 5^2) larger than the number of fast-food restaurants within .1 mile of a school. To make the test clearer and more conservative, we do not condition on the controls that we use in the regressions. The results at the bottom of Table 4 indicate that we cannot reject the null hypothesis of uniform placement of fast-food restaurants at either horizon. While the placement of fast-food restaurants may still be endogenous when comparing availability at greater distances (Austin et al. 2005), at the distances that we consider in this paper we find no evidence of endogenous placement. Overall, we find no systematic evidence of an effect of demographic controls on the proximity of fast-food restaurants at very small distances from a school. [22]

(e) Effect by Grade. This paper focuses on 9th graders, since they are newly exposed to fast-food restaurants near their high schools. Students in 5th and 7th grade are also assessed in the spring using the FITNESSGRAM®, and the available fitness measures are the same as those for 9th graders. The percent of 5th and 7th graders who are obese is very similar to the share for 9th graders. However, since elementary schools tend to be smaller than high schools (with middle schools in between) there are more observations for elementary schools. Estimates for students in these grades are shown in Table 5. Compared to the estimates for 9th graders (repeated for convenience in Columns 1 and 2), the estimated effect of a fast-food restaurant at .1 miles is much smaller for 7th graders than for 9th graders: It is zero in models both with and without school fixed

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[21] In Web Appendix Table 4A, we present an alternative approach to documenting the extent of selection. We regress the availability of fast-food at different distances on the set of demographic variables, essentially reversing the dependent and independent variables relative to Table 4. This alternative specification allows us to conduct F-tests for the significance of all the controls. The finding, as in Table 4, is that there is no evidence of selection at very close distances from a fast-food restaurant.

[22] Web Appendix Table 5 presents an additional placebo similar to Figure 2. Unlike Figure 2, we include availability only in year *t* and in year *t+3* (*t-3*). The results are similar if we use as placebo the availability of fast-food 2 years ahead and 2 years earlier. The findings indicate that conditional on the availability of fast-food restaurants in year *t*, availability in year *t+3* does not predict obesity rates. Similarly, we do not find any significant effect of the presence of a fast-food restaurant within .1 mile of the school 3 years prior, even though the estimates are noisy and the contemporaneous effect is no longer significant.

effects. The effect is also small for 5th graders in the models without school fixed effects, but becomes large and similar to the estimate for 9th graders in models with school fixed effects.

6. Empirical Findings: Mother Sample

We now turn to results based on weight gain during pregnancy from the Vital Statistics data. There are several motivations for this part of our analysis. While an important reason for focusing on pregnant women is the availability of geographically detailed data on weight measures for a very large sample, weight gain for pregnant women is an important outcome in its own right. 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; Lin, forthcoming; Rooney and Schauberger, 2002; Thorsdottir et al., 2002; Wanjiku and Raynor, 2004). Figure 3 indicates that the incidence of low APGAR scores (APGAR scores less than 8), an indicator of poor fetal health, increases significantly with weight gain above about 15-20kg. While this relationship may not be causal, Currie and Ludwig (2009) show that even in mother fixed effects models, high weight gain during pregnancy is associated with infants who are large for gestational age, and therefore difficult to deliver.

From the statistical point of view, the mother sample has important advantages over the school sample, since it varies at the individual level and is longitudinally linked. Since we observe weight gains for multiple pregnancies for the same mother, we can ask how weight gain is affected by changes in the proximity to a fast-food restaurant between pregnancies. These within-mother estimates control for all constant unobserved characteristics of the mother (such as whether she was exposed to a lot of fast food growing up, and her nutrition knowledge at the beginning of the period of observation).

It is important to examine the impact of exposure to fast-food restaurants on adults, as well as school children. Moreover, one advantage of the weight gain measure is that unlike weight in levels, only recent exposure to fast food should matter. For these reasons, despite the lack of information on weight level and therefore obesity for mothers, the results for mothers complement the results for school children.

(a) Benchmark Estimates. Table 6 presents our estimates of equation 2. The dependent variable in columns 1, 2 and 3 is an indicator equal to 1 if weight gain is above 20kg. The dependent variable in column 4 is an indicator equal to 1 if weight gain is above 15kg. We chose these measures given that the cutoff for adverse affects of pregnancy weight gain is around 15-20kg. However, we also show estimates for continuous weight gain in column 5.

The fixed-effect models with zip-code fixed effects (Column 1) and with mother fixed effects (column 2) point to a positive effect of proximity to a fast-food restaurant on probability of weight gain above 20 kg. We obtain similar results for the probability of weight gain above 15kg. (Column 4) and continuous weight gain (Column 5), in both cases using the specification with mother fixed effects. The availability of a fast-food restaurant within .5 miles is associated with an increase of .19 percentage points (1.6 percent) in the probability of weight gain larger than 20kg, an increase of .44 percentage points (1.3 percent) in the probability of weight gain larger than 15kg, and an increase of 0.049kg (04 percent) in weight gain. As in the school sample, we find no evidence that non-fast-food restaurants are associated with positive effects on weight gain.

Figure 1b shows the estimates of exposure to fast-food at various distances for the benchmark models (Column 2). Compared to the effect of exposure at .5 miles, there is a monotonic increase in the effect of availability from .5 miles, to .25 miles, and .1 miles, though the difference from the effect at .5 miles is not statistically significant. For 9th graders, instead, only availability of a fast-food restaurant within .1 miles seems to matter, and fast-food restaurants further away have no discernible impact on obesity.

In these mother fixed effects models, proximity to a restaurant may change either because a restaurant opens or closes, or because the mother changes location. In order to isolate the effect of the former, we restrict the sample to mothers who did not move between births. Results for this subsample (Column 3) on the effect of proximity to a fast-food restaurant are somewhat larger than for the full sample (Column 2).

(b) Magnitude of the Estimated Effect. The estimated effect of exposure to fast-food restaurants at a .5 mile distance is to increase the weight gain of mothers during pregnancy by 49 grams (Table 6, Column 5). Dividing this weight gain of about 0.1 pounds by the approximately 270 days of pregnancy yields an increase in caloric intake due to fast-food of about 1.3 calories per day. (This calculation uses the CDC estimate that 3,500 additional calories induces a 1-pound weight increase). Even the larger estimate of weight gain for proximity to a fast-food restaurant at .1 mile corresponds to only an additional 4 calories per day. It is the large size of the data set that provides us with the precision needed to identify such small effects. Overall, the caloric impacts of proximity to a fast-food restaurant for mothers are one to two orders of magnitude smaller than the estimates for children. The findings are consistent with higher transport costs for the 9th graders (who cannot drive) relative to mothers.

(c) Additional Specifications. Table 7 shows estimates from a number of additional specifications. This Table follows the structure of Table 3. Columns 1 to 3 present models in which only one measure of restaurant availability is included in each regression, namely availability within .5 miles.

In column 1, we test whether a broader definition of a fast-food restaurant generates different results. As we did for schools, the broader definition is based on the Wikipedia, excludes ice cream, donut, and coffee shops, and adds in all independent restaurants that have the words “pizza” or “burger” in their names. The model includes the indicator for one of the top 10 fast-food restaurants within .5 miles, an indicator for the presence of another fast-food restaurant within .5 miles, and an indicator for the presence of a non fast-food restaurant in this radius. The broader definition does not have any additional impact over and above the baseline “top 10” definition, suggesting that there is something unique about the largest and most widely known fast-food restaurant brands.[23] Column 2 shows estimates from a model which excludes Subway from the top 10, since Subway is arguably healthier than the other chains; the estimates are very similar to the baseline estimates. Column 3 reports estimates of a model where the independent variable is an indicator equal to 1 for any restaurant. Similar to our findings for schools and consistent with Anderson and Matsa (2009), we find no evidence that the presence of any restaurant affects weight gain during pregnancy.

In columns 4 to 7 we investigate whether weight gain varies by ethnicity and maternal education. The effect of a new fast-food restaurant is largest for African

[23] Robinson et al. (2007) report that young children consistently prefer food wrapped in familiar fast food packaging, suggesting that the advertising conducted by large chains is effective in spurring demand.

American mothers followed by Hispanic mothers, with no effect for non-Hispanic white mothers. In particular, the coefficient for African American mothers, .0066, is three times the coefficient for the average mother. Relative to the average of the dependent variable for African-Americans, this amounts to a 5 percent increase in the probability of weight gain over 20 kilos, a large effect. When we consider differences on the basis of education, we find that the impact is much larger in the less educated group, and that indeed, there is no effect on more educated mothers. The effect of non fast-food restaurants is reliably zero across the different racial and educational categories.

As in the school sample, we have also considered a number of alternative specifications (Web Appendix Table 6): (i) an optimal trimming model, where we include only mothers that have a propensity score between .1 and .9 or being within .5 miles of a fast-food; (ii) a proximity regression where we use only the subsample of mothers that are within 1 mile of a fast-food restaurant and examine the effect of being within .5 miles; (iii) a mother fixed effect model where we allow for a larger effect of proximity to 2 or more fast-foods. These specifications yield estimates similar to those described above, with no additional effect of a second fast-food.

We have also estimated the effects of fast-food restaurants on some additional birth outcomes (Web Appendix Table 7). The results suggest that the availability of a top 10 fast-food restaurant within .5 miles of the mother's residence is associated with a slightly higher incidence of maternal diabetes. There is no effect on the probability that the mother had a very low weight gain (clinically defined as less than 7.26kg) or on the probability of low birth weight.

(d) Threats to Identification and Placebo Analysis. In column 1 of Table 8 we ask whether there is evidence of changes in pregnancy weight gain as a function of *future* fast-food restaurant openings. While *current* fast-food restaurants within 0.50 miles increase the current probability of weight gain above 20Kg, there is no evidence that *future* fast-food restaurants increase weight gain. This is consistent with our identifying assumption. Column 2 shows estimates from models that include indicators for whether there was a fast-food restaurant in the mother's current location 3 years ago. This test is not as strong as the other because it is possible that lagged exposure to a fast-food restaurant could have an effect on current weight gain. Here both current proximity to a fast-food restaurant and lagged proximity to a fast-food restaurant have positive coefficients in the regression for weight gain over 20Kg, but neither coefficient is statistically significant.[24]

In columns 3 and 4, we undertake a placebo test of a different type, asking whether the availability of fast-food restaurants is correlated with individual-level demographics, conditional on mother fixed effects. The few variables that are time-varying within mothers include smoking during pregnancy and marital status. If our identifying assumption is correct, these two outcome variables should not be correlated with availability of fast-food restaurants. Indeed, we find no evidence that probability of smoking or marriage rates are correlated with fast-food restaurants at any distance, although the probability of smoking appears to be correlated with availability of non fast-food restaurants. In Table 3B we present further evidence on predictors of the availability of fast-food restaurants.

7. Conclusions

This paper investigates the health consequences of proximity to fast-food restaurants for two vulnerable groups: young teens and pregnant women. Our results point to a significant effect of proximity to fast-food restaurant on the risk of obesity, though the magnitude of the effect is very different for school children and adults. The presence of a fast-food restaurant within a tenth of a mile of a school is associated with at least a 5.2 percent increase in the obesity rate in that school (relative to the presence at .25 miles). Consistent with highly non-linear transportation costs for school children, we find no evidence of an effect at .25 miles and at .5 miles. The effect at .1 miles distance is equivalent to an increase in daily caloric consumption of 30 to 100 calories due to proximity of fast-food. The effect for pregnant women is quantitatively smaller and more linear in distance. A fast-food restaurant within half a mile of a residence results in a 1.6 percent increase in the probability of gaining over 20 kilos. This effect increases to a 5.5 percent increase when a fast-food is within .1 miles from the residence of the mother. The effect at .5 miles translates into a daily caloric intake of 1 to 4 calories, two orders of

[24] We obtained very similar results if we examined 1 year or 2 year leads and lags.

magnitudes smaller than for school children, though for African-American mothers, the effects are three times larger.

The quantitative difference in the impact of fast-food between school children and mothers, and between mothers of different races have potential policy implications. To the extent that the estimates for mothers are representative of the estimates for adults with good transportation options, attempts to limit the presence of fast-food in residential areas are unlikely to have a sizeable impact on obesity. Instead, narrower policies aimed at limiting access to fast food could have a sizable impact on populations with limited ability to travel, such as school children, or women in inner-city neighborhoods.

Using our estimates, we can do a calibration of the impact of fast-food restaurant penetration on school children and women. Taking into account that only about 6.7 percent of schools in our sample have a fast-food restaurant within .1 miles, fast-food restaurants near schools can be responsible for only 0.5 percent of the increase in obesity over the last 30 years among 9th graders.[25] Still, the results suggest that measures designed to limit access to fast food among teenagers more broadly (such as restrictions on advertising to children, or requirements to post calorie counts) could have a beneficial effect.[26]

If we assume that the effect of fast-food on weight gain for pregnant mothers is the same as for non-pregnant women (an admittedly strong assumption that is likely to give an upper bound estimate), then fast-food restaurants near a women's residence could be responsible for about 2.7 percent of the increase in weight in the last ten years among women.[27] While we cannot explain a large share of the changes in obesity and weight in

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[25] According to our measure, about 33% of 9th graders in California were obese during 1999-2007. Since obesity among adolescents (age 12-19) approximately tripled from 1970 to late 1990s, we estimate the increase in obesity of 9th graders in the past 30 years to be about 22 percentage points. Hence, we compute the effect as 1.7 percentage points (the estimated impact of fast-food on obesity at .1 miles) multiplied by .067 (the share of schools at .1 miles in 1999-2007, assumed to be zero in the 1960s) divided by 22 percentage points.

[26] Bollinger et al. (2009) find that posting calorie counts in Starbucks in New York City reduced calories consumed by about 6%, which is significant, but not large enough to have a major impact on obesity rates by itself.

[27] CDC (using NHANES data) reports that obesity has risen by about 10 percentage points for 20-34 year old females over the past 10 years (from 18.5% in the 1988-94 wave to 28.4% in the 1999-2002 wave) and that the average weight in this group has increased by about 6.7 kilograms. Our estimates indicate that a fast-food restaurant within .5 miles of a residence increases weight gain by 49 grams over 9 months, which over a ten-year period translate to 650 grams. Since fast-food restaurants are within .5 miles of a residence

either case, a potential explanation of the possibly larger fraction explained for mothers is that the effect is found at a longer distance (.5 miles); the second is the longer assumed exposure time. If, for example, having a fast-food restaurant near the school continued to influence children's eating habits throughout high school, then the cumulative effect for teens might well be larger than that estimated here.

These findings contribute to the debate about the impact of fast-food on obesity by providing credible evidence on magnitudes of the effect of fast-food. Still, this research leaves several questions unanswered. We cannot speculate about the generalizability of our research to other samples; it is possible that adolescents and pregnant women are uniquely vulnerable to the temptations of fast-food restaurants. In addition, our research cannot distinguish between a rational price-based explanation of the findings and a behavioral self-control-based explanation. Finally, since fast food is ubiquitous in America, we cannot study the impact of a fast-food restaurant entry in a society where fast-food is scarce. We hope that some of these questions will be the focus of future research.

(in our data) for 27.7 percent of women, fast-food restaurant proximity can have contributed to 650 grams times .277 divided by 6,700 grams, which equals 2.7 percent.

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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.

Appendix Table 1 shows more information about the top 10 fast-food restaurants, other major restaurant chains, and chains that are not counted as fast food for the four states in our study (California, Michigan, New Jersey, and Texas).

Figure 1a: Impact of Fast Food Availability on Obesity among 9th Graders

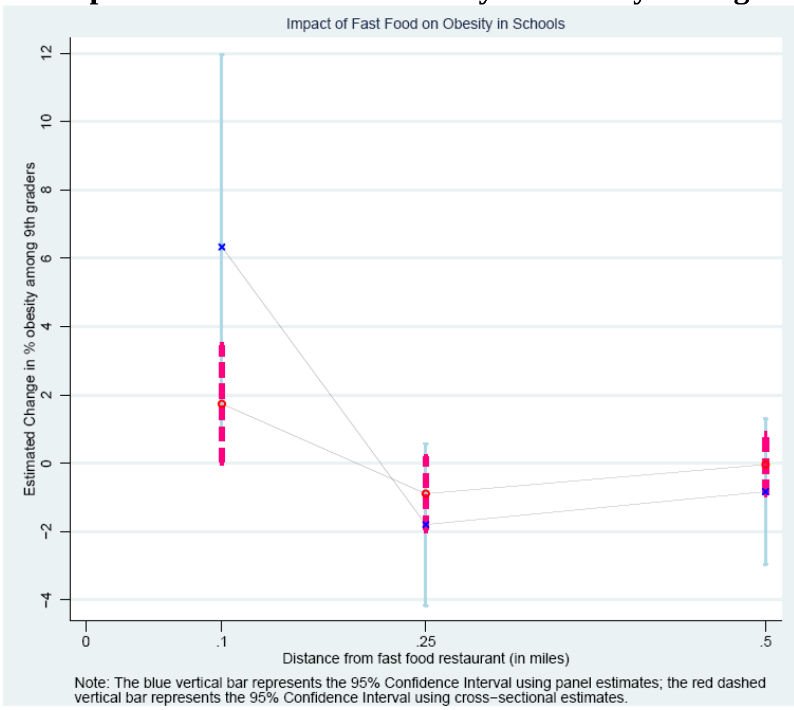
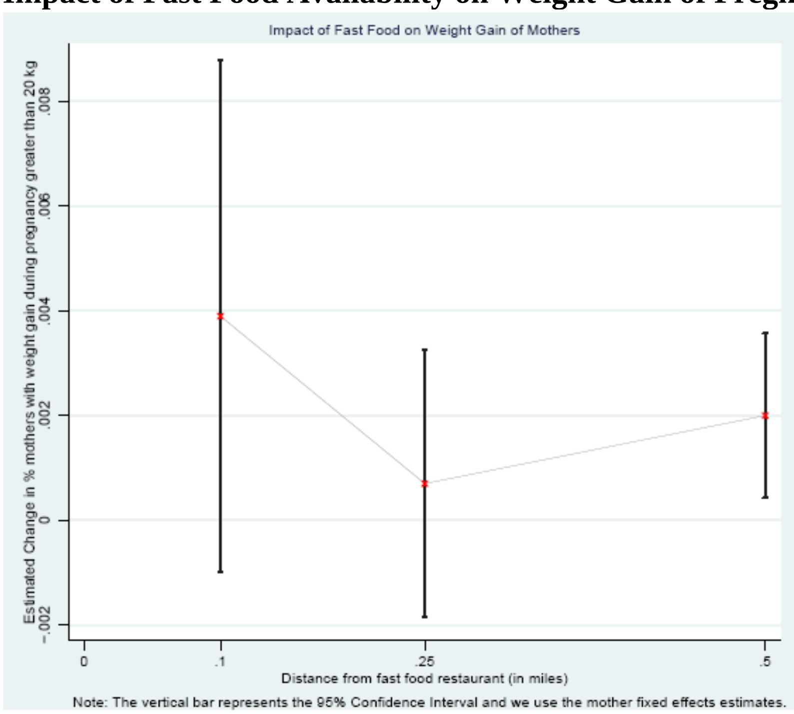
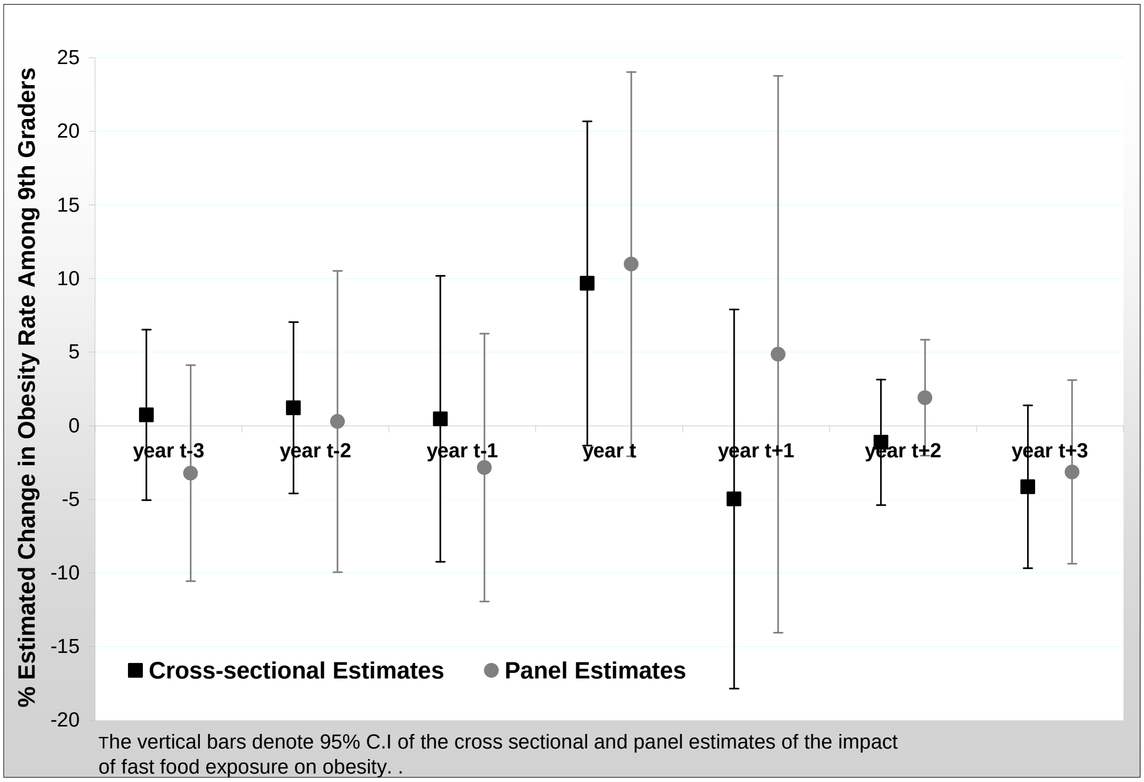


Figure 1b: Impact of Fast Food Availability on Weight Gain of Pregnant Mothers



Notes: Figure 1a plots the estimated impact of exposure to fast-food at .1, .25, and .5 miles on the obesity rate of 9th graders in the cross-section (Column 2 in Table 2) and in the panel (Column 4 in Table 2). Figure 1b plots the estimated impact on the probability of weight gain above 20 kg for mothers, in the specification with mother fixed effects (Column 2 in Table 6). The Figure plots the effect of exposure at distance j relative to the next largest distance. As such, the effect for .1 (respectively, .25) miles is the effect of exposure to fast-food at .1 (.25) miles, compared to exposure to fast-food at .25 (.5) miles; that is, it is the coefficient α (β) in equation 1. The effect for .5 miles captures the effect of exposure at .5 miles, compared to no fast-food within .5 miles, that is, it is the coefficient γ in equation 1.

Figure 2: Estimated Impact of Past, Current and Future Exposure to Fast Food on Obesity among 9th Graders



Notes: Figure 2 plots the estimated impact of exposure to fast-food at .1 miles on the obesity rate of 9th graders in the cross-section and with school fixed effects. The estimates are from one specification including indicator variables for the presence of a fast-food at distance of j miles (for j=.1, .25. and .5) in years *t-3, t-2, t-1, t, t+1, t+2, t+3.* As such, the estimated impact of exposure in year t-2, for example, should be interpreted as the impact of lagged exposure to fast-food, holding constant current exposure.

Figure 3: Correlation Between Gestational Weight Gain and Low APGAR Scores

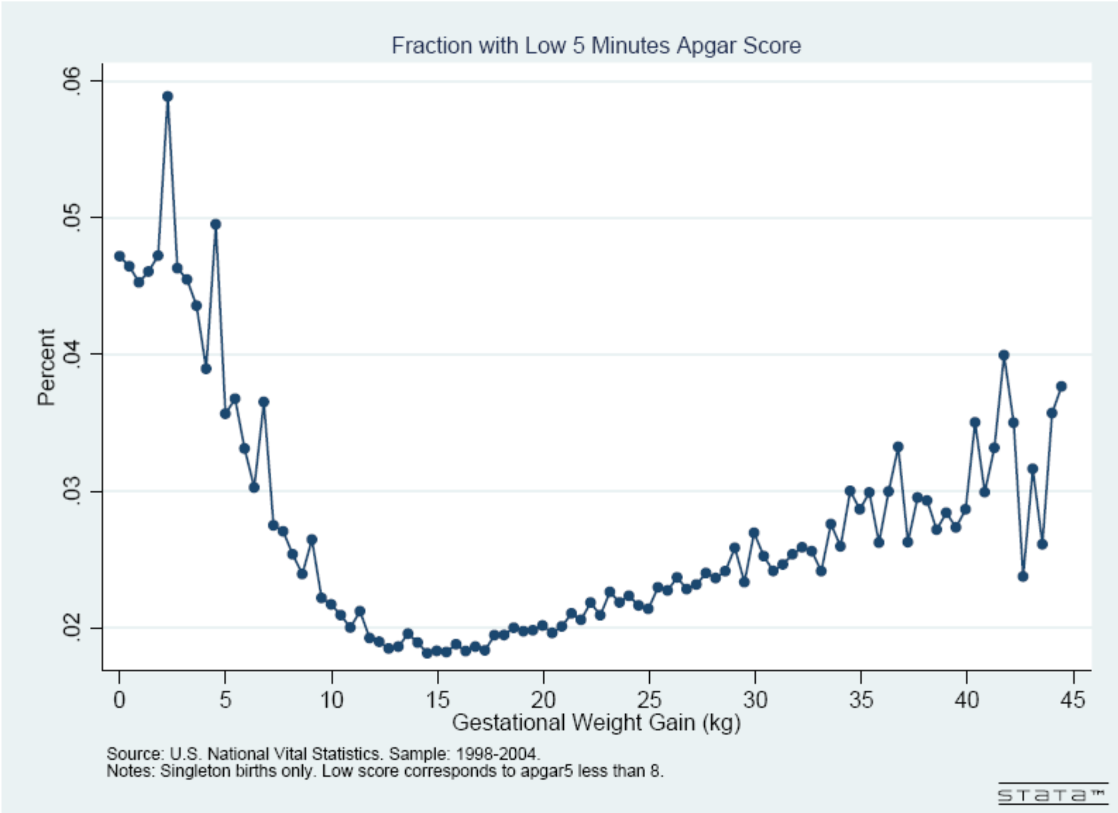


TABLE 1A
SUMMARY STATISTICS FOR CALIFORNIA SCHOOL DATA

	All	<.5 miles FF	<.25 miles FF	<.1 miles FF
# School-Year Observations	8373	5188	2321	559
No. Students in 9th grade	366.27	384.30	383.05	400.74
School Characteristics				
School qualified for Title I funding	0.397	0.411	0.406	0.436
Number of students	1566.184	1663.978	1663.624	1715.707
Student teacher ratio	22.393	22.841	22.668	22.857
Share Black students	0.084	0.093	0.093	0.086
Share Asian students	0.107	0.117	0.118	0.116
Share Hispanic students	0.380	0.409	0.416	0.436
Share Native American students	0.014	0.010	0.010	0.012
Share immigrant students	0.034	0.029	0.030	0.033
Share female students	0.475	0.477	0.477	0.490
Share eligible for free lunch	0.290	0.306	0.313	0.311
Share eligible for subsidised lunch	0.063	0.064	0.063	0.063
FTE teachers per student	0.048	0.047	0.047	0.047
Average Test Scores for 9th grade	56.255	54.964	54.737	52.291
Test Score information missing	0.024	0.020	0.022	0.016
School District Characteristics				
Student teacher ratio	20.897	21.095	20.911	21.092
Share immigrant students	0.028	0.025	0.025	0.028
Share non-English speaking (LEP/ELL) students	0.206	0.224	0.225	0.222
Share IEP students	0.126	0.125	0.132	0.120
Staff student ratio	0.102	0.099	0.102	0.095
Share diploma recipients	0.086	0.084	0.082	0.091
Share diploma recipients missing	0.004	0.004	0.008	0.000
2000 Census Demographics of nearest block				
Median household income	48596	45687	44183	44692
Median earnings	25674	24668	24271	23942
Average household size	2.97	2.93	2.84	2.88
Median contract rent for rental units	743.74	741.19	734.14	706.29
Median gross rent for rentals units	835.74	825.46	812.54	781.93
Median value for owner-occupied housing	202783	199824	199834	195244
Share White	0.629	0.597	0.591	0.578
Share Black	0.056	0.062	0.064	0.053
Share Asian	0.090	0.099	0.098	0.110
Share male	0.491	0.489	0.487	0.494
Share never married	0.289	0.310	0.320	0.314
Share married	0.546	0.519	0.505	0.513
Share divorced	0.103	0.107	0.111	0.107
Share High-School degree only	0.220	0.219	0.219	0.220
Share some college	0.235	0.226	0.223	0.219
Share Associate degree	0.072	0.069	0.071	0.072
Share Bachelor's degree	0.150	0.149	0.151	0.139
Share Graduate degree	0.078	0.076	0.077	0.069
Share in labor force	0.616	0.618	0.619	0.617
Share unemployed	0.083	0.085	0.088	0.079
Share with household income<$10K	0.092	0.099	0.106	0.101
Share with household income>$200K	0.026	0.022	0.020	0.020
Share with wage or salary income	0.782	0.784	0.784	0.789
Share of housing units occupied	0.946	0.953	0.953	0.950
Share in owner-occupied units	0.592	0.530	0.481	0.488
Share Urban	0.912	0.974	0.971	0.987
Outcome				
Percent obese students	32.949	33.772	33.724	35.733

Note: This Table lists all the controls used for the school regressions, with the exception of year and school fixed effects.

TABLE 1B
SUMMARY STATISTICS FOR BIRTH DATA

	All Births	Siblings Only	Siblings <=.5 mi	Siblings <=.25 mi	Siblings <=.1 mi
# Mother-Year Observations	5683798	3019256	835798	258707	44828
Demographic Characteristics					
Age of mother	26.975	26.772	26.450	26.249	25.963
Mother graduated from high school	.320	.310	.312	.315	.314
Mother attended some college	.332	.333	.301	.288	.268
Mother attended college or more	.079	.077	.065	.059	.050
Mother is black	.156	.164	.196	.195	.202
Mother is hispanic	.278	.263	.309	.324	.348
Mother is smoking	.107	.107	.108	.111	.111
Child is male	.512	.512	.512	.511	.507
Parity	1.016	1.180	1.200	1.190	1.180
Mother is married	.687	.696	.651	.639	.623
Other control variables are: (i) indicators for single year of age of the mother, (ii) indicators for year of birth, (iii) indicator for missing variables: education, race, smoking, gender, parity, marital status					
Outcomes					
Weight gain greater than 20kg	.126	.118	.120	.121	.123
Weight gain greater than 15kg	0.364	0.352	0.349	0.350	0.351
Weight gain (in Kg.)	13.664	13.491	13.410	13.412	13.400

Notes: There are 1,527,328 mothers with greater than or equal to two children in the full sample. There are 3,262 zip codes. 412,829 mothers experience a change in fast food availability within .5 miles, 181,250 experience such a change within .25 miles, and 37,976 experience a change within .1 miles.

TABLE 2
IMPACT OF FAST-FOOD ON OBESITY IN SCHOOLS: BENCHMARK RESULTS

Dep. Var.:	Percent of 9th graders that are obese			
	(1)	(2)	(3)	(4)
Availability of Fast Food Rest.	3.0807	1.7385	6.1955	6.3337
Within .1 miles	(1.6072)*	(0.8740)**	(2.9446)**	(2.8750)**
Availability of Other Restaurant	0.6817	-0.6162	1.0939	1.0026
Within .1 miles	(1.0308)	(0.5704)	(1.9123)	(1.8236)
Availability of Fast Food Rest.	-2.4859	-0.891	-1.8486	-1.7947
Within .25 miles	(1.1112)**	(0.5452)	(1.1812)	(1.2095)
Availability of Other Restaurant	2.1416	0.0505	0.269	0.0375
Within .25 miles	(0.8757)**	(0.4895)	(1.0113)	(0.9428)
Availability of Fast Food Rest.	1.3903	-0.0391	-0.9173	-0.8311
Within .5 miles	(0.8219)*	(0.4475)	(1.1152)	(1.0871)
Availability of Other Restaurant	1.2266	0.4638	0.1266	-0.4151
Within .5 miles	(0.8407)	(0.4881)	(0.9083)	(0.8160)
School Fixed Effects	-	-	X	X
Year Fixed Effects	-	X	-	X
School Controls	-	X	-	X
Census Block Controls	-	X	-	X
Implied Cumulative Effect of Exposure	1.9851	0.8084	3.4296	3.7078
to Fast Food Rest. within .1 miles	(1.5094)	(0.8535)	(3.0601)	(2.9838)
R^2	0.0209	0.4296	0.636	0.6512
N	8373	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 implied cumulative effect reported in the table is the sum of the coefficients in rows 1, 3 and 5, and is the total effect of exposure to a fast food restaurant at 0.1 mile compared to no exposure to fast food restaurants within 0.5 miles. 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. Table 1A lists the School and Census block controls. Standard errors clustered by school in parenthesis.

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

TABLE 3
IMPACT OF FAST-FOOD ON OBESITY IN SCHOOLS: ADDITIONAL MODELS

Dep. Var.:	Percent of 9th graders that are obese				
	All Students			Hispanic St.	Black Stud.
	(1)	(2)	(3)	(4)	(5)
Availability of Fast Food Rest. Within .1 miles	1.8063 (0.9113)**			2.0067 (1.0135)**	-1.5417 (1.2056)
Availability of Fast Food (Broad Def.) Restaurant Within .1 miles	-0.4643 (0.9239)				
Availability of Non-Fast Food Rest. Within .1 miles	-0.707 (0.6111)				
Availability of Fast Food Rest. (Exclud. Subway) Within .1 miles		1.7223 (0.9071)*			
Availability of Other Rest. Within .1 miles		-0.6134 (0.5648)		-0.3049 (0.6169)	-0.4451 (0.8610)
Availability of Any Restaurant Within .1 miles			-0.4719 (0.5393)		
School Fixed Effects	-	-	-	-	-
Year Fixed Effects	X	X	X	X	X
School Controls	X	X	X	X	X
Census Block Controls	X	X	X	X	X
Controls for Restaurants at .25 and .5 miles	X	X	X	X	X
Average of Dependent Variable	32.9494	32.9494	32.9494	36.9517	35.4517
R^2	0.4299	0.4295	0.4287	0.2215	0.2516
N	8373	8373	8373	6946	2851

Notes: Each column is a different OLS regression. The regressions are weighted by the number of students. The dependent variable in columns 1-3 is the percentage of students in the 9th grade who are classified as obese. The dependent variable in columns 4 and 5 is the percentage of Hispanic and Black students respectively 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. Entries in row 1 and 3 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 2 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 entry in row 4 is the coefficient on a dummy for proximity to one or more of the top 10 fast food chains excluding Subway.

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. Table 1A lists the School and Census block controls. Standard errors clustered by school in parenthesis. The specifications in Columns (4) and (5) include fewer observations because only school-year observations with at least 10 students in the race category report the data.

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

TABLE 4

IMPACT OF FAST-FOOD ON OBESITY IN SCHOOLS: PLACEBOS USING DEMOGRAPHIC VARIABLES

Dep. Var.:	Share Black	Share Hispanic	Share Asian	Share Title I Students	Share Free Lunch	Average Test Score	Pred. Obesity Based on Controls
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Panel A. Cross-Section							
Availability of Fast Food Rest. Within .1 miles	-0.0039 (0.0101)	0.0146 (0.0290)	-0.0249 (0.0168)	0.0653 (0.0703)	-0.0276 (0.0295)	-2.9162 (2.5761)	0.9599 (0.7820)
Availability of Fast Food Rest. Within .25 miles	-0.0084 (0.0074)	0.0062 (0.0201)	0.0122 (0.0099)	-0.0761 (0.0409)*	0.0066 (0.0170)	1.8543 (1.7399)	-0.6041 (0.5100)
Availability of Fast Food Rest. Within .5 miles	0.0102 (0.0060)*	-0.0089 (0.0145)	-0.0006 (0.0072)	0.02 (0.0323)	-0.0047 (0.0121)	1.1212 (1.2110)	-0.0114 (0.3743)
Panel B. School Fixed-Effect Panel							
Availability of Fast Food Rest. Within .1 miles	-0.004 (0.0042)	-0.0017 (0.0081)	-0.0037 (0.0036)	-0.0365 (0.0389)	-0.0408 (0.0280)	0.0465 (1.4675)	-0.0092 (0.5481)
Availability of Fast Food Rest. Within .25 miles	0.0027 (0.0025)	-0.002 (0.0064)	0.0065 (0.0037)*	0.0399 (0.0480)	0.0023 (0.0154)	0.557 (1.2330)	-0.0483 (0.4146)
Availability of Fast Food Rest. Within .5 miles	-0.003 (0.0021)	-0.0022 (0.0048)	0.0003 (0.0026)	0.0044 (0.0348)	0.0156 (0.0121)	-2.4215 (0.8345)***	-0.2734 (0.1914)
School Controls	-	-	-	-	-	-	-
Year Fixed Effects	X	X	X	X	X	X	X
Census Block Controls	X	X	X	X	X	X	X
Controls for availability of Other Restaurants	X	X	X	X	X	X	X
Average of Dependent Variable	0.0843	0.3804	0.1072	0.3971	0.2901	57.6665	32.8015
N	8373	8373	8373	8373	8373	8168	8373

Panel C. Test of Uniform Distribution of Fast-Foods

No. fast foods at .25 miles - (No. fast foods at .1 miles * (2.5)^2) = -.0135 (s.e. .0552), n.s.

No. fast foods at .5 miles - (No. fast foods at .1 miles * 5^2) = -.1335 (s.e. .2245), n.s.

Notes: Each column is a different OLS regression. The regressions are weighted by the number of students. The dependent variables are different school-level demographic variables. The dependent variable in Column 7 is the predicted share of obese students based on a regression of the share obese on all the demographic controls. The unit of observation is a school-grade-year for schools in California in the years 1999 and 2001-2007. Since the (placebo) dependent variables in these regressions are school-level demographics, the regressions do not include school controls. The Census block controls are from the closest block to the address of the school and are listed in Table 1A. 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 BY GRADE

Dep. Var.:	Percent of obese 9th graders		Percent of obese 7th graders		Percent of obese 5th graders	
	(1)	(2)	(3)	(4)	(5)	(6)
Availability of Fast Food Rest.	1.7385	6.3337	0.1233	1.2712	0.8946	6.1332
Within .1 miles	(0.8740)**	(2.8750)**	(1.1135)	(1.1135)	(0.7124)	(2.8280)**
Availability of Other Restaurant	-0.6162	1.0026	-0.2018	-0.4833	0.4267	0.629
Within .1 miles	(0.5704)	(1.8236)	(0.4239)	(1.0045)	(0.2997)	(0.6281)
Availability of Fast Food Rest.	-0.891	-1.7947	0.0777	-1.5916	-0.279	-1.0562
Within .25 miles	(0.5452)	(1.2095)	(0.4439)	(1.1223)	(0.2811)	(0.7568)
Availability of Other Restaurant	0.0505	0.0375	0.6333	1.2198	0.2501	-0.3428
Within .25 miles	(0.4895)	(0.9428)	(0.3186)**	(0.5830)**	(0.1918)	(0.4126)
Availability of Fast Food Rest.	-0.0391	-0.8311	-0.4059	0.6946	0.4341	0.0418
Within .5 miles	(0.4475)	(1.0871)	(0.3157)	(0.6353)	(0.1844)**	(0.4985)
Availability of Other Restaurant	0.4638	-0.4151	0.2137	-1.209	0.2879	0.7276
Within .5 miles	(0.4881)	(0.8160)	(0.3748)	(0.8322)	(0.2312)	(0.3905)*
School Fixed Effects	-	X	-	X	-	X
Year Fixed Effects	X	X	X	X	X	X
School Controls	X	X	X	X	X	X
Census Block Controls	X	X	X	X	X	X
Average of Dependent Variable	32.9494	32.9494	32.5601	32.5601	31.7794	31.7794
R^2	0.4296	0.6512	0.465	0.6684	0.3666	0.5582
N	8373	8373	13422	13422	37351	37351

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 specified 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. 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. Table 1A lists the School and Census Block controls. Standard errors clustered by school in parenthesis.

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

TABLE 6
FAST-FOOD AND WEIGHT GAIN FOR MOTHERS: BENCHMARK RESULTS

Dep. Var.:	Weight Gain During Pregnancy Larger than 20kg			Weight Gain > 15 Kg.	Weight Gain (in kg.)
	(1)	(2)	(3)	(4)	(5)
Availability of Fast Food Rest.	0.0007	0.0039	0.0054	0.0051	0.0704
Within .1 miles	(0.0018)	(0.0025)	(0.0045)	(0.0035)	(0.0432)*
Availability of Other Restaurant	-0.0001	-0.0012	-0.0007	0.0003	-0.0048
Within .1 miles	(0.0007)	(0.0010)	(0.0017)	(0.0014)	(0.0169)
Availability of Fast Food Rest.	0.0014	0.0007	0.0006	0.0022	0.0250
Within .25 miles	(0.0009)	(0.0013)	(0.0022)	(0.0018)	(0.0215)
Availability of Other Restaurant	0.0002	0.0009	0.0006	0.0016	0.0185
Within .25 miles	(0.0005)	(0.0008)	(0.0013)	(0.0011)	(0.0129)
Availability of Fast Food Rest.	0.0011	0.0020	0.0028	0.0044	0.0491
Within .5 miles	(0.0006)*	(0.0008)**	(0.0014)**	(0.00113)***	(0.0135)***
Availability of Other Restaurant	0	-0.0001	-0.0033	-0.0019	-0.0165
Within .5 miles	(0.0006)	(0.0008)	(0.0014)**	(0.0012)	(0.0136)
Sample	All Mothers	All Mothers	Stayers	All Mothers	All Mothers
Zip-Code Fixed Effects	X	-	-	-	-
Mother Fixed Effects	-	X	X	X	X
Maternal Characteristics	X	X	X	X	X
Implied Cumulative Effect of Exposure	0.0031	0.0066	0.0088	0.0117	0.145
to Fast Food Rest. within .1 miles	(0.0018)*	(0.0024)***	(0.0043)**	(0.0034)***	(0.0410)***
Average of Dependent Variable	0.118	0.118	0.11	0.352	13.49
R^2	0.008	0.007	0.009	0.012	0.023
N	3019194	3019256	1584414	3019256	3019256

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. Entries in rows 1, 3 and 5 are the coefficients on a dummy for the existence of a fast food restaurant at a given distance from the mother's residence. Entries in rows 2, 4 and 6 are coefficients on dummy for the existence of a non-fast food restaurant at a given distance from the mother's residence. The sample in Column 3 is restricted to mothers who stay at the same place between pregnancies. The implied cumulative effect reported in the table is the sum of the coefficients in rows 1, 3 and 5, and is the total effect of exposure to a fast food restaurant at 0.1 mile compared to no exposure to fast food restaurants within 0.5 miles. All the regressions include a full set of demographic controls listed in Table 1B. Age was controlled for using single year of age dummies. Regressions also included indicators for missing maternal education, race, ethnicity, smoking, child gender, parity, and maternal marital status, and dummies for each year of birth. Standard errors clustered by zip code in column 1 and by mother (columns 2-5) in parenthesis.

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

TABLE 7
IMPACT OF FAST-FOOD ON WEIGHT GAIN LARGER THAN 20KG: ADDITIONAL MODELS

Dep. Var.:	Weight Gain During Pregnancy Larger Than 20kg						
Sample:	All Mothers			Hispanic Mothers	Black Mothers	High School or Less	Some College or More
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Availability of Fast Food Rest.	0.0019			0.0022	0.0066	0.0033	0.0002
Within .5 miles	(0.0009)*			(0.0013)*	(0.0016)***	(0.0009)***	(0.0012)
Availability of Fast Food (Broad Def.)	0.0009						
Restaurant Within .5 miles	(0.0009)						
Availability of Non-Fast Food Rest.	-0.0002			-0.0015	-0.0032	0.0000	0.0004
Within .5 miles	(0.0008)			(0.0015)	(0.0021)	(0.0010)	(0.0011)
Availability of Fast Food Rest.		0.0025					
Within .5 miles excluding Subway		(0.0007)***					
Availability of Other Rest.		0.0002					
Within .5 miles		(0.0008)					
Availability of Any Restaurant			0.0011				
Within .5 miles			(0.0007)				
Zip-Code Fixed Effects	-	-	-	-	-	-	-
Mother Fixed Effects	X	X	X	X	X	X	X
Maternal Characteristics	X	X	X	X	X	X	X
Average of Dependent Variable	0.126	0.126	0.126	0.101	0.131	0.126	0.106
R^2	0.006	0.007	0.007	0.011	0.002	0.007	0.007
N	3019256	3019256	3019256	794535	495045	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. Entries in row 1 and 3 are the coefficients on a dummy for the existence of a fast fast food restaurant and a non-fast food restaurant within 0.5 miles from the mother's residence. The entry in row 2 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) within 0.5 miles from the mother's residence. The entry in row 4 is the coefficient on a dummy for the existence of a fast food restaurant from one of the top 10 fast food chains excluding Subway. All the regressions include a full set of demographic controls listed in Table 1B. Age was controlled for using single year of age dummies. Regressions also included indicators for missing maternal education, race, ethnicity, smoking, child gender, parity, and maternal marital status, and dummies for each year of birth.Standard errors clustered by mother in parenthesis.

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

TABLE 8
IMPACT OF FAST-FOOD ON WEIGHT GAIN: PLACEBOS

Dep. Var.:	Weight Gain During Pregnancy > 20 Kg.		Mother Smokes	Mother is Married
	Placebos based on leads	Placebos based on lags	Placebos based on demographic variables	
	(1)	(2)	(3)	(4)
Availability of Fast Food Rest.			0.0001	0.0007
Within .1 miles			(0.0019)	(0.0028)
Availability of Other Restaurant			0.0012	-0.0016
Within .1 miles			(0.0007)	(0.0011)
Availability of Fast Food Rest.			0.0002	-0.0002
Within .25 miles			(0.0009)	(0.0014)
Availability of Other Restaurant			0.0001	-0.0008
Within .25 miles			(0.0006)	(0.0008)
Availability of Fast Food Rest.	0.0035	0.0010	0.0007	0.0002
Within .5 miles	(0.0011)***	(0.0012)	(0.0006)	(0.0009)
Availability of Other Restaurant	-0.0006	-0.0021	0.0021	-0.0001
Within .5 miles	(0.0011)	(0.0012)*	(0.0006)***	(0.0009)
Availability of Fast Food Rest.	-0.0014			
Within .5 miles 3 Years Later	(0.0011)			
Availability of Other Restaurant	0.0012			
Within .5 miles 3 Years Later	(0.0012)			
Availability of Fast Food Rest.		0.0019		
Within .5 miles 3 Years Earlier		(0.0013)		
Availability of Other Restaurant		0.0025		
Within .5 miles 3 Years Earlier		(0.0012)**		
Zip-Code Fixed Effects	-	-	-	-
Mother Fixed Effects	X	X	X	X
Maternal Characteristics	X	X	X	X
R^2	0.007	0.008	0.008	0.047
N	3019256	2694834	3005825	2889618

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. Entries in rows 1, 3 and 5 are coefficients on dummies for the existence of a fast food restaurant and the entries in rows 2, 4 and 6 are coefficients on dummies for the existence of a non-fast food restaurant respectively within the specified distances from the mother's residence. Entries in rows 7 and 8 are coefficients on a dummy for the existence of a fast food restaurant and a non-fast food restaurant respectively within 0.5 miles from the mother's residence three years after the pregnancy. Entries in rows 9 and 10 are coefficients on a dummy for the existence of a fast food restaurant and a non-fast food restaurant respectively within 0.5 miles from the mother's residence three years before the pregnancy. All the regressions include a full set of demographic controls listed in Table 1B. Age was controlled for using single year of age dummies. Regressions also included indicators for missing maternal education, race, ethnicity, smoking, child gender, parity, and maternal marital status, and dummies for each year of birth. 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			Major Fast-Food Restaurants in Wikipedia List and not in top-10 List			Major Restaurants in non-Fast Food Category		
Rank (1)	Name (2)	Percent (3)	Rank (4)	Name (5)	Percent (6)	Rank (7)	Name (8)	Percent (9)
1	Mc Donalds	8%	1	Starbucks	12%	1	Ihop	0.002%
2	Subway	7%	2	Dairy Queen	7%	2	Sizzler	0.002%
3	Burger King	5%	3	Baskin Robbins	6%	3	Togos Eatery	0.001%
4	Taco Bell	4%	4	Jamba Juice	5%	4	Chilis	0.001%
5	Pizza Hut	4%	5	Fosters Freeze	5%	5	Applebees	0.001%
6	Little Caesars	3%	6	Orange Julius	4%	6	Tcby	0.001%
7	Kfc	3%	7	Smoothie King	4%	7	Cocos	0.001%
8	Wendys	3%	8	Juice Stop	4%	8	Aramark	0.001%
9	Dominos Pizza	3%	9	Braums	3%	9	Big Boy	0.001%
10	Jack In The Box	3%	10	Moes Southwest	2%	10	Outbak	0.001%

Notes: Data on restaurant establishments are from Dun & Bradstreet. "Percent" in column 3 is the number of establishments of the relevant chain over the total number of fast food restaurants. "Percent" in column 6 is the number of establishments of the relevant chain over the total number of restaurants in the Wikipedia list excluding the top 10 chains. "Percent" in column 9 is the number of establishments of the relevant chain over the total number of restaurants, excluding fast food restaurants and restaurants on the Wikipedia list. See discussion in Appendix 1 for more details on our classification of restaurants.