THE EFFECT OF BREAKFAST IN THE CLASSROOM ON OBESITY AND ACADEMIC PERFORMANCE: EVIDENCE FROM NEW YORK CITY*

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ABSTRACT

Participation in the federally-subsidized school breakfast program (SBP) often falls well below that of the lunch program. In NYC, for example, less than one third of all students eat a school breakfast each day, even though it is provided free to all students and roughly 3 in 4 students are poor. To increase participation, many schools have adopted Breakfast in the Classroom (BIC), serving breakfast direct to students in class at the start of the school day. Breakfast consumption has been found to improve child cognitive performance, and two recent studies have found a positive effect of BIC on achievement. Its impact on obesity, however, is unknown. In this paper, we exploit the staggered introduction of BIC in NYC to estimate its impact on meal participation, obesity, BMI, academic performance, attendance, and perceptions of the school environment. We find little evidence that BIC increased obesity, and some evidence it reduced it, particularly among middle school girls. There are mostly positive effects of BIC on achievement, with the largest effects for boys. These effects are, however, much smaller than those found in previous studies. We find consistently positive, but small, effects of BIC on attendance rates.

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1. Introduction

Since 1966, the federal School Breakfast Program (SBP) has subsidized breakfasts for needy children, with the goals of reducing hunger, improving nutrition, and facilitating learning (Bhattacharya, Currie, & Haider, 2006; Millimet, Tchernis, & Husain, 2010; Poppendieck, 2010).[1] Participation in the SBP, however, often falls well below that of the school lunch program (Bartfeld & Kim, 2010; Basch, 2011; Dahl & Scholz, 2011). In New York City, for example, less than one third of all students take a breakfast each day, even though it is provided free to all students and roughly 3 in 4 students live in low income households (Leos-Urbel et al., 2012).[2]

To increase participation in the SBP, many school districts have adopted Breakfast in the Classroom (BIC), which serves breakfast direct to students in class at the start of the school day, rather than make it available in the cafeteria before school. The logic is that by providing breakfast at the start of the school day, students unable or unwilling to arrive early for breakfast will be more likely to participate. BIC may also eliminate the stigma associated with having to arrive early to school for a subsidized meal. NYC schools began implementing BIC in 2007 and today the program serves more than 300 of the city's 1,700 schools.[3]

Research shows that the practice, timing, and nutritional quality of breakfast can affect the cognitive performance of children (e.g., Wesnes et al., 2001; Rampersaud et al., 2005). While there is little work evaluating the BIC program in particular, two recent studies found that moving breakfast to the classroom can have positive effects on math and reading achievement and behavior (Imberman & Kugler, 2012; Dotter, 2012). The long-run impact of the BIC program on obesity and overall child health, however, is unknown and *a priori* ambiguous. There is evidence a regular, nutritionally appropriate breakfast can help individuals maintain a healthy weight (e.g., Cho et al.,

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[1] USDA's description of the SBP can be found here: http://www.fns.usda.gov/cnd/breakfast/

[2] A 2012 report from the Food Research and Action Center rated NYC last out of 26 urban school districts in breakfast participation among subsidy-eligible students (FRAC, 2012).

[3] "It's a Hit: Breakfast in the Classroom," *The New York Times*, November 17, 2008, A21.

2003). But there are also concerns that BIC facilitates over-eating. In NYC, for example, expansion of the BIC program was halted by the Bloomberg administration when an unpublished study found that BIC students were frequently eating *two* breakfasts—one at home and another during school.[4] The New York City Council—and later, the U.S. Secretary of Agriculture—objected, calling for expansion of the program citywide.[5]

In this paper, we exploit the staggered introduction of BIC in NYC to estimate its impact on obesity, academic performance, attendance, and perceptions of the school environment. We begin by investigating whether a school's adoption of BIC had a significant impact on daily participation in the SBP. We then match data on BIC adoption to longitudinal student data on body mass index (BMI), standardized test scores, attendance rates, NYC School Survey responses, and demographics to estimate the impact of the program on students. Our identification strategy is chiefly a difference-in-difference design, contrasting observationally similar students in schools that did and did not adopt BIC, before and after implementation.

We find that the introduction of BIC had a substantial effect on participation in the SBP and no effect on lunch program participation. We find little evidence that BIC increased obesity, and some evidence that it reduced the incidence of obesity, particularly among middle school girls. Consistent with Imberman & Kugler (2012) and Dotter (2012), we find mostly positive effects of BIC on reading and math achievement in grades 3-8, but the estimates are typically only significant for boys. As a whole, our achievement effects are much smaller than those found in previous studies. Finally, we find consistently positive, but small, effects of BIC on attendance rates and middle school student attitudes toward classroom teachers and school safety.

[4] NYC Department of Mental Health and Hygiene (2012). See also Citizens' Committee for Children of New York (2012) and "Hiccup in the Most Important Meal," *The New York Times*, April 19, 2012, A1.
[5] See "Obesity Debate Over Where to Serve School Breakfasts," *The Wall Street Journal*, August 22, 2012, A16; and "Classroom Breakfast Policy is Challenged," *The Wall Street Journal,* February 28, 2013, A17.

2. Background

2.1 The effects of school meals on health and academic achievement

There is considerable evidence that the availability and quality of school meals programs can affect the nutritional intake and academic outcomes of participating students. For example, in a study of the SBP, Bhattacharya, Currie, and Haider (2006) used detailed survey data from the NHANES III to investigate how access to the SBP affected children's breakfast consumption and nutrient intake. They found no impact of the SBP on total calories consumed or the likelihood of eating breakfast, but found large effects on the nutritional quality of breakfasts eaten, with fewer calories from fat, and higher serum levels of vitamins C, E, and folate.[6] Schanzenbach (2009) examined the body weight of students participating in the school lunch program and found that children eating school lunches were more likely to be obese than those bringing their own lunch, a finding she attributed to higher caloric intake among students taking school lunches. A study by Millimet, Tchernis, and Husain (2010) corroborated this finding on school lunches, but—consistent with Bhattacharya, Currie, and Haider (2006)—found that participation in the SBP was associated with lower rates of obesity.

Evidence for a causal impact of school meals programs on educational outcomes is more mixed, but frequently positive. In one study of the long-run effects of the school lunch program, for example, Hinrichs (2010) found sizable effects on the educational attainment of adults who were exposed to the program early in life. Using administrative data from Chile, McEwan (2013) found no effects of providing free high-calorie meals to low income children on test scores, school attendance, and grade repetition. Similarly, Dunifon and Kowaleski-Jones (2003) found little association between school lunch program participation in the U.S. and achievement after

[6] In an unpublished study, Waehrer (2008), on the other hand, used time-diary data from the Child Development Supplement of the Panel Study of Income Dynamics and found that SBP participants were less likely to consume breakfasts during the week than on the weekends.

accounting for selection into the program.[7] In a clever study examining responses to test-based accountability in Virginia, Figlio and Winicki (2005) found that schools under accountability pressure substantially increased the caloric content of their meals on test days, and saw larger increases in passing rates as a result. Consistent with that finding, Imberman and Kugler (2012) found that the introduction of BIC into a large urban school district had large positive effects on reading and math achievement, even when the program was implemented a short time before the test date. (We describe this study in greater detail in Section 2.2).

That the consumption and quality of breakfast can have at least a short-term effect on child cognitive performance is also confirmed in a number of experimental studies.[8] For example, a study in the U.K. randomly assigned 10-year-old students to different breakfast regimens at home each day and found students receiving a higher energy breakfast scored higher in school on tests of creativity and number checking (Wyon et al., 1997). They were also less likely to report feeling bad or hungry to their teacher. Similarly, Wesnes et al. (2003) randomly assigned students to receive one of four types of breakfast on successive days (one of two types of cereal, a glucose drink, or no breakfast) and found that students eating a cereal breakfast performed better on a series of tests of attention and memory over the course of the morning. Simeon and Grantham-McGregor (1989) conducted a small experiment in which under-nourished children in the West Indies were randomly assigned to receive a breakfast or a cup of tea on alternate days. After consuming a breakfast, students performed better on cognitive tests of arithmetic and problem solving than when drinking only tea.

Relevant to the BIC program, at least one study found that the timing of *when* breakfast is consumed can mediate its effects on cognitive performance. In a randomized control trial, Vaisman et al. (1996) found that 11- to 13-year-old students who ate a regular breakfast before school (two

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[7] More comprehensive reviews of this literature can be found in Briefel et al. (1999), Hoyland, Dye, and Lawton (2009), Ponza et al. (1999), and Rampersaud et al. (2005).

[8] A more thorough review can be found in Pollitt and Matthews (1998) and Hoyland, Dye, and Lawton (2009).

hours before testing) performed no better than a control group on tests of cognitive functioning. However, students who ate a cereal and milk breakfast in class (30 minutes before testing) performed significantly better.

2.2 Breakfast in the Classroom

Breakfast in the Classroom alters the traditional SBP by serving breakfast in class at the start of the school day, rather than making it available in the cafeteria before school hours (FRAC, 2012). The intention of the BIC program is to increase participation among students who are unable or unwilling to arrive early to school, and to potentially reduce stigma associated with visiting the cafeteria before school for a subsidized meal. BIC advocates have also argued the program provides an opportunity to integrate nutrition education into the curriculum, as teachers can use the time to teach good eating habits. Proponents tout the social aspects of the program as well, citing the benefits of eating together as a group.[9]

BIC breakfasts are consumed during the first 10-20 minutes of class, often during morning announcements or while the teacher takes attendance or returns homework. Meals are bagged the prior evening by school food staff, placed into insulated containers, and refrigerated overnight. They are then delivered to classrooms in the morning, or distributed to students as they arrive ("Grab and Go"). Because breakfasts are assembled the night before, BIC menus generally differ from those prepared in the cafeteria. Specifically, BIC meals often consist of cold, pre-packed items such as cereal, fresh fruit, or bagels. Cafeteria breakfasts can, on the other hand, include hot meals such as

[9] For example, see http://www.healthyeating.org/Schools/Tips-Trends/Article-Viewer/Article/142/breakfast-at-school-a-communal-meal-that-makes-a-difference.aspx [last accessed March 1, 2013].

pancakes or egg omelets.[10] BIC meals are required to meet the same federal nutritional guidelines as cafeteria breakfasts.

The Food Research and Action Center (FRAC), a national advocate for the SBP in general and BIC in particular, has attributed high rates of SBP participation in urban school districts like Detroit, Houston, Newark, San Antonio, Washington, D.C., and Providence to the BIC program (FRAC, 2012, 2013). There has been little research, however, on BIC's effects on breakfast program participation, academic or behavioral outcomes, or health. One evaluation of a 2003-04 BIC pilot in upstate New York found that SBP participation doubled after implementation of the program, and documented modest improvements in attendance, behavior, and tardiness (Murphy, Drake, & Weineke, 2005). The study, however, lacked a control group and involved only a small number of schools.

Two recent working papers provide the most rigorous evidence to date on the effects of offering breakfast in the classroom. The first, Imberman and Kugler (2012), examined the impact of BIC on math and reading achievement in 5th grade, and attendance and report card grades in grades 1-5. Their setting was a large urban district that—like NYC—had previously offered breakfast free to all students. The district phased in BIC over a period of 11 weeks in 2009-10, which enabled the authors to contrast outcomes in early adopter schools (those implementing BIC before the test) with those in late adopting schools (implementing after the test) via a difference-in-difference design. They found substantial effects of BIC on reading and math achievement (0.10 s.d.), with larger effects for initially low-achieving students (0.13 – 0.14 s.d.), Hispanics (0.14 – 0.15 s.d.), and low-BMI students (0.26 s.d.). They found no impact of BIC on attendance rates or report card grades.

Interestingly, the achievement effects estimated in Imberman and Kugler (2012) did not vary with the amount of time students had been exposed to the BIC program. Thus, even schools that

[10] Not all schools in NYC have kitchen facilities for preparing hot meals. These schools would likely have served cold breakfasts prior to adopting BIC.

adopted BIC as little as one week prior to testing experienced large gains in test performance. Though perhaps surprising at first glance, this finding is reminiscent of Figlio and Winicki (2005), who showed that increasing the caloric content of lunches on test day could improve standardized test performance. It also aligns with experimental evidence described in Section 2 that found short-term effects of breakfast consumption on cognitive performance. The paper's finding of no impact on grades but a large impact on test scores is consistent with a short-run caloric effect and no sustained, long-run impact on achievement, but the study's short duration makes it difficult to rule out long-run effects.

The second paper by Dotter (2012) used the introduction of BIC in San Diego over a 4-year period to estimate its effects on achievement in 2nd – 6th grade, attendance, and classroom behavior. Its design is closer to ours, relying on difference-in-difference models with school and/or student fixed effects to estimate the impact of BIC adoption. Unlike NYC and the district in Imberman and Kugler (2012), however, San Diego previously offered universal free breakfasts only in schools with Provision 2 status under the National School Lunch Act ("UFM schools").[11] All others offered breakfast free or at a reduced rate to subsidy-eligible students and at full price to other students. BIC thus coincided with a shift to universal free breakfast in schools that were not already UFM. Like Imberman and Kugler (2012), Dotter found large effects of BIC on achievement (0.11 s.d. in reading and 0.15 s.d. in math), but only in schools that did not already offer free breakfasts to all students. He found no effect on attendance, but large positive effects on teacher-reported classroom behavior, such as exhibiting "respect for people and property."

These two studies supply the best available evidence on the effects of BIC, and go far beyond what was previously available. However, they have several limitations. First, neither provided

[11] Under Provision 2, a school may certify children as eligible for free or reduced-price meals for up to four consecutive years—without collecting annual data on eligibility—and provide meals free of charge to all students. The intent is to reduce the administrative burden on schools and parents related to proving income eligibility. For details, see: http://www.gpo.gov/fdsys/pkg/CFR-2012-title7-vol4/pdf/CFR-2012-title7-vol4-part245.pdf

evidence of the program's effect on student obesity or health, an important outstanding question in the literature. Second, both relied on relatively small samples of elementary schools. Imberman and Kugler's main estimates are for 5th grade achievement in approximately 85 treatment and 19 control schools; Dotter looked at a broader range of grade levels, but in a smaller number of schools (45 treatment and 22 control). His sample of non-UFM schools—where all of the effects were found—was smaller (19 treatment and 16 control). It is plausible there are heterogeneous effects of BIC by grade level (elementary, middle, high school) to the extent these schools differ in prior participation in the SBP and the importance of stigma. Third, only Dotter is able to say much about long-run effects, up to four years after the first BIC implementation. Imberman and Kugler provide a clean estimate of the short-run impact of BIC, but their results may say more about calorie intake and the malleability of standardized test performance. Our analysis improves on these limitations in several ways, by incorporating student-level measures of BMI and a significantly larger sample of students and schools at both the elementary and middle school level.[12]

Only one study that we are aware of has looked at the relationship between BIC and children's body mass index. Baxter et al. (2010) collected information on BMI, breakfast program participation, and energy intake (from researcher observations of meals consumed) for a sample of 4th grade students in 17 schools, seven of which had adopted BIC. They found BMI was significantly and positively related to BIC participation, with children in BIC consuming more calories at breakfast and having higher BMIs than children eating breakfast in the cafeteria. The study's use of direct observations of meals actually consumed is a decided advantage, but its design was purely cross-sectional, and thus could not account for selection of schools and students into the program.

[12] Some high schools in NYC have implemented BIC. However, as we explain in the next section, our data on high school students and schools appears to be less reliable than our data for elementary and middle school. Hence our analysis in this paper is restricted to students in elementary and middle grades.

3. Data

3.1 Overview of Data Sources and Measures

We draw on four primary data sources, all provided by the New York City Department of Education (NYCDOE) and its Office of School Food and Nutrition Services. The first is a database of BIC participation that includes program start dates for schools that ever adopted BIC, grades served by the program, number of BIC and total classrooms, and average daily BIC participation.[13] The second is a longitudinal database of breakfast and lunch program participation by school, spanning 2001-02 to 2011-12. This provides annual counts of meals served, average daily attendance (ADA), and Provision 2 (UFM) status. The third is administrative data for the universe of students in NYC public schools between 2006-07 and 2010-11, including basic demographics, educational needs and program participation (e.g., ELL and special education), standardized test scores in grades 3-8 in English Language Arts (ELA) and mathematics, and attendance rates. Finally, the fourth is annual student level height and weight measurements collected as part of the city's *Fitnessgram* initiative. As described below, these are used to compute body mass index (BMI) and indicators of overweight and obesity.

NYC schools have conducted *Fitnessgram* assessments since 2005-06 as part of the district's standards-based physical education program.[14] *Fitnessgram* requires all schools to collect students' height and weight each year, and to assess students' aerobic fitness, muscle strength, endurance, and flexibility. At the end of the year, students receive a report that summarizes their performance on the assessment and suggests ways for them to reach their "Healthy Fitness Zone" (targets for better health based on their age and gender). While coverage rates were comparatively low in the early years of the program, by 2011 nearly 1,700 schools were participating, collecting data on more than 810,000 students each year in all grades.

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[13] Details on this and other data sources are provided in the online Data Appendix.

[14] See Rundle et al. (2012), and Elbel et al. (2013).

From the *Fitnessgram* we used students' weight (in pounds) and height (in inches) to compute BMI as: $(weight / height^2)*703$. Biologically implausible values—defined as more than 4 s.d. below or 5 s.d. above the mean for the students' age in months and gender—were set to missing. Using BMI in combination with the student's age in months and gender at the time of measurement, we used 2000 CDC BMI-for-age charts to classify students as underweight, normal weight, overweight, or obese.[15] Specifically, children with BMIs at or below the 5th percentile nationally for their age and gender are classified as underweight; those between the 5th and 85th percentiles are considered normal weight; children between the 85th and 95th percentiles are classified as overweight; and children at or above the 95th percentile are classified as obese. Though there is some debate in the public health literature over the best measure of adiposity in children (e.g., Cole et al., 2005; Mooney, Baecker, & Rundle, 2013), we use two measures in this analysis: BMI standardized by age and gender (*z*-BMI), and a 0-1 indicator of obesity (BMI at or above the 95th percentile).

Our achievement data tracks students longitudinally as they progress through school, linking them across years with anonymous identifiers. For students in grades K-12, the data includes school of record (in October, March, and June), gender, race/ethnicity, age, eligibility for free or reduced price meals, recent immigrant status, days in attendance, and participation in other educational programs (e.g., special education and/or ELL). Attendance rates were calculated as the number of days present as a percentage of days enrolled. For students in grades 3-8, scale scores on the state ELA and mathematics tests were standardized to a mean zero, standard deviation one scale within grade and year.

[15] See http://www.cdc.gov/growthcharts/clinical_charts.htm. The most recent growth charts are current as of 2000-01.

3.2 BIC implementation in New York City

Figure 1 shows the number of NYC schools adopting BIC by month for the period 2007-08 to 2011-12.[16] (One school adopted the program on a pilot basis in fall 2006). Though the NYCDOE supplies meals to public, charter, and private schools, in this paper we focus only on regular public schools serving students in grades K-12. Pre-kindergarten, alternative, and special education schools are excluded. As Figure 1 illustrates, the largest number of BIC adoptions occurred in early 2010-11, although a significant number of schools began the program in 2008-09 and 2009-10. It is worth noting that not all schools adopted BIC at the start of the school year; many implemented mid-year. Figure 2 shows the cumulative number of BIC schools by month. By the end of 2010-11, nearly 200 had implemented BIC; by summer 2012, 289 schools had adopted the program, with an average daily participation of more than 36,000 students.[17]

Importantly, not all adopted BIC school-wide. In some cases the program appears to have been targeted to specific grade levels or to a subset of classrooms within the school.[18] Unfortunately, data linking specific students or classrooms to BIC adoption is unavailable, and we lack information about the process used by schools to determine which classrooms participate in BIC. As a proxy, we use a measure of within-school BIC "coverage," calculated as the percentage of all classrooms in the school offering BIC. Under an assumption of uniform class sizes, this measure could be interpreted as the probability a randomly drawn student at the school was in a classroom that offered BIC.[19] Figure 3 shows the distribution of the coverage measure for the 156 elementary and middle schools

[16] Figures 1-2 are a description of *all* schools in NYC that adopted BIC at any time during this period, not all of which appear in our analytic sample of students. Moreover, because our student-level data only covers years through 2010-11, none of the adoptions in 2011-12 contribute to our main estimates. We provide counts of schools in our student samples in Section 5.

[17] If one included private, charter, pre-kindergarten, alternative, and special education schools in this count, the total would rise to 353 schools and an average daily participation of about 42,000.

[18] We do have information from the Office of School Food database about the specific grades participating in BIC, and are currently estimating models that use indicators of grade-specific participation. This analysis was not available at the time of this draft, however.

[19] It is less clear what this measure means in middle schools, where students may move between classes during the day. We are currently uncertain whether the denominator in these schools (total classrooms) represents the total number of first-period classes, or the total number of classes offered throughout the day.

that adopted BIC prior to June 1, 2011.[20] About 21 percent of these schools adopted the program school-wide, and another 13 percent implemented in a majority of classrooms (50 to 99%). The remainder implemented BIC in fewer than 50% of all classrooms.

Table 1 presents descriptive statistics as of 2011-12 for schools that adopted BIC any time prior to June 30, 2012 and for those that never adopted BIC during this period.[21] BIC schools were somewhat larger, on average, and enrolled a greater percentage of students eligible for free or reduced price meals (74.3% versus 68.3%). BIC schools had a modestly higher share of black and Hispanic students, on average, but had fewer white and Asian students, and a greater percentage of ELLs and students receiving special education. The distribution of students across grade levels was approximately the same in BIC and non-BIC schools. Average daily participation in the school lunch program was nearly the same in these schools (68.7% and 67.2% respectively), while breakfast participation was noticeably higher in BIC schools; the latter in part reflects a BIC treatment effect demonstrated in Section 5.1. BIC schools were about 3 percentage points more likely to be a UFM school. BIC schools were represented in all five boroughs of the city, but disproportionately located in the Bronx (31.1% of BIC schools versus 20.5% of non-BIC schools).

3.3 Sample selection

Our analysis involves several overlapping samples of schools and students. First, to estimate the impact of BIC adoption on meals program participation, we use school-level data for the universe of public schools that provided breakfast or lunch to students at any time between 2001-02 and 2011-12. This represents 1,068 to 1,453 schools enrolling 970,000 to 1,030,000 students each

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[20] This subset corresponds most closely to our analytic sample of students. The distribution of coverage for all 289 BIC schools is available upon request.

[21] In Table 1 we use official statistics provided by the NYCDOE in its school Demographic Snapshot, rather than aggregate student-level data. ADA, UFM status, and meal program participation rates are taken from data provided by the Office of School Food. As in Figures 1-2, this table refers to *all* schools that adopted BIC during this period. Descriptive statistics for the students in our analytic sample are provided in Table 3.

year, and excludes private, charter, pre-K, alternative, and citywide special education schools (known in NYC as District 75 schools), suspension centers, and other special programs such as those for teens with children. For some models we limit this sample to the 2006-07 to 2011-12 period, years for which we also have school-level demographics (race/ethnicity, percent female, percent ELL and special education, and percent eligible for free and reduced price meals). The number of BIC schools in these samples corresponds to those in Figures 1-2.

To estimate the impact of BIC on obesity and BMI, we use individual data for all students in grades K-8 with *Fitnessgram* measures between 2007-08 and 2010-11. Students with biologically implausible BMI values are excluded, as are those in charter, alternative, special education, and high schools.[22] Additionally, students in schools where *Fitnessgram* coverage is lower than 50 percent for the year are excluded. Panel (A) of Table 2 shows counts of schools and students in our analytic *Fitnessgram* sample by BIC adoption status and year.[23] Across years, this sample includes 156 and 1,002 unique BIC and non-BIC schools, respectively. There are approximately 350,000 student-year observations in BIC schools and 2.1 million in non-BIC schools. About 118,000 student-years in BIC schools are observed after implementation of BIC, as the column labeled "BIC treated" indicates.

Our achievement samples are defined analogously to the *Fitnessgram* sample, consisting of students in regular public schools between 2007-08 and 2010-11. However, because state tests are only administered to students in grades 3-8, our achievement sample is restricted to these grades. (In models with controls for lagged test scores, we restrict the sample further to students in grades 4-8). Panel (B) of Table 2 shows counts of schools and students in our analytic math sample by BIC

[22] Conversations with the NYCDOE and the NYC Department of Health and Mental Health have raised concerns about the quality of *Fitnessgram* data in high school. Whereas height and weight measurements in elementary and middle schools are taken by school staff (e.g., the school nurse or P.E. teacher), they are frequently self-reported in high school. Our concern about measurement error in the high school data led us to exclude these students from our current paper.
[23] To be counted as "Ever BIC" in this panel, the school must have adopted BIC prior to its *Fitnessgram* measurement date in 2010-11.

adoption status and year. (Reading sample sizes are very similar. In the interest of space, we do not report these in Table 2). Across all years, the math sample includes 153 and 1,009 unique BIC and non-BIC schools, respectively, and about 80 to 85 percent as many student-year observations as in the *Fitnessgram* sample.

Table 3 provides descriptive statistics for our student samples.[24] For the most part, these mirror the school-level averages in Table 2, with students in BIC schools more likely to be black or Hispanic, low income, receiving special education, and limited English proficient. (Recall that Table 2 represents a broader sample of schools, including high schools and BIC adoptions through 2011-12, which accounts for most of the differences). Table 3 also reveals that students in schools adopting BIC were lower-achieving, on average, with mean ELA and math scores 0.13 to 0.16 s.d. below those of schools that never adopted BIC. Students in BIC schools were also more likely to be obese, with 22 percent above this threshold (versus 20.6% in never-BIC schools).

4. Empirical strategy

Our main identification strategy is a difference-in-difference design, using school fixed effects and student-level covariates to contrast observationally similar students in schools that did and did not adopt BIC, before and after implementation. This approach allows for the possibility of non-random selection of schools into the program on the basis of fixed, unobserved characteristics that are also correlated with the outcome of interest (e.g., obesity, meals program participation). Consistent identification of causal effects requires the absence of unobserved, time-varying effects that coincide with the adoption of BIC. We provide some graphical verification of this assumption in Figure 4, and tests for "effects" on exogenous covariates in Appendix Table 1 (which might be

[24] The unit of observation is a student-year.

indicative of differential trends across groups of schools), but defer more formal tests for a future draft.

Each of our student-level models takes the following general form for outcome Y_{igst} (obesity, *z*-BMI, math score, reading score, attendance, etc.) for student *i* in grade *g*, school *s*, and year *t*:

$$(1) \qquad Y_{igst} = \delta * BIC_{st} + \beta' \boldsymbol{X}_{it} + \alpha_t + \gamma_{sg} + u_{it}$$

$\boldsymbol{X}_{it}$ is a vector of student covariates potentially related to both the outcome *Y* and school-level adoption of BIC. These include age in months (for the *Fitnessgram* models, applicable to the date of measurement), gender, race/ethnicity, limited English proficiency, special education status, and eligibility for free or reduced price meals or enrollment in a UFM school (which can vary over time). Value-added specifications of the achievement models also include lagged math or reading scores in this vector of controls. a_t, are year effects and γ_{sg} are school-grade fixed effects. BIC_{st} is defined below. Standard errors are adjusted for clustering at the school, grade, and year level.

Our model for meals program participation is similar to the one in (1), but estimated using annual data at the school and meal level:

$$(2) \qquad \left(\frac{ADP_m}{ADA} * 100\right)_{mst} = \delta * BIC_{st} + \beta' \boldsymbol{W}_{st} + \alpha_t + \gamma_s + v_{st}$$

In (2), the dependent variable is the average daily participation rate for meal *m* (breakfast or lunch) in school *s* and year *t*, defined as the average number of *m* meals served per school day (ADP_m) divided by average daily attendance (*ADA*) and multiplied by 100. This can be thought of as the percent of students in attendance who take a meal *m* on an average day in school *s* in year *t*. a_t and γ_s are defined as in (1), and $\boldsymbol{W}_{st}$ is a vector of school-level covariates, including total enrollment, percent female, percent by race/ethnicity, percent ELL, percent receiving special education, percent eligible for free meals, and percent eligible for reduced price meals. ($\boldsymbol{W}_{st}$ is only available from 2006-07 forward).

Our BIC_{st} treatment is defined in two ways. The first is a simple indicator variable that is equal to one for student *i* (or school *s*) when his or her school adopted BIC prior to the outcome date in year *t* (e.g., *Fitnessgram* measurement or test date), and zero otherwise.[25] As noted in section 3.2, not all NYC schools adopted BIC on a school-wide basis. We wished to allow for the likely possibility that effects vary depending on the extent of BIC implementation. To this end, our second treatment measure is an interaction between the BIC indicator and "coverage" defined as the percent of all classrooms in the school offering BIC (illustrated in Figure 3). This variable ranges from zero (no BIC implementation) to 100 (full school implementation).

All estimates from our student-level models should be interpreted as "intent-to-treat." In treated schools, all or at least a fraction of students are *offered* BIC in their classroom. Students are not required to participate, and may refuse the free breakfast. There is sure to be non-random selection of students into BIC *within* treated schools. Moreover, the overall BIC effect can conceptually be thought to operate through at least four channels: (1) BIC encourages some students to participate in the SBP who previously did not; (2) BIC alters the content, timing, and location of breakfast for students who already participated; (3) BIC affects the classroom climate for *all* students in BIC classrooms, regardless of whether they participate; and (4) BIC affects perceptions of the school meals program even for students in classrooms not offering BIC, perhaps through a change in stigma. (For an example of the latter type of effect, see Leos-Urbel et al., 2012).

[25] This treatment variable is defined for students currently enrolled in school *s* in year *t*. To the extent students are mobile across schools over time, it is possible that students in a treatment school in year *t* attended a different (non-treatment) school in prior years. By the same token, students in a non-treatment school in year *t* may have attended a BIC school in prior years. We do not control for such movement in our current models. In general, this form of mobility would tend to bias our estimates toward zero.

In this paper, we do not attempt to decompose the effects of BIC into the above channels. Rather, our estimates should be viewed as the net effect of BIC adoption on students in schools that opt to adopt it. Additionally, in this version of the paper we do not explore how BIC effects vary with "dosage," defined as the length of time students have been offered the program. We have computed dosage using the total number of school days a student has been in a school *s* offering BIC prior to the measurement date in year *t*, and in future revisions will incorporate this treatment heterogeneity into our analysis.

5. Results

5.1 The impact of BIC on school meals program participation

Figure 4 illustrates the long-run trend in meals program participation in BIC and non-BIC schools during our study period. For BIC schools we centered the series at t=0, the year just prior to the school's adoption of the program (indicated with a dotted line). For "never BIC" schools, t=0 corresponds to the 2007-08 school year, the year before the modal school adopted BIC. The lines represent simple, unadjusted mean participation rates across schools in each group. The level and trends in breakfast participation rates were remarkably similar between BIC and non-BIC schools prior to the start of the program. In each group, breakfast participation averaged 20 to 21 percent of ADA in the years leading up to BIC, increasing at a steady annual rate of 1 percentage point per year. After BIC implementation, however, participation rates in BIC schools more than doubled, on average, while those in non-BIC schools plateaued at 21-22 percent.

We observe comparatively small changes in average lunch program participation after BIC adoption. Prior to the start of the program, lunch participation rates were consistently 2 to 3 points higher in BIC schools than non-BIC schools, which is not surprising given the former enrolled a larger share of students eligible for subsidized meals. After implementation, lunch participation rose about 8 to 10 percentage points more, on average, in BIC schools than in non-BIC schools. (As shown below, this difference was driven entirely by high schools).

Figure 5 illustrates trends over time in meal program participation for BIC schools separately by level (elementary, elementary/middle, middle, and high school). As is often the case, participation rates decrease as students get older. Prior to the start of the program, breakfast participation was below 15 percent in middle and high schools, and between 20-25 percent in elementary schools. After BIC implementation, participation rates increased at all levels. The absolute change in mean participation was similar across school levels, but the greatest change in participation proportionately was observed at the middle school level. Almost all of the change in lunch program participation appears to have occurred at the high school level, schools that are excluded in our student-level analyses.

Moving beyond descriptive changes in mean participation rates, we fit the regression model shown in (2) to estimate impacts of BIC adoption on participation. As a reminder, these models all include school fixed effects, so that coefficient estimates are identified off of changes within schools over time. The results are shown in Tables 4a (breakfast) and 4b (lunch). In these tables, each cell is the result of a separate regression using the specification indicated on the left and the sample indicated by the column header. The first panel of models uses 11 years of data with school and year effects only, and no school covariates. The second uses data from 2005-06 forward with school and year effects only, serving as a bridge between the first and third panels. The third panel uses data from 2005-06 forward and adds school covariates to the model. In practice, the different samples and specifications have very little impact on the results.

The point estimates in Tables 4a and 4b are highly consistent with the trends shown in Figures 4-5. Across all schools, we find BIC increased breakfast participation rates by about 12.5 to 13.4 percentage points on average, on a baseline rate of 19.4 percent. (All of the effects described in

Table 4a are statistically significant at the 0.001 level). The size of the effect varied across grade levels, ranging from a 7.7 to 8 percentage point increase in high school to a 13.8 to 14.9 percentage point increase in middle school (again, proportionately the largest effect when compared to a baseline rate of 12.5 percent). The impact was also larger in schools with greater BIC coverage, as rows (2), (4), and (6) indicate. To estimate the impact of full-school participation, one can multiply these coefficients by 100 finding that full-school BIC increased breakfast participation rates by 20 to 30 percentage points, depending on the grade level.

As suggested in Figure 4, Table 4b finds little effect of BIC on lunch participation rates. Across all schools, we find a statistically insignificant reduction in lunch participation of less than one half a percentage point. We do observe small effects when disaggregating by school level; for example, BIC adoption is associated with a 0.9 percentage point increase in lunch participation at the elementary level ($p<.10$), on an already-high baseline of 82 percent, and a 2.3 percentage point decrease at the middle school level ($p<.10$). Taken together, however, there is little evidence to suggest that BIC had much if any impact on lunch participation, say, by crowding out lunch consumption or reducing stigma associated with the lunch program.

5.2 The impact of BIC on obesity and BMI

Our estimates of the impact of BIC on obesity and BMI are reported in Table 5. All of our student-level impact estimates in Tables 5 through 9 are presented in a manner similar to this one, with each cell reporting the results from a different model. In the results reported in rows (1) and (3), the BIC treatment is specified as a dichotomous variable equal to one in school-years after BIC has been implemented, while in rows (2) and (4), the treatment varies with the extent of coverage in the school. Because coefficient estimates for the treatment and covariates tend to vary by gender, we divide the sample into male and female subsamples, and report separate estimates for all grade levels

(K-8), elementary students only (K-5), and middle school students only (6-8). All models include student covariates, year effects, and school-grade effects. Standard errors adjusted for clustering at the school, grade, and year level are reported in parentheses.

We find little evidence that BIC increased obesity rates, and some evidence that it reduced it among girls, although nearly all of the estimated effect sizes are small (Panel A of Table 5). For example, in our combined sample we find a very small, statistically insignificant reduction in the likelihood of being obese of 0.39 percentage points for girls and 0.03 points for boys (on a baseline of 22 percent). The effect appears to vary by school level, with middle school girls experiencing a comparatively larger 2.4 point reduction in the likelihood of being obese—a statistically significant and sizable effect—and girls in elementary school a small (and insignificant) increase in the likelihood of being obese of 0.48 percentage points. We find no significant effects of BIC on obesity for boys, at either the elementary or middle school level.

Allowing the treatment to vary with the level of classroom coverage in a school largely accentuates these results. For example, in our pooled sample, girls in schools in which 100 percent of classrooms were offered BIC saw a statistically insignificant 0.57 percentage point reduction in their likelihood of being obese (the "BIC coverage" coefficient multiplied by 100), while boys saw a 0.21 point decrease in their likelihood of being obese. The effects of BIC in reducing obesity rates in middle school is also larger in full school settings, with girls fully 5.3 percentage points less likely to be obese in middle schools offering BIC school-wide ($p<.05$), and boys about 1.6 points less likely (the latter is statistically insignificant). In elementary school, we find a small but significant increase in obesity rates for girls of 1.2 percentage points in schools that adopted BIC school-wide ($p<.10$).

As a threshold measure, obesity may not be ideal for detecting effects on student weight throughout the distribution. In Panel B of Table 5, we repeat the above analysis but with BMI standardized by age and gender as our outcome of interest (*z*-BMI). The results reported here are fully consistent with those shown in Panel A for obesity. In the pooled sample, BIC appears to have a small and statistically insignificant effect on BMI for both girls and boys. When allowing this effect to vary by school level, however, we find that BIC reduced BMI among middle school girls (by 0.05 s.d., which is obtained by dividing the coefficient by 100; $p<0.10$) and for boys (0.013 s.d.), with the latter being statistically insignificant. Here we again find that full school implementation was associated with larger effects. For example, the reduction in BMI among girls in schools that adopted BIC school-wide was estimated to be a larger 0.11 s.d., though this effect falls below statistical significance. The rise in BMI among elementary school girls is also larger in full BIC schools, at about 0.03 s.d. ($p<.10$).

5.3 The impact of BIC on student achievement

Table 6 reports our estimates of the impact of BIC on student achievement in ELA and mathematics. As explained in Sections 3-4, the regression models estimated here are virtually the same as those in Table 5, although the samples differ somewhat, with only tested students in grades 3-8 included. These achievement models all include lagged test scores as a covariate, which further restricts the sample to students in grades 4-8. To facilitate the reading of our coefficient estimates and standard errors, the units in this table are in hundredths of a standard deviation; divide by 100 to obtain s.d. units.

We find mixed evidence of an impact of BIC on achievement, with most of the effects positive but statistically insignificant. The notable exceptions are for boys, in ELA in grades 4-5 and math in middle school. In our combined sample, the overall effect of BIC on ELA achievement is an insignificant 0.008 s.d. for girls and 0.016 s.d. for boys ($p<.05$). In math, the analogous estimates are 0.003 s.d. for girls and 0.011 s.d. for boys (both insignificant). As was the case for obesity and BMI, BIC effects on achievement appear to vary by gender and grade level. Our largest point estimates are for elementary school boys in ELA, at 0.022 s.d., and middle school boys in math, at 0.024 s.d. All coefficient estimates for girls are statistically insignificant at conventional levels. The effects of BIC on achievement again appear to vary with the extent of classroom coverage in the school, although even for students in schools with full coverage the effects appear to be small. For instance, for boys in grades 4-5, school-wide BIC adoption is associated with a statistically significant 0.046 s.d. increase in ELA scores ($p<.05$). For girls, school-wide adoption is associated with a 0.019 s.d. increase in ELA scores, though the effect is statistically insignificant.

Taken together, the estimated effects of BIC on achievement are mixed and generally small. Boys in grades 6-8 appear to benefit most in math, scoring about 0.024 s.d. higher, when their school has adopted BIC. Similarly, boys in grades 4-5 score higher in ELA, especially in high-coverage schools. Girls do not appear to perform much better or worse on standardized tests with the adoption of BIC. Most of our coefficient estimates are positive in this case, but statistically insignificant (and small in size). In all cases these effects are considerably smaller than those estimated in previous work (Imberman & Kugler, 2012; Dotter, 2012). Although it remains unclear why our estimates depart from earlier studies, a possible explanation is weaker compliance with BIC in NYC schools. Table 4a documented a substantial increase in SBP participation in BIC schools, but the increase remained below that observed in San Diego. In that study SBP participation surpassed 90 percent under the BIC program, well above what is observed in NYC. Our findings are also consistent with Dotter in the respect that he found no effects in schools that already offered universal free breakfast, a condition that has existed district-wide in NYC since 2003 (Leos-Urbel et al., 2012).

5.4 The impact of BIC on attendance and perceptions of the school environment

Table 7 repeats the above analyses for student attendance rates, measured as the number of days present as a percentage of days enrolled. In this case all of the estimated effects are positive, and nearly all are statistically significant. For example, in our combined sample we find attendance rates were 0.126 percentage points higher for girls, on average, after the adoption of BIC in their school, and were 0.185 points higher for boys. The estimated effects are larger in middle school, at 0.208 points for girls and 0.266 for boys. These effects appear to be greater still in schools with full BIC coverage. For instance, girls' attendance rates in middle schools that adopted BIC school-wide were 0.45 percentage points higher, on average, and boys' attendance rates were 0.61 points higher.

While our study is the first to find a beneficial effect of BIC on student attendance, it should be noted that our estimated effect sizes are small. In elementary school, attendance rates are already high (about 92 percent in schools that ever adopted BIC), and in middle school they are about four points lower (88 percent). Assuming a 180-day school year, a 0.50 percentage point increase in attendance translates into 0.9 school days. Thus, the average effect of 0.13 to 0.19 percentage points found here amounts to about one quarter to one third of a school day.

As a first look at the socializing effects of the BIC program, we used the individual responses of middle school students to the NYC School Survey to test for differences in student attitudes toward their school, classroom, and teacher after the introduction of BIC. The results are reported in Table 9 for four survey questions: "I feel welcome in my school," "Most of the adults I see at school every day know my name or who I am," "My teachers encourage me to succeed," and "I am safe in my classes." The dependent variable in each case is equal to one if the student agreed or strongly agreed with the statement, and equal to zero otherwise. Across these survey questions, we find small and mostly positive effects of BIC on student perceptions of their school – particularly for boys. Middle school boys are 1.4 points more likely to agree that their teacher encourages them to succeed ($p<.01$) and 1.5 percentage points more likely to state that they feel safe in their class ($p<.05$).

5.5 A test for an "impact" of BIC on height

In Table 5, we found little evidence that adoption of Breakfast in the Classroom in NYC was associated with higher obesity rates. Most of our estimates were both statistically and practically insignificant. However, we did find some evidence of a reduction in obesity rates among middle school girls after the adoption of BIC, and a (less sizable) increase in obesity among elementary school girls. Although child nutrition is associated with height over the long-run, presumably any short-run impact of BIC on BMI that we observe must operate through weight. As a form of falsification test, we repeated our analysis of Table 5 using height in inches as the outcome of interest; our estimates are reported in Table 9.

For the most part, we do not observe any association between BIC adoption and height. For boys there is no apparent effect in our combined sample of students in grades K-8, and no effect in either the elementary or middle school subsamples. For girls, however, we do find a positive "effect" of BIC adoption on height in grades 6-8. The effect is small—only 0.36 inches—but is statistically significant at the .01 level, and is larger in schools with 100% coverage, at 0.93 inches. While such an effect could arise by chance, a positive effect on height would mechanically result in lower BMI. A back-of-the-envelope calculation, for example, indicates that an increase in height of 0.36 inches for a 90-pound child would decrease her BMI by about 0.20. Whether or not this effect is large enough to explain our observed reduction in BMI among middle school girls after the adoption of BIC will be addressed in a future revision.

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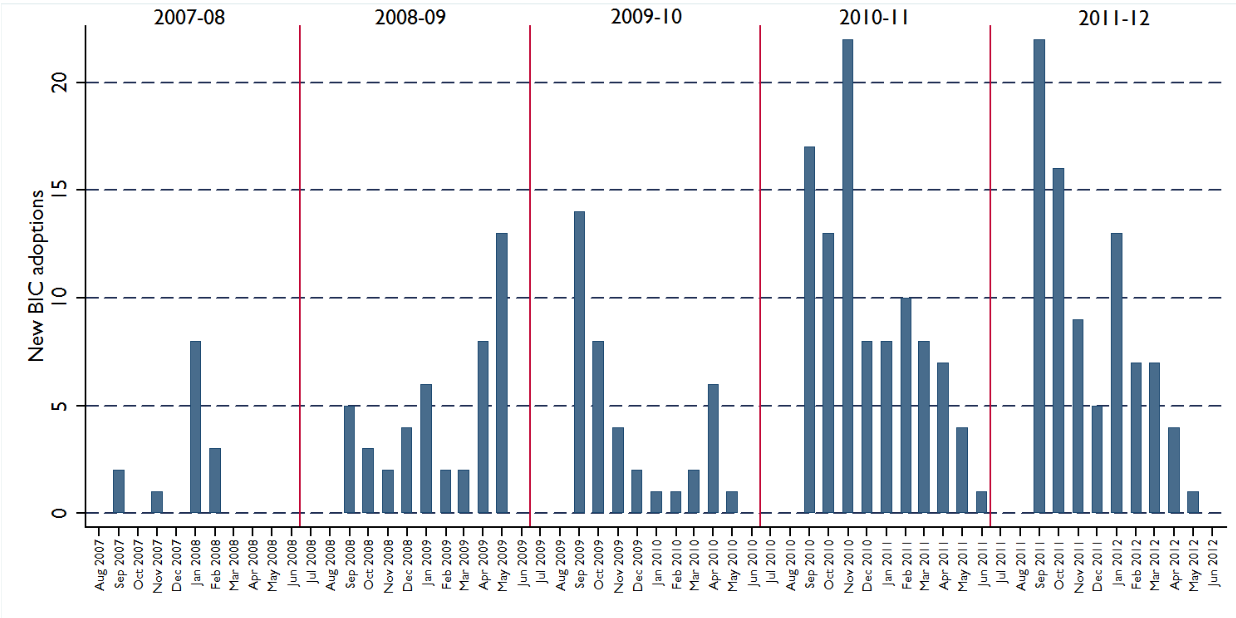
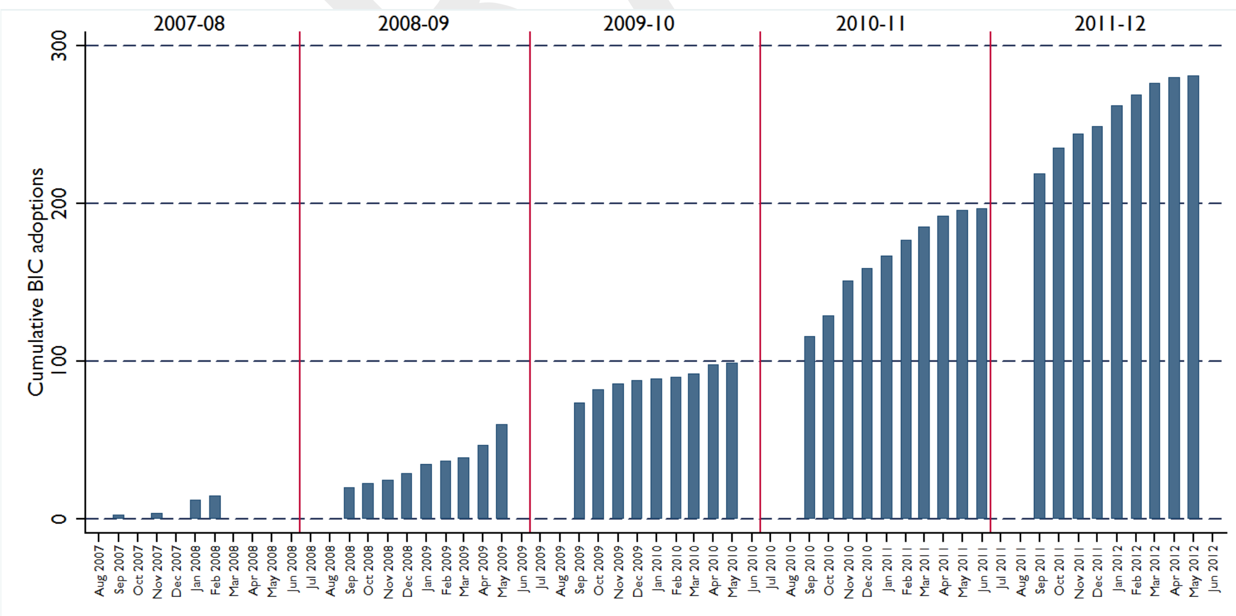
Figure 1: New Breakfast in the Classroom Adoptions by Month, New York City



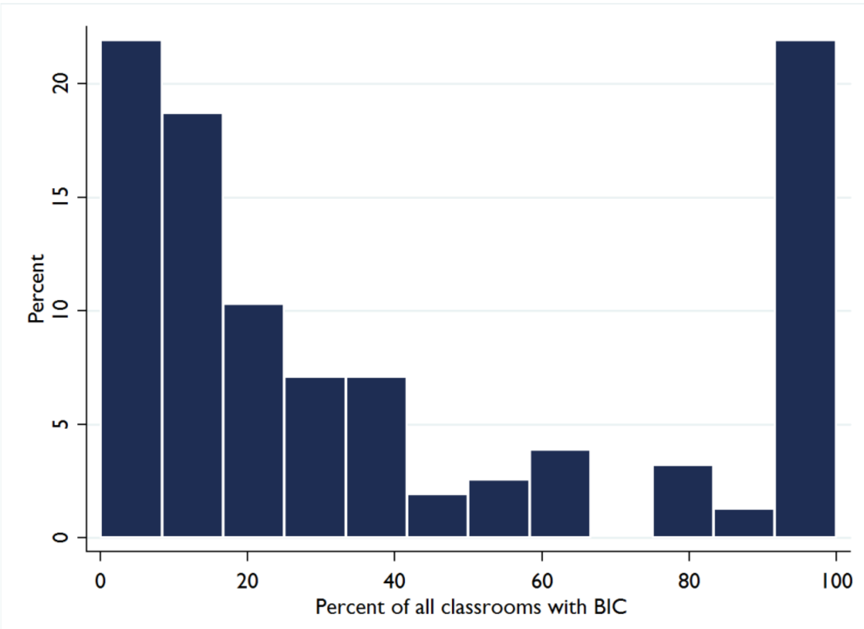
Notes: reflects all schools adopting BIC prior to June 30, 2012, with the exception of one that adopted the program in Fall 2006. Only regular public schools serving grades K-12 are included. Private, charter, alternative, and special education (District 75) schools are excluded, as are suspension or other special programs.

Figure 2: Cumulative Breakfast in the Classroom Adoptions by Month, New York City



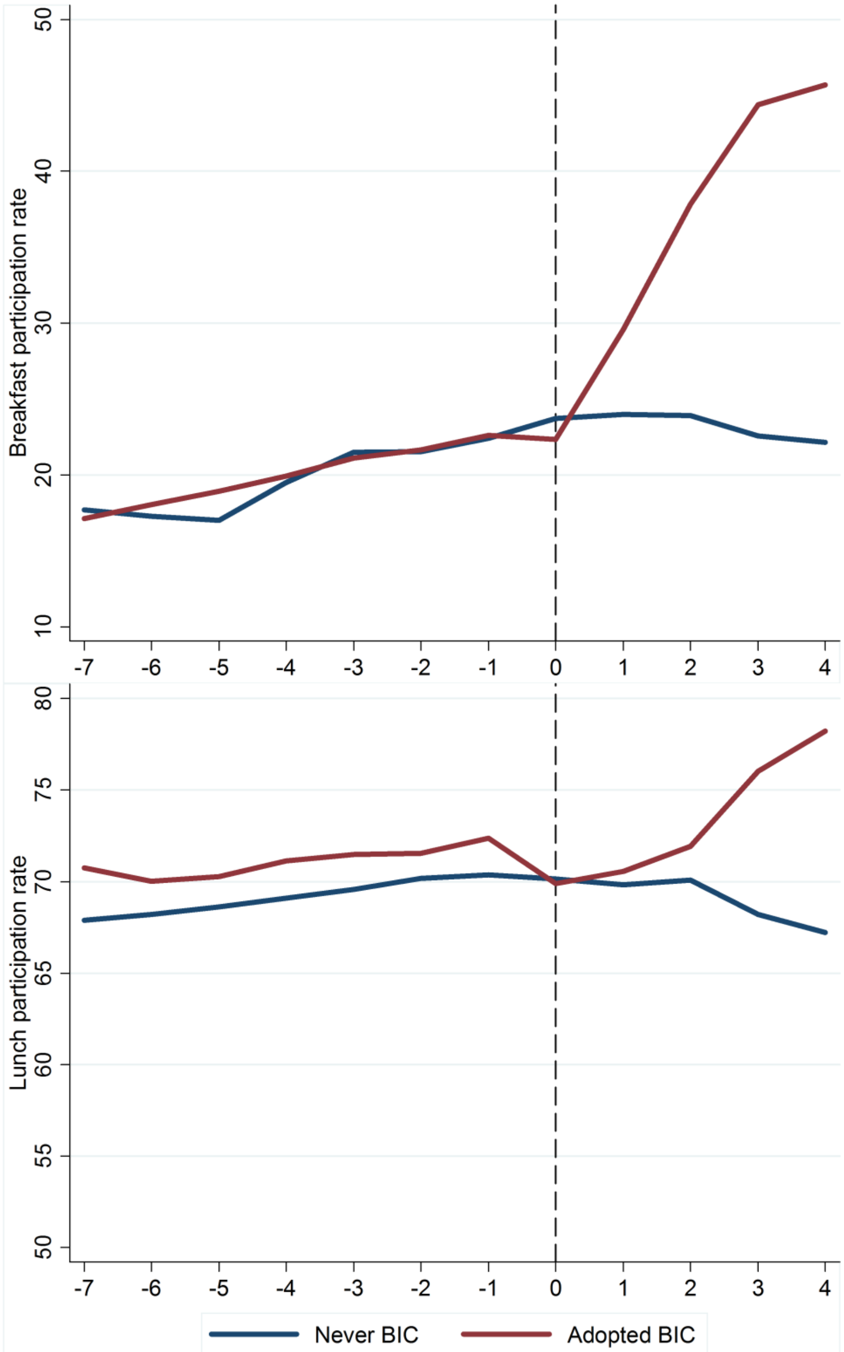
Notes: reflects all schools adopting BIC prior to June 30, 2012, with the exception of one that adopted the program in Fall 2006. Only regular public schools serving grades K-12 are included. Private, charter, alternative, and special education (District 75) schools are excluded, as are suspension or other special programs.

Figure 3: BIC Coverage, Schools Adopting Prior to June 2011



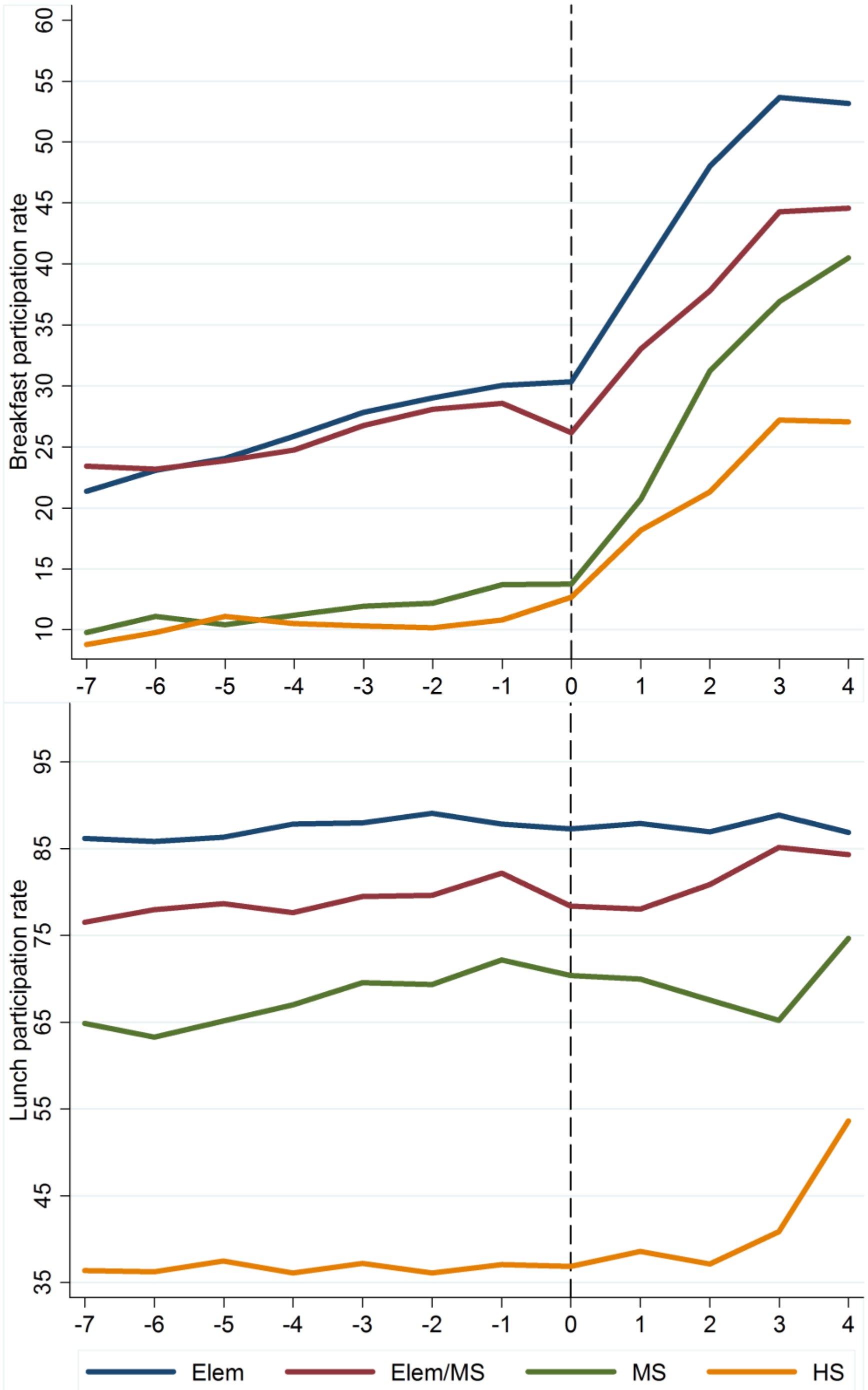
Notes: includes 156 elementary and middle schools that adopted BIC prior to June 1, 2011.

Figure 4: Mean Breakfast and Lunch Participation Rates



Notes: uses an unbalanced panel of schools. For schools adopting BIC, year zero is the school year prior to adopting BIC. For schools never adopting BIC, year zero is the 2007-08 school year (the modal year of BIC adoption was 2008-09).

Figure 5: Breakfast and Lunch Participation Rates of Schools Adopting BIC, by Level



Notes: uses an unbalanced panel of schools. Year zero is the school year prior to adopting BIC.

Table 1: Descriptive Characteristics of Schools by BIC Adoption Status

	Ever BIC	Never BIC
Register	755	644
Average daily attendance	669	586
Percent eligible for FRPL	74.3	68.3
Percent ELL	16.1	13.8
Percent special ed	16.4	14.8
Percent Asian	10.0	12.3
Percent black	34.3	32.9
Percent Hispanic	45.7	40.4
Percent white	9.1	13.3
Percent male	50.7	50.5
Percent enrollment Pre-K	2.7	2.7
Percent enrollment grades K-5	44.8	47.0
Percent enrollment grades 6-8	23.8	22.7
Percent enrollment grades 9-12	28.6	27.6
Breakfast participation rate	35.9	22.1
Lunch participation rate	68.7	67.2
UFM school	26.0	23.2
School starting time	8:13 am	8:15 am
Brooklyn	27.3	32.6
Manhattan	21.1	19.2
Queens	15.6	23.2
Staten Island	4.8	4.5
Bronx	31.1	20.5
N	289	1,164

Notes: “never BIC” refers to schools that never adopted Breakfast in the Classroom through 2011-12; “ever BIC” refers to schools that adopted Breakfast in the Classroom at any time before June 30, 2012. Only regular public schools serving grades K-12 are included. Private, charter, alternative, and special education (District 75) schools are excluded, as are suspension or other special programs.

Table 2: Counts of Schools and Students in Analytic Samples

	Never BIC		Ever BIC		BIC Treated	
	Schools	Students	Schools	Students	Schools	Students
Fitnessgram:						
2007	548	315,782	83	48,556	0	0
2008	711	394,231	109	62,551	3	2,075
2009	854	431,145	142	74,053	30	10,491
2010	928	466,769	150	81,191	78	37,903
2011	948	517,676	153	90,637	141	67,936
Unique schools / total students	1,002	2,125,603	156	356,988	141	118,405
Math:						
2007	898	343,033	143	61,794	0	0
2008	911	333,625	146	59,546	10	4,799
2009	929	326,366	151	59,073	31	11,465
2010	949	326,713	150	58,974	83	33,360
2011	966	356,079	151	64,502	148	63,116
Unique schools / total students	1,009	1,685,816	153	303,889	148	112,740

Notes: "never BIC" refers to schools that never adopted BIC through 2010-11; "ever BIC" refers to schools that adopted BIC at any time before the Fitnessgram measurement date or test date in 2010-11; "BIC treated" refers to student-years observed after BIC adoption. School and student counts in the ELA achievement models are not shown, as they are very similar to the math sample. (Slightly fewer students take the ELA exam than math—about 1.8% of the "never BIC" sample, and 1.6% of the "ever BIC" sample).

Table 3: Descriptive Statistics for Students in Analytic Samples

	Fitnessgram sample		Math sample	
	Ever BIC	Never BIC	Ever BIC	Never BIC
Percent:				
Female	49.9	49.9	50.2	50.0
Asian	13.2	17.6	11.8	16.3
Black	31.2	27.1	32.1	29.4
Hispanic	42.7	38.5	43.2	39.1
White	12.8	16.8	12.7	14.9
Low income	88.8	84.9	88.1	85.3
English at home	58.9	57.5	58.9	57.3
Foreign born	12.5	13.2	14.8	16.0
LEP	15.0	14.0	12.2	11.5
Special education	12.5	11.8	13.0	12.3
Grade KG	10.3	11.0	-	-
Grade 1	11.7	12.3	-	-
Grade 2	11.7	12.0	-	-
Grade 3	11.3	11.8	16.2	17.0
Grade 4	10.8	11.1	16.1	16.8
Grade 5	10.7	11.0	16.3	16.5
Grade 6	11.1	10.0	17.0	16.2
Grade 7	11.1	10.3	17.2	16.6
Grade 8	11.3	10.5	17.4	17.0
z-BMI	0.0358	-0.0112	-	-
Percent Obese	22.0%	20.6%	-	-
Height (inches)	54.7	54.3	-	-
Attendance rate	-	-	92.3	93.1
ELA z-score	-	-	-0.1105	0.0248
Math z-score	-	-	-0.1333	0.0272

Notes: "ever BIC" refers to students in schools that adopted Breakfast in the Classroom at any time before the Fitnessgram measurement date or test date in 2010-11; "never BIC" refers to students in schools that never adopted Breakfast in the Classroom during this period. Math sample includes students in grades 3-8; however, "attendance rate" refers to students in grades K-8. Sample sizes are provided in Table 2.

Table 4a: Impact of BIC Adoption on Breakfast Participation

	All schools	Elementary	Middle	High
Years 2001-2012, school and year effects				
(1) Post BIC adoption	0.134***	0.147***	0.149***	0.080***
	(0.003)	(0.004)	(0.008)	(0.008)
(2) Post BIC x coverage (0 – 100)	0.003***	0.003***	0.003***	0.002***
	(0.000)	(0.000)	(0.000)	(0.000)
2006 forward, school and year effects only:				
(3) Post BIC adoption	0.127***	0.139***	0.138***	0.079***
	(0.004)	(0.005)	(0.010)	(0.008)
(4) Post BIC x coverage (0 – 100)	0.003***	0.003***	0.003***	0.002***
	(0.000)	(0.000)	(0.000)	(0.000)
2006 forward, adding covariates:				
(5) Post BIC adoption	0.125***	0.135***	0.138***	0.077***
	(0.004)	(0.005)	(0.010)	(0.009)
(6) Post BIC x coverage (0 – 100)	0.003***	0.003***	0.003***	0.002***
	(0.000)	(0.000)	(0.000)	(0.000)
N – school/year	14504	8673	3022	2746
Mean breakfast participation 2001-2012	0.194	0.241	0.125	0.097
N – school/year	9010	5188	1947	1866
Mean breakfast participation 2006 forward	0.218	0.271	0.149	0.115

Notes: each cell is a coefficient estimate from a separate regression. For example, in row (1), the reported coefficient is for the "post BIC adoption" indicator in a model estimated using an unbalanced panel of school observations spanning 2001-2012. In row (2), the reported coefficient is for the interaction of "post BIC adoption" and the percentage of classrooms in the school that adopted BIC. The columns represent various subsamples: all schools, elementary schools only (including elementary/middle combinations), middle schools only (including middle/high combinations) and high schools only. The dependent variable is the annual breakfast participation rate for a given school and year, measured as average daily breakfasts served divided by average daily attendance. Standard errors in parentheses (*** p<0.001).

Table 4b: Impact of BIC Adoption on Lunch Participation

	All schools	Elementary	Middle	High
Years 2001-2012, school and year effects				
(1) Post BIC adoption	-0.002	0.009*	-0.023*	-0.019
	(0.004)	(0.004)	(0.011)	(0.013)
(2) Post BIC x coverage (0 – 100)	0.000	0.000	0.000	-0.001**
	(0.000)	(0.000)	(0.000)	(0.000)
2006 forward, school and year effects only:				
(3) Post BIC adoption	-0.001	0.004	-0.012	-0.006
	(0.004)	(0.004)	(0.011)	(0.013)
(4) Post BIC x coverage (0 – 100)	0.000	0.000	0.000	0.000
	(0.000)	(0.000)	(0.000)	(0.000)
2006 forward, adding covariates:				
(5) Post BIC adoption	-0.002	0.004	-0.008	-0.006
	(0.004)	(0.004)	(0.011)	(0.013)
(6) Post BIC x coverage (0 – 100)	0.000	0.000	0.000	0.000
	(0.000)	(0.000)	(0.000)	(0.000)
N – school/year	14117	8329	2976	2755
Mean lunch participation 2001-2012	0.695	0.813	0.625	0.354
N – school/year	8785	4986	1920	1870
Mean lunch participation 2006 forward	0.706	0.822	0.663	0.382

Notes: each cell is a coefficient estimate from a separate regression. For example, in row (1), the reported coefficient is for the "post BIC adoption" indicator in a model estimated using an unbalanced panel of school observations spanning 2001-2012. In row (2), the reported coefficient is for the interaction of "post BIC adoption" and the percentage of classrooms in the school that adopted BIC. The columns represent various subsamples: all schools, elementary schools only (including elementary/middle combinations), middle schools only (including middle/high combinations) and high schools only. The dependent variable is the annual lunch participation rate for a given school and year, measured as average daily lunches served divided by average daily attendance. Standard errors in parentheses (*** $p<0.001$).

Table 5: Impact of BIC on Obesity and BMI

	All grade levels		K-5 only		6-8 only	
	Female	Male	Female	Male	Female	Male
Panel A: Impact on Obesity						
(1) BIC	-0.3947	-0.0331	0.4792	0.1978	-2.4098**	-0.5880
	(0.3680)	(0.2729)	(0.3190)	(0.3304)	(0.9460)	(0.4819)
(2) BIC coverage (0 – 100)	-0.0057	-0.0021	0.0121*	0.0031	-0.0527**	-0.0162
	(0.0087)	(0.0057)	(0.0068)	(0.0068)	(0.0263)	(0.0101)
Panel B: Impact on z-BMI						
(3) BIC	-0.6132	-0.1472	1.2889	0.3843	-4.9815*	-1.2787
	(1.0361)	(0.7580)	(0.9262)	(0.9170)	(2.6224)	(1.3222)
(4) BIC coverage (0 – 100)	-0.0077	0.0039	0.0319*	0.0172	-0.1136	-0.0305
	(0.0240)	(0.0156)	(0.0183)	(0.0189)	(0.0727)	(0.0266)
Student characteristics	Y	Y	Y	Y	Y	Y
Year effects	Y	Y	Y	Y	Y	Y
School * grade effects	Y	Y	Y	Y	Y	Y
Observations	1,238,134	1,243,590	850,377	856,284	387,757	387,306
R-squared for models (1) and (2)	0.036	0.033	0.033	0.034	0.042	0.031
R-squared for models (3) and (4)	0.060	0.047	0.055	0.050	0.072	0.043

Notes: Standard errors adjusted for clustering by school, grade, and year in parentheses (*** p<0.01, ** p<0.05, * p<0.1). Obese is defined as being above the 95th percentile nationally for one's gender and age in months, based on the 2000 CDC BMI-for-age charts. "BIC coverage" is the interaction of "post BIC adoption" and the percentage of classrooms in the school that adopted BIC. All Models control for age, race, low income status, LEP, immigrant, and special education status. Low income is measured by eligibility for free or reduced price meals or enrollment in a Universal Free Meal school. Age is measured in months at the time of the Fitnessgram measurements. We exclude charter school students, students attending citywide special education schools (District 75), students in schools where Fitnessgram coverage is less than 50 percent, and students with biologically implausible BMIs.

Table 6: Impact of BIC on ELA and Math Achievement

	All grade levels		4-5 only		6-8 only	
	Female	Male	Female	Male	Female	Male
Panel A: Impact on ELA z-score						
(1) BIC	0.8092	1.6052**	0.6921	2.1640**	0.9301	1.0647
	(0.740)	(0.722)	(1.140)	(1.098)	(0.962)	(0.953)
(2) BIC coverage (0 – 100)	0.0067	0.0122	0.0192	0.0463**	-0.0034	-0.0128
	(0.013)	(0.012)	(0.021)	(0.020)	(0.015)	(0.015)
Panel B: Impact on math z-score						
(3) BIC	0.3429	1.1383	-1.5412	-0.8139	1.4562	2.4192**
	(0.874)	(0.819)	(1.270)	(1.184)	(1.171)	(1.110)
(4) BIC coverage (0 – 100)	0.0061	0.0089	-0.0138	-0.0237	0.0192	0.0343
	(0.018)	(0.018)	(0.027)	(0.028)	(0.025)	(0.024)
Student characteristics	Y	Y	Y	Y	Y	Y
Year effects	Y	Y	Y	Y	Y	Y
School * grade effects	Y	Y	Y	Y	Y	Y
Observations	616,385	606,513	245,766	240,878	370,619	365,635
R-squared for models (1) and (2)	0.485	0.498	0.482	0.489	0.487	0.505
R-squared for models (3) and (4)	0.624	0.616	0.591	0.578	0.647	0.642

Notes: Standard errors adjusted for clustering by school, grade, and year in parentheses (*** p<0.01, ** p<0.05, * p<0.1). "BIC coverage" is the interaction of "post BIC adoption" and the percentage of classrooms in the school that adopted BIC. All Models control for lagged score, age, race, low income status, LEP, immigrant, and special education status. Low income is measured by eligibility for free or reduced price meals or enrollment in a Universal Free Meal school. We exclude charter school students and those attending citywide special education schools (District 75).

Table 7: Impact of BIC on Attendance

	All grade levels		K-5 only		6-8 only	
	Female	Male	Female	Male	Female	Male
(1) BIC	0.1257***	0.1847***	0.0685	0.1245***	0.2082**	0.2657***
	(0.0440)	(0.0440)	(0.0441)	(0.0441)	(0.0962)	(0.0981)
(2) BIC coverage (0 – 100)	0.0030***	0.0039***	0.0020**	0.0026***	0.0045**	0.0061***
	(0.0011)	(0.0011)	(0.0011)	(0.0011)	(0.002)	(0.0021)
Student characteristics	Y	Y	Y	Y	Y	Y
Year effects	Y	Y	Y	Y	Y	Y
School * grade effects	Y	Y	Y	Y	Y	Y
Observations	1,526,122	1,541,640	1,018,843	1,033,464	507,279	508,176
R-squared for models (1) and (2)	0.142	0.142	0.148	0.152	0.134	0.128

Notes: Standard errors adjusted for clustering by school, grade, and year in parentheses (*** p<0.01, ** p<0.05, * p<0.1). "BIC coverage" is the interaction of "post BIC adoption" and the percentage of classrooms in the school that adopted BIC. All Models control for age, race, low income status, LEP, immigrant, and special education status. Low income is measured by eligibility for free or reduced price meals or enrollment in a Universal Free Meal school. We exclude charter school students and those attending citywide special education schools (District 75).

Table 8: Impact of BIC on Middle School Students' Perceptions of the School Environment

	Q2		Q3		Q6		Q63	
	Female	Male	Female	Male	Female	Male	Female	Male
BIC	0.0054	0.0042	0.0195***	-0.0000	0.0022	0.0137***	0.0056	0.0150**
	(0.0060)	(0.0057)	(0.0073)	(0.0080)	(0.0047)	(0.0049)	(0.0065)	(0.0075)
Student characteristics	Y	Y	Y	Y	Y	Y	Y	Y
Year effects	Y	Y	Y	Y	Y	Y	Y	Y
School * grade effects	Y	Y	Y	Y	Y	Y	Y	Y
Observations	323,458	313,882	317,749	308,083	322,072	312,514	314,680	301,842
R-squared	0.049	0.034	0.067	0.062	0.024	0.023	0.059	0.043

Q2:	I feel welcome in my school.
Q3:	Most of the adults I see at school every day know my name or who I am.
Q6:	My teachers encourage me to succeed.
Q63:	I am safe in my classes.

Notes: Standard errors adjusted for clustering by school, grade, and year in parentheses (*** p<0.01, ** p<0.05, * p<0.1). All Models control for age, race, low income status, LEP, immigrant, and special education status. Low income is measured by eligibility for free or reduced price meals or enrollment in a Universal Free Meal school. We exclude charter school students, those attending citywide special education schools (District 75), and students in schools where fewer than 50 percent of students respond to the survey. Sample is limited to middle school students in AY 2007-2010.

Table 9: Test for Impacts of BIC on Height

	All grade levels		K-5 only		6-8 only	
	Female	Male	Female	Male	Female	Male
(1) BIC	0.1191**	0.0326	0.0131	0.0314	0.3622***	0.0456
	(0.0480)	(0.0295)	(0.0316)	(0.0299)	(0.1385)	(0.0679)
(2) BIC coverage (0 – 100)	0.0028**	0.0006	0.0003	0.0010*	0.0093**	-0.0003
	(0.0012)	(0.0006)	(0.0006)	(0.0006)	(0.0039)	(0.0013)
Student characteristics	Y	Y	Y	Y	Y	Y
Year effects	Y	Y	Y	Y	Y	Y
School * grade effects	Y	Y	Y	Y	Y	Y
Observations	1,238,134	1,243,590	850,377	856,284	387,757	387,306
R-squared for models (1) and (2)	0.825	0.819	0.714	0.704	0.226	0.321

Notes: Standard errors adjusted for clustering by school, grade, and year in parentheses (*** $p<0.01$, ** $p<0.05$, * $p<0.1$). Dependent variable is height in inches. "BIC coverage" is the interaction of "post BIC adoption" and the percentage of classrooms in the school that adopted BIC. All Models control for age, race, low income status, LEP, immigrant, and special education status. Low income is measured by eligibility for free or reduced price meals or enrollment in a Universal Free Meal school. Age is measured in months at the time of the Fitnessgram measurements. We exclude charter school students, students attending citywide special education schools (District 75), students in schools where Fitnessgram coverage is less than 50 percent, and students with biologically implausible BMIs.

Appendix Table: "Impact" of BIC on Exogenous Covariates

	All schools, 2006-2012	Schools in Fitnessgram sample, 2007-2011	Schools in ELA sample, 2007-2011
BIC adoption effect on:			
(1) Enrollment	-3.000	-	-
	(19.693)		
(2) Percent ELL	0.667***	0.325	0.247
	(0.169)	(0.274)	(0.275)
(3) Percent special ed	0.598***	0.948**	1.099***
	(0.137)	(0.298)	(0.321)
(4) Percent Asian	-0.098	-0.162	-0.333
	(0.112)	(0.178)	(0.180)
(5) Percent black	0.119	-0.043	-0.252
	(0.161)	(0.233)	(0.249)
(6) Percent Hispanic	<0.001	-0.220	0.563
	(0.170)	(0.255)	(0.292)
(7) Percent white	0.090	-	-
	(0.114)		
(8) Percent female	0.111	-0.295	-0.838**
	(0.122)	(0.232)	(0.264)
(9) Percent free meal eligible	0.374	-0.0193	-0.0130
	(0.462)	(0.0104)	(0.0956)
(10) Percent reduced meal eligible	0.183	-	-
	(0.151)		
(11) Percent immigrant	-	0.525**	0.878***
		(0.182)	(0.181)
(12) Lag z-score	-	-	0.0151
			(0.0130)
(12) Percent grade K-5	-0.224	-	-
	(0.208)		
(13) Percent grade 6-8	-0.241	-	-
	(0.291)		
(14) Percent grade 9-12	0.209	-	-
	(0.194)		
N of school-years	9,001	4,626	5,398

Notes: each cell is a coefficient estimate from a separate regression in which the indicated variable is regressed on year dummies, school fixed effects, and "post BIC," an indicator equal to one for schools that adopted Breakfast in the Classroom prior to the observed year (and zero otherwise). The columns represent various subsamples: all schools 2006-2012 (corresponding to our analytic sample in Table 2), schools in the Fitnessgram sample (corresponding to our sample in Tables 5a-5b), and schools in the ELA sample (corresponding to our sample in Table 6). Robust standard errors are in parentheses (*** p<0.01, ** p<0.05, * p<0.1).