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EXPANDING THE SCHOOL BREAKFAST PROGRAM:
IMPACTS ON CHILDREN'S CONSUMPTION, NUTRITION AND HEALTH

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ABSTRACT

School meals programs are the front line of defense against childhood hunger, and while the school lunch program is nearly universally available in U.S. public schools, the school breakfast program has lagged behind in terms of availability and participation. In this paper we use experimental data collected by the USDA to measure the impact of two popular policy innovations aimed at increasing access to the school breakfast program. The first, universal free school breakfast, provides a hot breakfast before school (typically served in the school's cafeteria) to all students regardless of their income eligibility for free or reduced-price meals. The second is the Breakfast in the Classroom (BIC) program that provides free school breakfast to all children to be eaten in the classroom during the first few minutes of the school day. We find both policies increase the take-up rate of school breakfast, though much of this reflects shifting breakfast consumption from home to school or consumption of multiple breakfasts and relatively little of the increase is from students gaining access to breakfast. We find little evidence of overall improvements in child 24-hour nutritional intake, health, behavior or achievement, with some evidence of health and behavior improvements among specific subpopulations.

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School meals programs are a front line of defense against childhood hunger, particularly for the 22.4 percent of children who live in households that experience food insecurity. While the school lunch program has long been nearly universally offered, availability of the school breakfast program (SBP) has lagged behind. There have been recent – and highly successful – attempts to expand access to the SBP. For example, between 1989 and 2000 the total number of breakfasts served doubled (McLaughlin et al. 2002). According to our calculations from NHANES data, as of 2009-10 almost three-quarters of children attend a school that offers the SBP, up from approximately half of students in the 1988-94 wave.

A large research literature supports the commonly held notion that breakfast is an important meal. Children who skip breakfast have lower nutrient and energy intake across the day – in other words, they do not make up for the skipped meal by consuming more calories later in the day. Briefel et al. (1999) summarize the research evidence on cognitive impacts, and conclude "skipping breakfast interferes with cognition and learning, and that this effect is more pronounced in poorly nourished children." Despite the importance of breakfast, only 86 percent of elementary school children aged, and 75 percent of children aged 12-19, consume any type of breakfast on a typical day (USDA ARS, 2010).

Policy makers have long been troubled by the low take-up rate of the SBP, which was 26 percent in 2010 (compared with a 63 percent participation rate in the school lunch program, see Fox et al. 2013). This is in part troubling because there is evidence that school breakfast is nutritionally superior to breakfast at home (Bhattacharya et al. 2006; Devaney and Stuart 1998; Millimet et al. 2010). Two factors appear to drive the low take-up of breakfast: stigma and timing. Recent policy innovations have attempted to ameliorate these barriers to participation.

To address (perceived) stigma associated with participation in the school breakfast program, some districts have offered universal free school breakfast instead of the standard program that provides free breakfast only to students who are income-eligible for a subsidy.[1] There is some evidence, described below, that this policy change increases take-up rates. The limitation remains, however, that in order to participate in the breakfast program a student generally has to arrive at school prior to the start of classes and this is reported to be an important barrier for some children. To address this, another recent policy innovation has

[1] The USDA has special reimbursement provisions that encourage schools to adopt universal free meals programs.

been to serve breakfast in the classroom (BIC) during the first few minutes of the school day. BIC eliminates the need for students to arrive to school early to participate in the school breakfast program, and dramatically increases participation in the SBP (FRAC 2009; FNS undated). This program has recently gained momentum, with major expansions in cities such as Washington, D.C., Houston, New York City, Chicago, San Diego and Memphis.

In this paper we re-analyze experimental data previously collected by the U.S. Department of Agriculture to measure the impact of these two popular policy innovations: universal free breakfast, and breakfast in the classroom. As described below, re-analysis of the data is necessary because the original evaluation of the experiment was incomplete. In particular, it did not separately estimate the impacts of the two policies even though the experimental design allowed such estimates to be conducted. In this re-analysis, we calculate experimental estimates of both the impact of universal free cafeteria breakfast and the impact of BIC.

We extend the analysis in three additional directions. First, in order to improve statistical power of the analysis and following the recent program evaluation literature (Kling et al. 2007; Anderson 2008; Hoynes et al. 2012), we combine similar outcomes into summary indexes covering areas such as nutrition at breakfast, nutrition over 24 hours, and child health outcomes. Second, we implement an instrumental variables approach to estimate the causal impact of eating breakfast on student outcomes. Third, in an appendix we address the policy decision facing a school district by constructing difference-in-difference estimates of the relative effectiveness of BIC compared with universally free cafeteria breakfast.

I. Literature Review

Two recent types of policy innovations have attempted to increase breakfast takeup, and there has been recent evidence on their impacts using a variety of difference-in-differences research designs. The first type of policy is the introduction of universal free breakfast, which allows children to participate in the school breakfast program at no charge regardless of whether they are typically eligible for free or reduced-price school meals. Ribar and Haldeman (2013) study the introduction and discontinuation of universal free school breakfasts in Guilford County, North Carolina, and find that take-up of school breakfast increases by 12 to 16 percentage points when the program is universally free of charge. While most of the increased participation was among students formerly ineligible for subsidized meals, they also find an increase among those who were eligible for free meals all along. When the program was discontinued, there were no changes in attendance rates or test scores. Leos-Urbel et al. (2013) compare New York City public schools that implement universal free school breakfast to those that retain the traditional program in a triple-difference framework. They find strong impacts on participation but no impacts on student test scores, and a small positive impact on attendance for some subgroups.

The second area of recent policy innovation is offering breakfast in the classroom during the school day. Imberman and Kugler (2014) investigate the very short-term impacts of the introduction of a BIC program in a large urban school district in the southwestern United States. The program was introduced on a rolling basis across schools, and the earliest-adopting schools had the program in place for up to 9 weeks before the state's annual standardized test was administered. They find an increase in both reading and math test scores, but no impact on grades or attendance. Additionally, there was no difference in impact between those schools that had adopted the program for only one week vs. those that had the program for a longer time. The pattern in the results led the authors to conclude that the test score impacts were driven by short-term cognitive gains on the day of the test due to eating breakfast and not underlying learning gains.[2] Dotter (2012), on the other hand, finds stronger longer-run impacts of the staggered introduction of a BIC program in elementary schools in San Diego. Using a difference-in-differences approach, he finds that BIC increases test scores in math and reading by 0.15 and 0.10 standard deviations, respectively. He finds no test score impacts on schools that previously had universal free breakfast, and no impacts on attendance rates. As shown below, our results from the randomized experiment are consistent with the earlier literature in that we find no consistent attendance impacts.[3] On the other hand, we also find no positive impact of BIC on test scores and can rule out effect sizes as large as those found in the earlier, quasi-experimental literature.

[2] This interpretation is consistent with earlier research by Figlio and Winicki (2005), which found that schools with much at stake in a test-based accountability system served higher-calorie lunches during testing weeks.

[3] We find modest positive attendance impacts in year 3 only.

II. Empirical Approach

This paper uses data from a randomized experiment implemented in 153 schools across 6 school districts designed to test the impact of universal free school breakfast.[4] That is, at baseline all schools in the experiment at least offered the standard school breakfast program. Control group schools continued to offer the standard program, which serves free or reduced-price (maximum price of 30 cents) breakfast to those that are income-eligible and can be purchased at full price for those ineligible for a meal subsidy (current average price $1.13, Fox et al. 2013). The breakfast is typically served before school in the cafeteria. Treatment schools offered school breakfast free of charge to all students regardless of their usual eligibility for subsidized meals.[5] The experimental design first matched schools into pairs (or occasionally groups of 3 schools), and then treatment status was randomly assigned within the pair. There are 70 matched pairs in the experiment, which we call "randomization pools" because random assignment is done within each of these 70 pairs. After randomization occurred, the treatment schools got to choose whether to implement their universal school breakfast as a traditional program – that is, in the cafeteria before school – or as a BIC program. The treatment lasted for 3 years.

The original evaluation found that treatment schools nearly doubled their SBP participation, and that students in treatment schools were 4 percentage points more likely to consume a "nutritionally substantive breakfast." There were no statistically significant impacts on most other measures of food intake, food security, student health, or achievement outcomes.

A. The Need for Re-analysis

In the original evaluations of the experiment (Bernstein et al. 2004), outcomes were presented separately for the overall treatment and control groups, and then the treatment group outcomes were presented separately by whether they adopted a cafeteria-based or classroom program. But it is inappropriate to compare the separate treatment groups to a pooled control group, and may lead to biased

[4] The experiment was conducted by the USDA in conjunction with Abt Associates from 1999 through 2003 and was entitled the School Breakfast Pilot Project. We obtained the public-use data by requesting it from USDA.
[5] Under normal circumstances, a child is eligible for free meals if his or her family's income is less than or equal to 130 percent of the poverty threshold, and is eligible for reduced-price meals if the family income is less than or equal to 185 percent of the poverty threshold.

estimates of the policy impacts if different types of schools selected into cafeteria vs. classroom breakfast programs. In practice, this is an important concern because there is evidence that the treatment schools differed prior to program implementation. In the year before the experiment began, schools that would go on to implement a cafeteria-based program had a 14 percent participation rate in the SBP, while those that would opt for a BIC program had a 22 percent participation rate (see Table 1). As shown below, the two types of treatment schools also differed along other characteristics such as rates of disadvantage. As a result, impact estimates separately comparing them to a pooled control group may be seriously biased.

Appropriate impact estimates can be constructed, though. As described above, in the experimental protocol schools were first paired on observable characteristics and then treatment or control status was randomly assigned within pairs. Subsequently, treatment schools were allowed to choose the location of their universal school breakfast program. The design of the experiment is represented in Figure 1, below. Since random assignment was conducted within treatment pairs, it is possible to measure the causal impact of the universal cafeteria breakfast and the causal impact of BIC by comparing each treatment group to its matched control group. To graphically demonstrate how to estimate the impact of the program in this experimental design, see that outcomes for groups should be compared vertically. That is, the impact of a universal cafeteria breakfast could be estimated as the difference between A and A'. Similarly, the impact of the BIC program can be estimated as the difference between B and B'. Of course, the overall impact of universal school breakfast (regardless of location) can be estimated as the difference between average outcomes in the set A + B compared to those in the control group A'+B'.

Figure 1: Experimental design setup

	Location	
	Cafeteria	Classroom
Treatment	A	B
Control	A'	B'

Surprisingly, the official USDA evaluation failed to provide the experimental impacts separately for BIC vs. cafeteria-based programs. Below, we first reanalyze the data using the appropriate control group. This will allow us to make separate conclusions about the impacts of a universal cafeteria breakfast and universal breakfast in the classroom, which to date have not been known because of the limitations of the original analysis.

B. Outcomes to be measured

Many prior analyses of school breakfast programs are limited by the outcome variables that are available. Among the quasi-experimental literature, studies have looked either at take-up (Ribar and Haldeman, 2013), or academic achievement (Frisvold 2012; Imberman and Kugler 2014; Dotter 2012), or detailed nutrition outcomes (Bhattacharya et al. 2006), or a combination of take-up and achievement (Leos-Urbel et al. 2013). To our knowledge, no paper in the prior literature has access to all of these outcomes in the same dataset. Not only do we have detailed information on a range of outcomes, but we also have three years of outcome data, allowing us to investigate the impacts of the programs as they mature.

We start by analyzing the impact of each of the programs on take-up, and how the impacts vary across characteristics such as prior income-eligibility for free breakfast, gender, race, and other characteristics that were measured prior to the experiment. Next, we turn to nutrition and health outcomes. We measure whether a student consumed any breakfast, or consumed a "nutritionally adequate" breakfast as defined in the prior literature. We also measure whether a student consumes two breakfasts (typically, one at home and one at school), and the household's food security status. We analyze consumption of total calories and micronutrient intake as percent of RDA and measure these both for breakfast and over a 24-hour period. For measures of student health, we have parent-reported health status, and height and weight (from which we calculate BMI and obesity). Finally, we analyze behavioral and cognitive measures such as test scores, school attendance, and tardiness.

Because we observe many outcome variables and in order to increase statistical precision, we follow the recent literature (e.g. Kling, Liebman and Katz 2007; Anderson 2008; Hoynes, Schanzenbach and Almond 2012) and estimate summary standardized indices that aggregate information over multiple treatments. The summary index is the simple average across standardized z-score measures of each component. The z-score is calculated by subtracting the mean and dividing by the standard deviation of the pooled control group. In particular, we form five indices. Two nutrition indices cover nutrient intake at breakfast and over 24-hours, respectively. The health outcomes index includes parent-reported health status, whether the child has a chronic health problem, and (separate) indicators for whether the child is obese or overweight[6]. The behavior measures include measures of whether a student is inattentive, defiant, and so on. Finally, the index of academic outcomes combines math and reading test scores across the three years of the experiment. Summary statistics of the five indices and their component parts are presented in Appendix Table 1.

C. Impact of SBP participation and Breakfast Consumption

We address whether participation in the SBP improves student outcomes. There are conflicting and sometimes perverse-signed impact estimates in the literature (summarized in Briefel et al. 1999, also Waehrer 2007), though most prior studies have been correlational.[7] The prior literature is severely limited because there are few research designs available to isolate the causal impact of SBP participation on outcomes.

We are also able to make statements about the causal impact of breakfast consumption by using the experimental data and an instrumental variables approach. In particular, we use a school's random assignment to treatment status to instrument for a student's breakfast consumption. This will allow us to estimate the impact of breakfast consumption on the so-called "compliers" in a local average treatment effect framework – that is, the impact on students who were induced to eat a breakfast in the program by the universal school breakfast policy (Angrist and Pischke 2009). The impacts of the program on this group are of particular interest to policy makers.

III. Results

A. Validity of the Experiment

Table 1 presents means of pre-determined characteristics across the treatment and control groups. As described above, we present three groups of estimates: first the pooled results for the impact of universal free breakfast regardless of the type of program adopted, then separately those for the BIC experiment and cafeteria-based experiment. The first two columns in each set of results presents means for

[6] Following the standard CDC definition, a student is defined as "overweight" or "obese" if he/she is at or above the 85th or 95th percentile, respectively, of a standardized BMI distribution.
[7] Bhattacharya et al. (2006) is a notable exception, in which the authors use quasi-random variation in SBP availability and find that the program improves nutritional intake among participants.

the control and treatment groups, respectively. The third column presents the p-value of a test for whether the means are the same across groups after conditioning on randomization pool fixed effects. In general, the treatment and control groups are well-balanced across background characteristics, with no statistically significant differences for the pooled group or the cafeteria group. Among the BIC group, however, there is a small difference in student-level eligibility for free or reduced-price lunch, with the treatment group being slightly less disadvantaged than the control group. The differences are not statistically significant across other measures of disadvantage, such as family income less than $20,000 per year, minority status, or whether the student is from a single parent household. Our subsequent analyses are largely unchanged if we control for these background characteristics. There are no significant differences in school-level characteristics (shown in panel B). Note that the schools in the BIC sample are substantially more disadvantaged than the cafeteria sample. Among the control groups, 61 percent of the BIC group is eligible for free or reduced-price lunch, compared with 51 percent of the cafeteria-based group. When restricted to free lunch only, the rates are 45 and 34 percent, respectively. Furthermore, students in the BIC control group take up school breakfasts in 22% of school days in the base year as compared to 14% for the cafeteria-based group. These differences underscore the need to compare the BIC treatment group to the appropriate control group.

B. Outcomes

Table 2 shows results for participation and nutrition intake during the first year of the experiment. The table presents coefficients on an indicator for treatment group in a regression that controls for randomization-pool fixed effects and the following covariates: free and reduced lunch eligibility, household income, race, single parent household, gender and age. Standard errors (adjusted for homoscedasticity at the school level) are shown in parentheses. Participation is measured as the proportion of days that a student has taken a school breakfast, whether or not the child took the school breakfast on the day that the nutrition information was collected. The overall (pooled) impact on SBP participation is 18 percentage points, a near doubling of participation compared with the control group. There is a substantial difference in treatment effects, however, across program type. The BIC program increased year 1 participation by 38 percentage points, or a 144 percent increase in participation. The cafeteria-based program also significantly increases participation, but by a more modest 10.5 percentage points, or a 52 percent increase in rate. Since breakfasts are reimbursed on a per-pupil basis, a child's participation in SBP determines the total cost of the program. Another way to measure participation is whether a child "usually" takes a school breakfast. When we define "usually" as participation in 75 percent or more days, the impacts on participation are even larger in percentage terms. The impacts are a 13 percentage-point increase in participation in the pooled sample (an increase of over 160 percent), and 29 percentage points in the BIC sample (a 242 percent increase). These increases in program participation could reflect students going from consuming no breakfast to a school breakfast, but could also reflect substitution of a home breakfast for a school breakfast, or consumption of multiple breakfasts. The total impact on nutritional intake depends on the extent of the substitution.

The impact on breakfast consumption varies depending on the definition of breakfast chosen.[8] At one extreme, we can define any positive caloric intake in the morning to be breakfast consumption. According to this definition, 96 percent of the pooled control group eats some breakfast. Overall, universal school breakfast does not change this probability, although the BIC program increases the likelihood that a child eats any breakfast by 2 percentage points. If we implement a more stringent threshold for what counts as breakfast – a "nutritionally substantive" breakfast that requires consumption of at least 2 food groups and at least 15 percent of the daily allowance of calories – then the impact is stronger. The pooled impact is an increase of 3 percentage points, compared to a control group level of 59 percent consuming that quality level of breakfast. This is driven almost entirely by a 10 percentage-point increase among the BIC group, with an insignificant 1 percentage-point estimate among the cafeteria-based program group.[9] BIC substantially increases both participation and the likelihood that a student actually eats breakfast, while a universal cafeteria-based program increases participation in the program but primarily alters where – and not whether – students eat breakfast.

The next row displays the impact on whether a student reports eating two nutritionally substantive breakfasts, one at school and one at another location. Here again the impact is primarily driven by the BIC

[8] "Breakfast" includes all foods and beverages, excluding water, consumed between 5:00 a.m. and 45 minutes after the start of school, and also any foods consumed before 10:30 a.m. that the student/parent reported as being part of breakfast.

[9] Impacts are similar if we use alternate definitions of breakfast commonly used in the literature, such as consuming 2 food groups and 10 percent of RDA of calories, or consuming 3 food groups and 25 percent of RDA of calories.

group, which causes a 5-point increase in eating two breakfasts. This represents more than doubling the likelihood of eating two breakfasts. The BIC program reduces the likelihood that a student eats breakfast only outside of school by 45 percentage points, while the universal cafeteria-based program reduces this likelihood by 13 points.

The final set of rows report impacts on calorie and nutrient intakes, both at breakfast(s) and over a 24-hour period, as well as on food security. Consistent with the reported meal intake patterns, BIC participants consume an additional 1.7 percent of the recommended daily allowance (RDA) of calories (adjusted for child's age) at breakfast. There is no measured difference in calorie intake among the cafeteria-based program group. The program does not appear to be increasing the nutrient intake at breakfast for either treatment group.[10] The 24-hour dietary impacts suggest that any increase in consumption at breakfast is offset at other times during the day, and 24-hour calorie and nutrition intakes are no higher for the treatment groups. Finally, neither program appears to impact household food security status.

Overall, the universal cafeteria-based program appears to shift where students consume breakfast, but does not substantially alter whether or how much breakfast is consumed. On the other hand, the BIC program changes where students eat breakfast as well as how much they eat. It raises the likelihood that a child eats any breakfast, and also raises the likelihood that he or she eats two breakfasts. Since the cafeteria-based program does not change students' nutritional intake, it would be surprising to find that it impacts other outcomes. On the other hand, since BIC increases nutritional intake (both in terms of increasing the likelihood that a child eats any breakfast, and in terms of meal quality) and also potentially crowds out some classroom instructional time, the expected impacts are ambiguous.

Table 3 shows impacts on academic, behavioral and health outcomes during the first year of the experiment. For completeness, we include the impacts from the pooled sample and the cafeteria-based program, but we concentrate our discussion on the BIC results[11]. The BIC treatment does not statistically significantly improve any outcome. The point estimate for the test score index is -0.052 indicating a

[10] The index consists of consumption of vitamins A, B-6, B-12, C, riboflavin, folate, calcium, iron, magnesium and zinc.

[11] Further analysis of the relative impact of BIC vs. cafeteria based universal breakfast programs using a difference-in-difference approach is presented in the Appendix. Such an analysis may be useful as schools often face the decision to introduce universal school breakfast in the cafeteria or in the classroom.

statistically insignificant 5 percent of a standard deviation decline in average math and reading test scores. The standard errors allow us to reject a positive impact as small as 0.03 standard deviations, which is smaller than the results found in the quasi-experimental literature.[12] When broken out separately by subject, the estimated impact (standard error) for math is -0.085 (0.052) and reading is -0.023 (0.037). The estimated impact of BIC on attendance and tardiness is wrong-signed but not statistically significant. The BIC impact on the "bad behavior index" is right-signed, in that the point estimate indicates a decrease in misbehavior, but not statistically different from zero. There is no impact on child health as measured by child's (age-adjusted) BMI, an indicator for being overweight or the health index. Note that the control group means across many of these characteristics indicate that the BIC sample is more disadvantaged than the cafeteria-based sample.

Table 4 shows impacts for subsequent years. We define the BIC sample consistently over time based on their status in the first year of the program, even though six BIC treatment schools switched to a cafeteria-based program at some point during the experiment. The impact on SBP participation is relatively stable over time, with the pooled impact essentially doubling takeup, BIC increasing takeup by about 150 percent, and the cafeteria-based program increasing it by approximately 54 percent. There is no evidence of a positive impact on test scores, with small and insignificant impacts in year two and three, and when the data are pooled across all 3 years of outcomes. Impacts on attendance rates are positive and significant in year 3 only, with an estimated 1.05 percentage-point increase in attendance rate for the BIC group. The pooled impacts on attendance rates across all 3 years, however, are small or wrong-signed and not statistically significantly different from zero. The BIC appears to increase tardiness significantly in some years, though, again, the magnitude of the impact is quite small (i.e. less than a day per school year).

Table 5 explores whether the BIC impacts are different across subgroups. Each triplet of columns represents a different subgroup. The first column in each pair presents the control group mean, the second column presents the impact of BIC treatment after conditioning on randomization pool fixed effects and previously mentioned demographic controls and the last column presents the number of observations. There is some variation in the impact on participation and breakfast eating. Free-lunch ineligible students

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[12] In order to increase precision of the estimates, we control for baseline test scores in the models. As expected, addition of these controls does not change the impact estimates but they do reduce the standard errors by 20-30 percent.

increase their participation rates by more in response to BIC than do free-lunch eligible students, but the impact on breakfast consumption is slightly stronger among the more disadvantaged group. Similarly, BIC increases the likelihood that boys participate in the program more than girls, but has a stronger increase on the likelihood that a girl eats a nutritionally substantial breakfast. Among high-poverty, urban schools, BIC increases participation by 138 percent, and increases breakfast eating by over 27 percent. Despite differences in treatment intensity, there is no significant positive impact on test scores or attendance.[13] Results are generally stable across the behavior index measure (indicating an improvement in behavior), but only reach statistical significance among the subset of minority students. However, the BIC treatment statistically significantly increases health and decreases the incidence of overweight when the sample is limited to certain sub-populations, such as students who attend high-poverty, urban schools.

C. Impact of Eating Breakfast

An elusive question in the literature has been what is the impact of eating breakfast – whether at home or school – on a child's outcomes. As shown in Table 2 above, being randomly assigned to the BIC treatment increases the likelihood that a student consumes breakfast. We can thus use the school's random assignment to BIC as an instrument for breakfast consumption, and estimate the causal impact of breakfast consumption. It is important to emphasize that this is a local average treatment effect, and provides an estimate of the causal impact of breakfast consumption for those students who were induced to start eating breakfast because of the treatment. Results are presented in Table 6, and are limited only to the BIC sample (i.e. the randomization pools in which the treatment group participated in BIC).

The first triplet of columns shows results for a nutritionally substantial breakfast (i.e., as before this includes consumption of food from 2 food groups and at least 15 percent of daily RDA of calories). The first column shows the OLS relationship between breakfast eating and a variety of outcomes, after controlling for other background characteristics. Consistent with the prior literature, eating breakfast is correlated with better dietary outcomes. Eating breakfast is associated with a 0.46 standard deviation increase in nutritional intake as measured by the 24-hour micronutrient index, and a 16 percentage-point increase in daily calories as a percent of RDA. There is no systematic relationship in these data between

[13] We constructed the urban, high-poverty sample to be similar to the sample used in Dotter (2012) and we can rule out impacts as large as he finds on test scores.

breakfast eating and child's BMI, or whether the child is overweight. There is also no statistically significant association between breakfast eating and child outcomes such as behavior, attendance or test scores.

Moving to column 2, we can estimate the causal impact of being induced to eat a substantive breakfast by the BIC program. The instrument predicts a 10-point increase in breakfast eating, and is a strong predictor with an F-statistic of over 16. Instrumenting for breakfast consumption flips the signs of most of the estimates, suggesting that the correlations in the OLS results are largely driven by selection. The standard errors are quite large and most of the IV estimates are not statistically significantly different from zero. Nonetheless, the point estimates from the IV results for behavior, health and overweight status suggest that eating breakfast may improve these outcomes. On the other hand, the estimates on attendance, and test scores become more negative when instrumented.

Instead of defining breakfast as a binary variable equal to one if consumption is at or above a floor, an alternative measure of breakfast, displayed in columns (4) and (5), is the total calorie consumption in the morning. In this case, the instrument is considerably weaker with an F-statistic of 4.8. Results are generally similar as those in the first two columns, with the point estimates in the IV results suggesting declines in overweight and bad behavior but wrong-signed, though small, estimates on attendance and test scores. The standard errors are large and none of the estimates are statistically significantly different from zero.

IV. Discussion and Conclusions

The USDA implemented an extremely important experiment on the impacts of making school breakfast uniformly available at no cost, both in the cafeteria before school and in the classroom. Our reanalysis isolated the impact of each of these programs on nutrition, health, attendance and achievement. We find that expanding the school breakfast program substantially increases program takeup, especially under the BIC treatment. Furthermore, universal free school breakfast and BIC also increase the likelihood that a child eats a nutritionally substantive breakfast. BIC also increases the likelihood that a child eats two breakfasts. The additional consumption appears to be offset across the rest of the day, so there is no measurable impact on 24-hour nutrition as measured by calories or nutritional intake.

Despite the increase in breakfast consumption under BIC, we find no positive impact on most other outcomes. In contrast to the earlier, quasi-experimental literature, we find no positive impact on test scores and some evidence of negative impacts. Similarly, there appears to be no overall positive impact on attendance rates or child health. There is suggestive evidence that BIC may improve behavior and health in some highly disadvantaged subgroups, though.

Of course, the results should be viewed with the important caveat that our results do not indicate that the school breakfast program is not effective. There is already a reasonably high program participation rate among the control group, and a higher breakfast consumption rate among the control group, indicating that some children who do not participate in the school program eat breakfast at home. In other words, our results do not shed light on what would happen if the school breakfast program were reduced or eliminated, nor do they suggest that reducing or eliminating the school breakfast program is warranted. The results speak only to attempts to further expand the program, through universal access or BIC programs. These results indicate that much of the increase in program participation induced by program expansions represents substitution from consumption of breakfast at home to school. A substantial share of children is induced to start consuming breakfast by the program, and a slightly smaller share is induced to consume two breakfasts. The relatively modest measured benefits suggest that policy-makers should carefully consider how to trade these off against the increased program costs.

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Appendix

Difference-in-difference estimates

The more relevant policy question for a school or district considering implementing a universal school breakfast program is the relative effectiveness of a traditional cafeteria-based school breakfast relative to breakfast in the classroom. To experimentally address this policy question, schools would need to have been randomly assigned across these groups. Referring back to Figure 1, this would mean that schools should have been randomly assigned to columns in addition to rows (i.e. randomly assigned to group A or group B). Under a design like this, a simple difference-in-difference estimate (i.e. comparing outcomes across cells [A – A'] – [B – B'] = δ) would yield an unbiased estimate of the relative impact of universal breakfast in the cafeteria vs. the classroom.

Unfortunately, schools were not randomly assigned but instead self-selected into treatment type. Under the arguably palatable assumption that schools choose the program that will improve their outcomes the most, we can estimate an upper bound on the relative effectiveness of the two types of universal breakfast programs by comparing effect sizes across the groups. The relative effect of a classroom vs. cafeteria universal program is an important policy-relevant question, with little evidence to date on it. Therefore we calculate the difference-in-difference estimates, attempting to estimate the relative effectiveness of BIC compared to a cafeteria-based program, even though this parameter is not experimentally identified.

We calculate the difference-in-difference estimates, comparing each treatment type to its randomly assigned control group, then test for differences in impact across the two treatment types. Results are shown in Appendix Table 2. Most notably, BIC increases participation relative to universal cafeteria breakfast by an average of 28 percentage points. Similarly, BIC increases the likelihood of actually eating breakfast (not merely participating in the program) by between 2 and 8 percentage points depending on the definition of breakfast. It also raises the likelihood that a child eats two breakfasts by 5 points relative to the cafeteria-based program. On the other hand, there are signs that the cafeteria-based program, relative to the BIC program, increases the likelihood that a child is not tardy (by around 1.2 days over a 180-day school year according to the pooled-year results). This makes sense, as participation in the cafeteria-based program requires a child be present at school before school starts. Since there are few statistically significant impacts of universal breakfast, the difference-in-differences estimates also show no impact of BIC relative to a cafeteria breakfast on other nutrition, health, attendance, behavior or achievement outcomes.

Table 1: Baseline Summary Statistics

	Any Universal School Breakfast Program				BIC Only				Cafeteria Only			
	Control	Treatment	p-value	N	Control	Treatment	p-value	N	Control	Treatment	p-value	N
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
Student-level characteristics												
Eligible for Free or Reduced Lunch	0.54	0.54	0.39	4358	0.61	0.58	0.02	1054	0.51	0.52	0.97	3339
Eligible for Free Lunch	0.37	0.37	0.20	4358	0.45	0.39	0.00	1054	0.34	0.36	0.80	3339
Income < $20K	0.19	0.18	0.18	3278	0.20	0.18	0.10	783	0.18	0.18	0.60	2521
Black	0.10	0.09	0.21	4169	0.10	0.10	0.73	1035	0.10	0.08	0.16	3167
Non-white	0.39	0.39	0.62	4169	0.37	0.35	0.14	1035	0.40	0.41	0.96	3167
Female	0.51	0.52	0.31	4358	0.53	0.52	0.60	1054	0.51	0.53	0.16	3339
Single Parent Household	0.24	0.25	0.70	3423	0.22	0.23	0.64	809	0.25	0.26	0.84	2640
Age (years)	9.8	9.8	0.29	4358	9.9	9.9	0.62	1054	9.8	9.8	0.29	3339
School Breakfast Program Participation (% of days) - Base Year	16.26	16.36	0.48	3380	21.55	22.80	0.54	939	14.42	13.83	0.17	2475
School-level characteristics												
% Eligible Free/Reduced Lunch - Base Year	45.6	45.6	0.81	151	54.4	54.7	0.73	37	42.2	42.9	0.96	117
% Eligible Free or Reduced Lunch - Year 1	46.2	45.2	0.20	153	55.1	52.9	0.19	38	42.4	42.9	0.63	119
% Minority Students - Base Year	32.6	33.8	0.90	153	33.4	29.1	0.11	38	31.7	35.2	0.46	119
School size - Base Year	507	471	0.15	151	646	550	0.20	37	481	447	0.30	117

Notes: P-values represent a test for whether the row variable is different in the treatment group than the control group, after conditioning on randomization pool fixed effects.

Table 2: Effect of School Breakfast Program on Participation and Nutrition, by Type of Program

	Any Universal School Breakfast			BIC Only			Cafeteria Only		
	Control group mean (1)	Impact (2)	N (3)	Control group mean (4)	Impact (5)	N (6)	Control group mean (7)	Impact (8)	N (9)
SBP Participation (% of days)	21.69	18.44***	3380	26.29	37.86***	939	20.01	10.50***	2475
		(1.58)			(2.18)			(1.15)	
Usually participate (>=75% of days)	0.08	0.13***	3380	0.12	0.29***	939	0.07	0.06***	2475
		(0.02)			(0.04)			(0.01)	
Ate Any Breakfast	0.96	0.00	4278	0.96	0.02*	1048	0.96	-0.00	3265
		(0.00)			(0.01)			(0.01)	
Ate Nutritionally Substantive Breakfast	0.59	0.03**	4278	0.60	0.10***	1048	0.59	0.01	3265
		(0.01)			(0.02)			(0.01)	
Ate 2 Substantive Breakfasts	0.02	0.01***	4278	0.02	0.05***	1048	0.02	-0.00	3265
		(0.00)			(0.01)			(0.00)	
Eats Breakfast Outside of School Only	0.69	-0.21***	4278	0.64	-0.45***	1048	0.70	-0.13***	3265
		(0.02)			(0.03)			(0.01)	
Breakfast: Total Energy (% RDA)	20.58	0.37	4278	20.67	1.70**	1048	20.57	-0.10	3265
		(0.32)			(0.78)			(0.32)	
Breakfast: Micronutrient Index	0.00	0.02	4278	-0.09	0.03	1048	0.03	0.01	3265
		(0.02)			(0.05)			(0.02)	
24 Hour: Total Energy (% RDA)	101.94	-1.15	3347	103.32	-2.00	803	101.65	-1.16	2570
		(0.81)			(1.86)			(0.90)	
24 Hour: Micronutrient Index	-0.00	0.00	3347	-0.07	-0.04	803	0.02	0.01	2570
		(0.02)			(0.04)			(0.02)	
Food Insecure	0.23	-0.01	3375	0.26	-0.02	809	0.22	-0.00	2592
		(0.01)			(0.02)			(0.01)	

Notes: Standard errors (clustered at the school level) are in parentheses. All regressions control for randomization-pool fixed effects and the following covariates: free and reduced lunch eligibility, household income, race, single parent household, gender and age. Definitions of breakfast are as follows: any breakfast is defined as consumption of any calories between 5:00 a.m. and 45 minutes after the start of school, and also any foods consumed before 10:30 a.m. that the student/parent reported as being part of breakfast on the survey date. A child ate a nutritionally substantive breakfast if he or she consumed food from at least 2 main food groups and >15% of calorie RDA during the same breakfast time period. A child ate 2 substantive breakfasts if he or she consumed a nutritionally substantive breakfast at school as well as another nutritionally substantive breakfast at another location during the breakfast time period. Micronutrient index combines the intake as a percentage of RDA for the following: Vitamins A, B-6, B-12, C, riboflavin, folate, calcium, iron, magnesium, and zinc.

Table 3: Effect of School Breakfast Program on First-Year Academic, Behavior and Health Outcomes, by Type of Program

	Any Universal School Breakfast			BIC Only			Cafeteria Only		
	Control group mean (1)	Impact (2)	N (3)	Control group mean (4)	Impact (5)	N (6)	Control group mean (7)	Impact (8)	N (9)
Test Score Index	-0.01	-0.03*	2572	-0.03	-0.05	554	0.00	-0.02	2024
		(0.02)			(0.04)			(0.02)	
Attendance (% of days)	95.97	-0.14	3603	95.74	-0.23	875	96.07	-0.15*	2752
		(0.09)			(0.22)			(0.09)	
Tardiness (% of days)	2.47	-0.34*	2051	2.37	0.11	445	2.51	-0.40*	1630
		(0.20)			(0.42)			(0.23)	
Bad Behavior Index	-0.00	0.00	4089	0.03	-0.04	998	-0.01	0.02	3119
		(0.02)			(0.04)			(0.02)	
BMI percentile for Age	63.35	1.18*	4300	66.13	0.76	1043	62.67	1.12*	3292
		(0.63)			(1.42)			(0.68)	
Overweight	0.31	0.02*	4300	0.38	-0.01	1043	0.30	0.03**	3292
		(0.01)			(0.02)			(0.01)	
Health Index	-0.01	0.02	4320	-0.10	0.05	1051	0.02	0.01	3304
		(0.02)			(0.04)			(0.02)	

reduced lunch eligibility, household income, race, single parent household, gender and age. Test score regressions additionally control for baseline math and reading test z-scores. Controlling for baseline test scores improves statistical precision but has little effect on impact estimates. Test score index is the average of math and reading z-scores, standardized by subject and grade based on the pooled control group. Attendance and tardiness is measured as the percent of total school days. The bottom 2% of attendance observations are trimmed. Bad behavior index contains 15 teacher-reported measures of the student's inability to control behavior and focus. A child is overweight if he/she is in the 85th percentile or above of BMI for his age. Health index combines parent-reported health status, and indicator variables for whether the child is overweight, obese or has any parent-reported health problems.

Table 4: Effect of School Breakfast Program in Subsequent Years

	Any Universal School Breakfast			BIC Only			Cafeteria Only		
	Control group mean	Impact	N	Control group mean	Impact	N	Control group mean	Impact	N
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Year 2									
SBP Participation (% of days)	20.97	21.38***	2459	26.00	41.59***	709	18.97	12.89***	1779
		(1.79)			(2.95)			(1.39)	
Test Score Index	-0.01	-0.05	1546	-0.10	0.01	341	0.01	-0.06*	1208
		(0.03)			(0.06)			(0.03)	
Attendance (% of days)	95.92	0.18**	2642	95.77	0.16	651	95.99	0.14	2011
		(0.09)			(0.19)			(0.10)	
Tardiness (% of days)	1.75	-0.11	1511	0.98	0.37*	337	1.91	-0.20	1194
		(0.18)			(0.21)			(0.21)	
Year 3									
SBP Participation (% of days)	19.40	18.08***	1679	22.67	36.07***	457	18.16	11.00***	1240
		(1.85)			(3.43)			(1.48)	
Test Score Index	-0.01	0.00	1285	-0.01	-0.02	255	-0.01	0.01	1030
		(0.04)			(0.05)			(0.04)	
Attendance (% of days)	95.88	0.13	1790	94.88	1.05***	420	96.20	-0.14	1383
		(0.12)			(0.34)			(0.11)	
Tardiness (% of days)	2.12	-0.18	988	1.51	1.14	206	2.29	-0.42	795
		(0.26)			(0.87)			(0.26)	
Pooled Outcomes: Years 1, 2 and 3									
SBP Participation (% of days)	21.35	18.68***	3380	25.50	38.52***	939	19.82	10.72***	2475
		(1.53)			(2.16)			(1.04)	
Test Score Index	-0.02	-0.02	2619	-0.07	-0.01	571	0.00	-0.02	2054
		(0.02)			(0.04)			(0.02)	
Attendance (% of days)	95.82	0.01	3678	95.58	-0.07	890	95.92	-0.01	2812
		(0.08)			(0.21)			(0.08)	
Tardiness (% of days)	2.23	-0.23	2064	1.76	0.42*	446	2.33	-0.33**	1642
		(0.14)			(0.24)			(0.16)	

Notes: Standard errors (clustered at the school level) are in parentheses. All regressions control for randomization-pool fixed effects and the following covariates: free and reduced lunch eligibility, household income, race, single parent household, gender and age. Test score regressions additionally control for baseline math and reading test z-scores.

Table 5: Effect of Breakfast in the Classroom Program, by Subgroup

	A: Free-lunch eligible			B: Free-lunch ineligible		
	Control group mean	Impact	N	Control group mean	Impact	N
SBP Participation (% of days)	41.48	24.00***	382	14.76	46.30***	557
		(2.60)			(2.62)	
Ate Nutritionally Substantive Breakfast	0.62	0.10***	436	0.58	0.09***	612
		(0.04)			(0.03)	
Attendance (% of days)	95.29	-0.79***	361	96.10	-0.03	514
		(0.28)			(0.26)	
Bad Behavior Index	0.16	-0.04	418	-0.08	-0.04	580
		(0.06)			(0.05)	
Test Score Index	-0.26	-0.04	214	0.14	-0.06	340
		(0.07)			(0.05)	
Overweight	0.37	0.04	434	0.40	-0.05	609
		(0.03)			(0.04)	
Health Index	-0.10	-0.03	438	-0.09	0.11**	613
		(0.05)			(0.06)	
	C: Male			D: Female		
	Control group mean	Impact	N	Control group mean	Impact	N
SBP Participation (% of days)	24.03	41.70***	442	28.34	34.38***	497
		(2.19)			(2.69)	
Ate Nutritionally Substantive Breakfast	0.66	0.07**	498	0.55	0.11**	550
		(0.03)			(0.04)	
Attendance (% of days)	95.80	-0.01	413	95.68	-0.39	462
		(0.25)			(0.28)	
Bad Behavior Index	0.23	-0.02	475	-0.16	-0.05	523
		(0.05)			(0.05)	
Test Score Index	0.03	-0.07	255	-0.08	-0.02	299
		(0.06)			(0.06)	
Overweight	0.41	-0.03	496	0.36	0.00	547
		(0.04)			(0.04)	
Health Index	-0.12	0.05	500	-0.08	0.05	551
		(0.06)			(0.06)	
	E: Urban, High-Poverty School			F: Minority		
	Control group mean	Impact	N	Control group mean	Impact	N
SBP Participation (% of days)	27.30	37.74***	206	34.80	31.21***	314
		(5.07)			(3.33)	
Ate Nutritionally Substantive Breakfast	0.63	0.17***	225	0.66	0.08	374
		(0.03)			(0.05)	
Attendance (% of days)	95.50	-0.52***	201	95.90	-0.07	309
		(0.16)			(0.30)	
Bad Behavior Index	0.10	0.07	220	0.19	-0.18***	354
		(0.18)			(0.07)	
Test Score Index	-0.19	-0.29***	126	-0.17	-0.15**	197
		(0.07)			(0.08)	
Overweight	0.40	-0.10***	225	0.43	-0.03	374
		(0.04)			(0.04)	
Health Index	-0.18	0.22***	226	-0.17	0.06	374
		(0.04)			(0.06)	

Notes: Standard errors (clustered at the school level) are in parentheses. Outcomes reported for first year only. All regressions control for randomization-pool fixed effects and the following covariates: free and reduced lunch eligibility, household income, race, single parent household, gender and age. Test score regressions additionally control for baseline math and reading test z-scores.

Table 6: Instrumental Variables Estimates of the Effect of Breakfast Consumption

	Endogenous Variable: Ate Nutritionally Substantive Breakfast			Endogenous Variable: Total Energy (%RDA) Intake at Breakfast		
	OLS	**IV**	**N**	**OLS**	**IV**	**N**
	(1)	**(2)**	**(3)**	**(4)**	**(5)**	**(6)**
FIRST STAGE		0.10***			1.70**	
Instrument		(0.02)			(0.78)	
F-statistic		*16.53*			*4.79*	
SECOND STAGE						
24 Hour: Micronutrient Index	0.46***	-0.35	802	0.02***	-0.02	802
	(0.05)	(0.39)		(0.00)	(0.03)	
24 Hour: Total Energy (% RDA)	15.58***	-17.11	802	0.99***	-1.19	802
	(2.09)	(18.64)		(0.09)	(1.62)	
BMI percentile for Age	2.05	8.34	1039	-0.03	0.49	1039
	(2.00)	(13.75)		(0.09)	(0.77)	
Overweight	0.02	-0.11	1039	-0.00	-0.01	1039
	(0.03)	(0.21)		(0.00)	(0.01)	
Health Index	-0.05	0.50	1046	0.00	0.03	1046
	(0.05)	(0.42)		(0.00)	(0.03)	
Bad Behavior Index	0.02	-0.34	993	0.00	-0.02	993
	(0.05)	(0.38)		(0.00)	(0.02)	
Attendance (% of days)	0.16	-2.85	870	-0.00	-0.17	870
	(0.24)	(2.37)		(0.01)	(0.16)	
Test Score Index	-0.03	-0.39	531	0.00	-0.02	417
	(0.04)	(0.47)		(0.00)	(0.03)	

Notes: Standard errors adjusted for homoskedasticity at the school level. The instrumental variable is the school's random assignment to receive the universal school breakfast program. Sample is limited randomization pairs in which the treatment school opted into the Breakfast in the Classroom program. All regressions control for randomization-pool fixed effects and the following covariates: free and reduced lunch eligibility, household income, race, single parent household, gender and age. Test score regressions additionally control for baseline math and reading test z-scores.

Appendix Table 1: Effect of Universal School Breakfast Program on Index Sub-Components

A: Breakfast - Micronutrient Index

	Any Universal School Breakfast			BIC Only			Cafeteria Only		
	Control group mean (1)	Impact (2)	N (3)	Control group mean (4)	Impact (5)	N (6)	Control group mean (7)	Impact (8)	N (9)
Calcium	35.75	2.34***	4278	34.63	4.24**	1048	36.18	1.59**	3265
		(0.74)			(1.82)			(0.77)	
Folate	51.05	0.42	4278	45.21	-0.22	1048	52.83	0.45	3265
		(1.07)			(2.83)			(1.10)	
Iron	63.56	-0.16	4278	56.8	1.03	1048	65.5	-0.73	3265
		(1.34)			(3.42)			(1.41)	
Magnesium	31.41	1.19*	4278	27.61	2.52**	1048	32.62	0.67	3265
		(0.62)			(1.25)			(0.71)	
Niacin	60.21	0.00	4278	55.14	-1.12	1048	61.73	0.22	3265
		(1.44)			(3.56)			(1.52)	
Riboflavin	109.63	1.45	4278	99.55	4.56	1048	112.67	0.19	3265
		(2.05)			(5.16)			(2.12)	
Thiamin	78.29	0.47	4278	72.09	2.08	1048	80.16	-0.26	3265
		(1.51)			(3.81)			(1.57)	
Vitamin A	60.42	2.57*	4278	54.43	2.03	1048	62.22	2.43*	3265
		(1.45)			(4.18)			(1.38)	
Vitamin B-6	79.25	-0.05	4278	71.62	-3.19	1048	81.44	0.82	3265
		(2.12)			(4.92)			(2.31)	
Vitamin B-12	97.94	-1.72	4278	93.5	-5.84	1048	99.23	-0.40	3265
		(3.16)			(8.19)			(3.26)	
Vitamin C	86.24	0.57	4278	78.24	-3.77	1048	89.34	1.04	3265
		(2.95)			(6.21)			(3.42)	
Zinc	51.64	0.94	4278	44.17	4.34	1048	53.85	-0.22	3265
		(1.31)			(3.31)			(1.31)	

Notes: Row variables represent nutrient intake at breakfast as a percent of recommended daily allowance (RDA).

B: 24 Hour - Micronutrient Index

	Any Universal School Breakfast			BIC Only			Cafeteria Only		
	Control group mean (1)	Impact (2)	N (3)	Control group mean (4)	Impact (5)	N (6)	Control group mean (7)	Impact (8)	N (9)
Calcium	135.65	0.33	3347	134.98	-4.71	803	135.49	1.72	2570
		(2.14)			(4.92)			(2.35)	
Folate	149.56	2.33	3347	140.49	0.25	803	152.36	2.35	2570
		(2.15)			(4.08)			(2.50)	
Iron	182.38	0.25	3347	179.51	-4.52	803	183.21	0.95	2570
		(2.33)			(4.29)			(2.74)	
Magnesium	135.85	0.32	3347	127.87	-1.02	803	138.27	0.37	2570
		(1.44)			(2.71)			(1.71)	
Niacin	210.68	-0.14	3347	203.35	-3.64	803	213.44	-0.12	2570
		(2.86)			(6.63)			(3.13)	
Riboflavin	311.58	2.24	3347	297.2	0.34	803	315.89	1.88	2570
		(3.44)			(7.38)			(3.98)	
Thiamin	244.95	1.33	3347	239.07	-3.28	803	247.03	1.87	2570
		(3.19)			(6.95)			(3.62)	
Vitamin A	164.29	2.93	3347	147.89	2.89	803	169.12	1.80	2570
		(2.47)			(5.27)			(2.85)	
Vitamin B-6	221.37	0.16	3347	212.9	-3.65	803	224.08	0.35	2570
		(3.18)			(6.27)			(3.69)	
Vitamin B-12	311.57	-10.42*	3347	297.99	-17.34	803	315.69	-9.33	2570
		(5.75)			(11.16)			(6.82)	
Vitamin C	259.46	-3.36	3347	253.77	-33.24***	803	262.54	3.05	2570
		(6.36)			(10.16)			(7.61)	
Zinc	173.72	-0.62	3347	165.92	-0.07	803	175.92	-1.22	2570
		(2.18)			(5.15)			(2.34)	

Notes: Row variables represent nutrient intake at breakfast as a percent of recommended daily allowance (RDA).

Appendix Table 1: Effect of Universal School Breakfast Program on Index Sub-Components (Continued)

	C: Bad Behavior Index								
	Any Universal School Breakfast			BIC Only			Cafeteria Only		
	Control group mean (1)	Impact (2)	N (3)	Control group mean (4)	Impact (5)	N (6)	Control group mean (7)	Impact (8)	N (9)
Has a hard time keeping his/her mind on activities.	2.85	0.09*	4086	3.10	-0.12	998	2.77	0.16***	3116
		(0.04)			(0.11)			(0.05)	
It is hard to get his/her attention when s/he is concentrating on something.	2.69	0.06	4086	2.77	-0.09	998	2.67	0.12**	3116
		(0.05)			(0.11)			(0.05)	
Will move from one task to another without completing any of them.	2.91	0.08	4079	2.97	-0.03	996	2.89	0.13**	3111
		(0.06)			(0.15)			(0.06)	
Has difficulty waiting in line.	2.55	0.00	4087	2.60	-0.08	998	2.53	0.04	3117
		(0.05)			(0.12)			(0.06)	
Has a lot of trouble stopping an activity when called to do something else.	2.59	0.07	4082	2.62	-0.12	993	2.58	0.14**	3117
		(0.05)			(0.11)			(0.06)	
Has trouble sitting still when s/he is told to.	2.55	0.06	4088	2.54	0.11	997	2.56	0.04	3119
		(0.05)			(0.09)			(0.06)	
Sometimes does not seem to hear me when I talk to him/her.	2.86	-0.03	4080	2.96	-0.25*	997	2.84	0.05	3111
		(0.06)			(0.14)			(0.06)	
Is easily distracted when listening to a story or someone talking.	3.12	0.06	4079	3.31	-0.21*	997	3.06	0.16***	3110
		(0.05)			(0.11)			(0.05)	
Can wait before entering new activities if s/he is asked to.	5.28	-0.01	4087	5.16	0.06	998	5.32	-0.04	3117
		(0.06)			(0.13)			(0.06)	
Can easily shift from one activity to another.	5.20	-0.05	4081	5.19	0.03	996	5.20	-0.08	3113
		(0.05)			(0.09)			(0.06)	
Is good at following instructions.	5.05	-0.01	4085	5.04	-0.11	998	5.05	0.01	3115
		(0.05)			(0.09)			(0.05)	
Shows good concentration skills when drawing and coloring.	5.17	0.04	4079	5.13	0.14	997	5.18	0.01	3110
		(0.05)			(0.10)			(0.05)	
Has an easy time leaving recess or lunch to come back to class.	5.06	0.08	4074	5.25	-0.07	995	5.00	0.13*	3107
		(0.06)			(0.11)			(0.07)	
Approaches places s/he has been told are dangerous slowly and cautiously.	4.31	0.30***	3962	4.21	0.12	982	4.35	0.35***	3008
		(0.09)			(0.19)			(0.10)	
Can easily stop an activity when s/he is told "no".	5.13	0.05	4073	5.17	0.08	997	5.12	0.03	3104
		(0.06)			(0.12)			(0.06)	

Notes: Scale 1-7 (where 1="Extremely untrue of this child" and 7="Extremely true of this child")

Appendix Table 1: Effect of Universal School Breakfast Program on Index Sub-Components (Continued)

	Any Universal School Breakfast			BIC Only			Cafeteria Only		
D: Health Index	**Control group mean (1)**	**Impact (2)**	**N (3)**	**Control group mean (4)**	**Impact (5)**	**N (6)**	**Control group mean (7)**	**Impact (8)**	**N (9)**
Obese	0.18	-0.01	4300	0.23	-0.04	1043	0.16	-0.00	3292
		(0.01)			(0.02)			(0.01)	
Overweight	0.31	0.02*	4300	0.38	-0.01	1043	0.30	0.03**	3292
		(0.01)			(0.02)			(0.01)	
Child's Health "Excellent" (Parent report)	0.55	0.03*	3415	0.53	0.04	808	0.56	0.02	2633
		(0.02)			(0.03)			(0.02)	
Child has chronic health Problem	0.20	-0.01	3404	0.21	0.01	805	0.20	-0.02	2625
		(0.01)			(0.02)			(0.01)	

	Any Universal School Breakfast			BIC Only			Cafeteria Only		
E: Test Scores	**Control group mean (1)**	**Impact (2)**	**N (3)**	**Control group mean (4)**	**Impact (5)**	**N (6)**	**Control group mean (7)**	**Impact (8)**	**N (9)**
Math (Year 1)	0.00	-0.03*	2536	0.03	-0.09*	550	-0.01	-0.02	1992
		(0.02)			(0.05)			(0.02)	
Reading (Year 1)	0.00	-0.02	2501	-0.07	-0.02	536	0.02	-0.02	1971
		(0.02)			(0.04)			(0.02)	
Math (Year 2)	0.00	-0.05	1521	-0.11	0.05	334	0.03	-0.08*	1190
		(0.04)			(0.08)			(0.04)	
Reading (Year 2)	0.00	-0.01	1351	-0.02	-0.06	309	0.00	0.00	1045
		(0.03)			(0.09)			(0.04)	
Math (Year 3)	0.00	-0.03	1265	-0.04	0.01	252	0.01	-0.03	1013
		(0.04)			(0.07)			(0.05)	
Reading (Year 3)	0.00	0.03	1252	0.06	-0.07	246	-0.01	0.06	1006
		(0.04)			(0.06)			(0.05)	
Math (Years 1-3)	-0.01	-0.03*	2583	-0.04	-0.01	565	0.01	-0.04*	2024
		(0.02)			(0.05)			(0.02)	
Reading (Years 1-3)	-0.02	-0.01	2552	-0.09	-0.01	552	0.00	-0.01	2006
		(0.02)			(0.04)			(0.02)	

Note: Standard errors (clustered at the school level) are in parentheses. All regressions control for randomization-pool fixed effects and the following covariates: free and reduced lunch eligibility, household income, race, single parent household, gender and age. Test score regressions additionally control for baseline math and reading test z-scores.

Appendix Table 2: Difference-in-difference Analysis: Impact of BIC Treatment Relative to Universal Cafeteria Breakfast

	Difference-in-difference Coefficient Estimate (1)	N (2)
Year 1		
SBP Participation (% of days)	27.98***	3380
	(2.47)	
Usually participate (>=75% of days)	0.24***	3380
	(0.04)	
Ate Any Breakfast	0.02*	4278
	(0.01)	
Ate Nutritionally Substantive Breakfast	0.08***	4278
	(0.03)	
Ate 2 Substantive Breakfasts	0.05***	4278
	(0.01)	
Eats Breakfast Outside of School Only	-0.30***	4278
	(0.03)	
Breakfast: Total Energy (% RDA)	1.56*	4278
	(0.89)	
Breakfast: Micronutrient Index	0.00	4278
	(0.06)	
24 Hour: Total Energy (% RDA)	-0.12	3347
	(1.91)	
24 Hour: Micronutrient Index	-0.04	3347
	(0.04)	
Food Insecure	-0.01	3375
	(0.02)	
Test Score Index	-0.03	2477
	(0.04)	
Attendance (% of days)	-0.03	3603
	(0.24)	
Tardiness (% of days)	0.47	2051
	(0.47)	
Bad Behavior Index	-0.06	4089
	(0.04)	
BMI percentile for Age	-0.01	4300
	(1.51)	
Overweight	-0.04	4300
	(0.02)	
Health Index	0.04	4320
	(0.04)	

Appendix Table 2: Difference-in-difference Analysis: Impact of BIC

	Difference-in-difference Coefficient Estimate (1)	N (2)
Year 2		
SBP Participation (% of days)	28.17***	2459
	(3.21)	
Test Score Index	0.05	1504
	(0.07)	
Attendance (% of days)	0.08	2642
	(0.22)	
Tardiness (% of days)	0.49*	1511
	(0.27)	
Year 3		
SBP Participation (% of days)	24.83***	1679
	(3.77)	
Test Score Index	-0.08	1248
	(0.07)	
Attendance (% of days)	1.17***	1790
	(0.36)	
Tardiness (% of days)	1.42*	988
	(0.74)	
Pooled Outcomes: Years 1, 2 and 3		
SBP Participation (% of days)	27.94***	3380
	(2.28)	
Test Score Index	0.01	2516
	(0.04)	
Attendance (% of days)	-0.00	3678
	(0.23)	
Tardiness (% of days)	0.69**	2064
	(0.29)	

Note: Coefficients reported are for the interaction between treatment status and BIC treatment pair. Standard errors (clustered at the school level) are in parentheses. All regressions additionally control for randomization-pool fixed effects, randomly assigned treatment status, and the following covariates: free and reduced lunch eligibility, household income, race, single parent household, gender and age. Test score regressions additionally control for baseline math and reading test z-scores.