Effect of Free School Meals on BMI and Student Attendance

Metro Atlanta Policy Lab for Education

Georgia Policy Labs

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September 2020

Working Paper

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ABSTRACT

We estimate the effect of new access to universal free school meals resulting from the Community Eligibility Provision (CEP) on child BMI and attendance. Under the CEP, schools with 40 percent or more of students who qualify for free school meals can offer free breakfast and lunch to all students. With administrative data from a large school district, we use student-level BMI measures from the FitnessGram© to compare within student outcomes before and after the implementation of the CEP across CEP-eligible and non-eligible schools. We find that exposure to the CEP increased BMI by about 0.07 standard deviations, equal to a 2-percentage point increase in the reference distribution or nearly 3 pounds. Effects were driven by students previously eligible for free lunches, suggesting a potential "stigma" reducing effect or increased program awareness may have a role. We also find that the program led to an increase in the share of "overweight" students but not in obesity. In addition to the CEP's effects on student weight outcomes, we also estimate the program's effect on absences but do not find that the CEP led to a statistically significant change in number of days absent from school.

1. Introduction

The National School Lunch Program (NSLP) is the second largest food and nutrition assistance program in the United States. During a typical academic year, children consume between one-third and one-half of their daily calories in school (Schanzenbach, 2009; Briefel et al., 2009). The National School Lunch and School Breakfast Programs together provide consistently available food for millions of children from low-income households. In fiscal year 2018, nearly 100,000 schools and residential childcare centers provided low-cost or no-cost lunches to 29.7 million children at an annual cost of $13.8 billion (FRAC, 2017). As COVID-19 keeps many students out of school, additional concerns exist that loss of access to this program will have deleterious effects on the health of low-income students across the country.

There is also, however, growing concern over the quality of food served and its impact on child health. The last major policy changes to address these concerns were under the Healthy Hunger-Free Kids Act (HHFKA) of 2010. In addition to increasing minimum school meal nutrition standards, the HHFKA introduced the Community Eligibility Provision (CEP).[1] Under the CEP, schools with 40 percent or more of their students identified as eligible to receive free school meals can opt to participate in the CEP, which allows those schools to serve free lunch and breakfast to their entire student body—independent of any individual student's previous application and take-up of meals. The CEP's primary purpose is to address low free and reduced-price (FRP) meal participation rates among many eligible children. The low levels of FRP meal take-up may be due to lack of program awareness, complexities of the application process, or stigma attached to free school meal participation. During the 2019-20 school year, 30,667 schools (69 percent of all eligible schools) across the United States opted to participate in the CEP, offering universal free meals to 14.9 million students (Maurice et al., 2020).

A pivotal question surrounding school meals is their effect on student health. Evidence on the impact of school meals on Body Mass Index score (BMI), a measure of weight for height, and obesity is mixed. Some studies suggest children receiving school lunches are more likely to have higher BMI than their peers (Schanzenbach, 2009; Millimet et al., 2010) while others find no evidence of an effect (Schanzenbach & Zaki, 2014). Schwartz et al. (2020) provide some evidence that National School Lunch Program improves weight outcomes for non-poor children who received free meals through a universal program in New York City Schools. Provision of universal school meals may also incentivize students to attend school and reduce absences (Schwartz et al., 2020; Gordanier et al., 2019).

[1] Please see the Appendix for a glossary of acronyms.

In this study, we estimate the impact of attending a CEP school on two main outcomes: child weight and absences in a school year. Our advantage over previous work is access to individual student-level measures of BMI before and after the program's implementation. These records come from FitnessGram© data and administrative records from a metro-Atlanta-area school district over seven years, spanning from 2012 to 2018. These data allow us to compare students in (treatment) schools that transitioned to universal free meals through the CEP to those in (control) schools that did not use the program before and after the program's implementation. Using a student-level fixed effects model, we estimate the impact of attending a school that participates in the CEP on student weight outcomes and the total number of days a child is absent during a school year. Further, our data allow us to compare effects for students who were or were not eligible for free and reduced-price meals before implementation, allowing us to differentiate effects on students who became eligible for free meals and those who were always eligible.

We find that attending a school that transitions to CEP increases child BMI by 0.065 standard deviations (or about 2 percentage points) on average, where standard deviations and percentile points are normed within age and sex to all children in the United States.[2] This translates into an average increase in body weight of just under 3 pounds. We find consistent effects across sex, suggesting that both boys and girls see an increase in weight following the introduction of universal free school meals. Estimating differences across students who were ever and never eligible for free and reduced-price lunch during the pre-CEP period suggests that the CEP's weight effects are largely driven by students who were eligible for free meals prior to the CEP. These results are consistent with, but not sufficient to confirm, either a reduction in free school meal participation stigma or an increase in the take-up of free meals among previously eligible students, though we note that as in other studies we cannot observe whether students ultimately take no cost meals or not.

In addition to the CEP's impact on direct measures of BMI, we also estimate the program's effect on the probability of falling within the underweight, normal weight, overweight, and obese weight ranges. That is, an increase in average weight might be beneficial if accumulated among students who were previously underweight. Conversely, this average weight gain might be deleterious if it accrued among students who were previously overweight. We find that the implementation of the CEP decreases a student's probability of being normal weight by 1.8 percentage points while increasing the likelihood that

[2] Reference categories for BMI for age (z-scores and percentiles) are taken from 2000 CDC Growth Reference charts. Thus, Z-score and percentiles are not relative to peers but all children in the United States in 2000.

they will be overweight by 2.6 percentage points. Alternatively, we find that attending a CEP school decreases a student's probability of underweight, suggesting some beneficial effect of universal free school meals on weight for students toward the bottom of the distribution. We do not find that the CEP has a statistically significant effect on the probability of obesity.

While we find that the CEP leads to increases in child weight, another role that free school meals may play is as an incentive for students not to miss school. If households rely on free school meals to provide food for their child daily, they may be more likely to have them regularly attend school so that they do not miss meals or have to provide meals themselves. Additionally, a wide literature in health and education suggests that better nourished children are less likely to fall sick and hence are less likely to be absent from school (Hinrichs, 2010). We, however, find no evidence of an impact of school CEP participation on the average number of days children are absent from school.

Taken in sum, our results point to an increase in weight and BMI resulting from the adoption of the CEP in schools. We observe that this is driven by students who were previously eligible for free and reduced-price meals and that increased attendance is neither a product of the CEP nor a driver of weight changes. We situate these results within the existing literature and discuss what mechanisms might drive them.

2. Background

2.1 Policy Details

The Community Eligibility Provision (CEP) was introduced to schools in the United States as part of the 2010 Healthy Hunger-Free Kids Act (HHFKA). The CEP offers eligible schools the option to provide free breakfast and lunch to the entire student body. A school's eligibility to participate in the CEP is determined by the school's Identified Student Percentage (ISP). A school's ISP is the proportion of students in the school who are eligible for free school meals through participation in other government assistance programs such as SNAP or Medicaid or by meeting some other special criteria (e.g., being homeless or from a migrant family). According to the legislation, schools with an ISP of 40 percent or higher are eligible and may choose to participate in the CEP.[3]

The CEP was introduced to address the low free and reduced-price (FRP) meal participation rate.

[3] Participation may also be at the district level if a district's schools collectively have an average ISP of 40 percent or greater. Under district-wide enrollment, all schools in the district participate in the CEP, including schools that individually might have ISPs below 40 percent. In our case, schools individually participate in the CEP and not through district enrollment.

Eligible children do not enroll under the traditional system for a variety of reasons such as lack of information about their school meal options and difficulty in navigating the application process. There may also be a stigma attached to participation, and children or parents might not want to be identified as receiving FRP meals (Askelson et al., 2017). This stigma is meant to be removed in CEP schools as all students are eligible for free meals, implying that taking a school breakfast or lunch does not necessarily relay a signal of family income.

After piloting the program in 11 states, the CEP was made available nationwide for all qualifying schools beginning in June, 2014. During the 2019-20 school year, 69 percent of all CEP-eligible schools in the United States participated in the CEP, serving more than 14.9 million students in 30,667 schools (Maurice et al., 2020). Early evidence suggests CEP participation is correlated with significantly higher levels of school meal participation (Harkness et al., 2015; Ruffini, 2018). These findings are in line with earlier evidence suggesting that the introduction of universal free meals increases participation in school meals (Ribar & Haldeman, 2013; Leos-Urbel et al., 2013).

The reason we do not see all eligible schools participate in the CEP is most likely explained by meal cost reimbursement rules. Under the traditional school meal system, the United States Department of Agriculture (USDA) reimburses schools for each lunch and breakfast served at a predetermined value. Free meals are reimbursed at the highest level, followed by reduced price meals. Finally, full-price meals receive significantly lower reimbursements. For a CEP-participating school, the USDA reimburses 1.6xISP percent of meals at the free rate. The remaining (100 – 1.6xISP) are reimbursed at the much lower full-price rate (see Appendix Figure A1). This implies that for schools just above the eligibility mark of 40 percent ISP, 64 percent of the meals are reimbursed at the free rate while 36 percent are reimbursed at the full-price reimbursement, even though 100 percent of meals are provided to students for free. This reimbursement scheme creates a disincentive to CEP participation among the set of barely-eligible schools. Figure 1 shows that the variation in CEP participation is increasing in ISP, supporting the assumption that the participation decision is largely driven by meal reimbursement policy in the district we study. The incentive for schools just above the threshold of 40 percent is much smaller due to the low reimbursement rate. Schools with ISP at or above 62.5 percent have all meals reimbursed at the free rate and are much more likely to participate.

2.2 Mechanisms: How CEP can influence child weight

The impact of any school meal provision policy on child weight outcomes depends on two main factors:

who is impacted by the policy and how both the quantity and quality of meals consumed change (if at all) as a result of the policy. Literature assessing the quality of school meals in comparison to meals brought from home provides mixed evidence.[4] Conducted after the HHFKA's changes to school meal minimum nutrition standards, Smith (2017) finds that participation in NSLP and the School Breakfast Program (SBP) improves diets of nutritionally-disadvantaged children. The effect, however, varies considerably across the initial diet quality distribution with a decrease in diet quality for children toward the distribution's upper tail. It is also important to note that nutritional quality of meals is not the same at all schools (Ralston et al., 2008; Anderson et al., 2018). Frisvold and Price (2019) show that while there is not a strong relationship between free, reduced, or paid lunch status in terms of average calories, students who receive a free lunch have access to a school menu with an average Healthy Eating Index (HEI) score that is roughly 1.7 points lower (one-third of a standard deviation) than students who have a paid lunch. As our study compares students within the same school district, we do not expect significant differences in the quality of meals across schools, though we cannot rule this out. Additionally, effects of school meals are not homogenous across lunch and breakfast, with school breakfast participation leading to an expected decrease in weight even when lunch participation leads to an increase in child weight (Millimet et al., 2010).[5] Since the CEP makes both lunch and breakfast universally free, it is unclear what the aggregate effect would be if the two meal types produce opposite effects on weight.

The second factor determining the impact of free school meals are the subsets of students impacted by the policy change. We expect three groups of students to be impacted by the CEP in terms of school meal consumption and weight. First, consider children who were ineligible for either free or reduced-price meals prior to the introduction of the CEP. Under the traditional system, these students could either bring meals from home or buy school meals at full price. For the former, availability of free meals through the CEP might lead them to switch to school meals if cost was the main reason for bringing home meals. For those purchasing meals before the policy, the change to CEP participation functions as an income increase to the family as they no longer pay for meals they would have purchased under the prior regime.

Second, some students might have been eligible for free and reduced-price meals prior to the CEP but did not enroll. If this was due to preference for home meals over school meals, we might expect no

[4] See Cook et al. (2006), Kirkpatrick et al. (2010), Eicher-Miller et al. (2009), Kuku et al. (2012), Gundersen and Kreider (2009), Huang and Barnidge (2015), Artega and Heflin (2014), Huang et al., (2016), Farris et al., 2014.
[5] This may partly be due to the differential impact of breakfast and lunch program on dietary quality of children. See Bhattacharya et al. (2006), Frisvold (2015), Briefel et al. (2009), Gordon et al. (2007), Campbell et al. (2011), Fox et al. (2010).

change in weight following the CEP. That is, the effective price of meals does not change for them, though there may still be a stigma reduction. However, if certain families were simply unaware of their eligibility or the process of enrolling for FRP meals, we might expect them to participate in school meals due to the universal availability of free meals. Lastly, children who were eligible for reduced-price but not free meals might be induced into school meal participation once meals become free for all—either through the reduced stigma described above or because of the cost reduction.

For students switching from home-packed meals to school meals after the introduction of the CEP, the impact on weight depends on the quality of the meals. If meals from home were of higher quality than the comparable school meals, a potential worsening of their weight or BMI outcomes following adoption of the CEP is possible. Alternatively, if home meals are less healthy or non-existent, then participation in school meals may have a beneficial effect on weight.

If families sent meals from home not due to cost considerations but due to personal preferences, they may continue to do so even after meals are made universally free. If students continue to consume only meals from home, their diets would be unaffected by the CEP, and we would expect to see no change in their health outcomes. However, it is possible that children may consume some combination of their home meals and free meals offered at school. The impact, then, is ambiguous and depends on the quality of the two types of meals and the combination in which the students choose to consume it. There is also the possibility that students end up consuming both by supplementing meals brought from home with free school meals, which has the potential to produce substantial increases in their weight.

In our data, we do not observe whether a student actually consumed the school meal or not and therefore estimate the overall effect of the policy change across these groups. In each of our analyses, we separate students who were and were not eligible for free and reduced-price meals before the CEP to estimate differential impacts across these two groups. This will shed some light on whether any aggregate changes in BMI are driven by previously-eligible students, possibly via reducing stigma, inducing previously-eligible but unenrolled students to take meals, or through an impact on previously ineligible students who now take meals that were only offered to them at a price before.

We note that there is an income effect on families as well that we cannot measure. The switch to universal free school meals effectively puts more money in the pockets of families who were purchasing breakfasts and/or lunches—either through the school or making them at home—and now no longer have to. While this money could be spent on any number of resources, we cannot rule out the effect of spending more on meals served at home (e.g., dinners). The effect of increased spending on food for consumption outside of school on weight is ambiguous but might be larger for families for whom this saving is a larger share of total household income (i.e., poorer families).

Existing studies on the effects of school meal participation on child health show mixed results. There is evidence of school lunch participation increasing weight and likelihood of being obese (Schanzenbach, 2009; Millimet et al., 2010; Capogrossi & You, 2017). Hinrichs (2010) finds no evidence for a long-term effect of school meal provision on BMI. Alternatively, Gundersen et al. (2012) show that participation in school lunch significantly decreases rates of child obesity, food insecurity, and poor health.

While we do not know much about the health impacts of the CEP on children, literature examining programs that provide universal free school meals find little effect of universal free school lunch on BMI and some evidence that the change to universal free meals improves weight outcomes among non-poor students (Schwartz et al., 2020). Davis and Musaddiq (2019) use school-level data from the population of K-12 schools in Georgia to show that CEP participation leads to lower average student BMI scores and higher percentages of students falling within the healthy weight range. Alternatively, Davis (2020) uses student-level panel data for a nationally representative sample of students in late elementary and finds that attending a CEP school increases child BMI as well as the probability of being overweight or obese and decreases the probability of falling within the healthy weight range.

Participation in the CEP might also impact children on dimensions other than health. Previous literature on school meal participation has shown that the availability of universal free meals may (or may not) impact student attendance in either direction. Availability of two free meals serves as an incentive to attend school. On the other hand, participation in school breakfast programs may increase exposure to colds, flu, and other illnesses, leading to more absences (Ribar et al., 2011; Peterson et al., 2002). Comperatore and Fuller (2018) show that CEP participation reduced absences in North Carolina schools.

3. Data

The data for this study were made available through a partnership with a large metro-Atlanta school district through the Metro Atlanta Policy Lab for Education (MAPLE)—a component of the Georgia Policy Labs. For the district in this study, the database provides us with information on student demographics such as race, gender, and free and reduced-price lunch (FRL) status. This information is available for all students enrolled in grades K-12 in the districts' schools from 2010 to 2018. We note that, like many urban districts, there is considerable mobility, and we cannot follow students outside of the district. Therefore, our within student empirical strategy relies on students we observe in the district during two or more time periods, pre- and post-CEP implementation.

For health outcomes, we use data from FitnessGram examinations. Developed by the Cooper Institute, FitnessGram tests have been used across the United States to assess student health.[6] Mandated by the state of Georgia, the series of FitnessGram tests is administered annually to all public school students in the state who are enrolled in a physical education class taught by a certified physical education teacher.[7] Physical education requirements differ by age; therefore, the participation rate differs across different grade levels. In our data, two-thirds of all students between 2012 and 2018 took the FitnessGram at least once, and more than one-third took the battery of tests more than once, with higher rates naturally occurring for younger cohorts as they have had more exposure to the test. Figure 2 shows the share of students taking FitnessGram in each year by school type (elementary, middle, or high). We find that rates are highest and most consistent in middle school, with a large spike in elementary grades in 2018.[8] In our analysis section, we begin by observing what factors predict taking the FitnessGram in order to address potential selection concerns that might bias our estimates. In general, we find little evidence of systematic selection into FitnessGram that would bias results.

In addition to several tests of physical fitness (aerobic capacity, curl-ups, push-ups, etc.), the FitnessGram assessment directly measures each student's weight and height. These measurements are then used to calculate student BMI (defined as weight in kilograms divided by height in meters squared). The Centers for Disease Control and Prevention (CDC) defines healthy and unhealthy (underweight, overweight and obese) levels of BMI for children based on their percentile rank among all children of a given age and sex.[9]

Table 1 shows student-weighted summary statistics of schools that do (ever-CEP) and do not (never-CEP) participate in the CEP before and after the approximate implementation of the program (nearly all schools that adopted did so in 2016). On average, participating and non-participating schools have roughly equal proportions of students taking the FitnessGram, with a slight up-tick for CEP adopters after 2016. As expected, schools that participate in the CEP have a higher proportion of FRL students (92

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[6] For details see cooperinstitute.org/vault/2440/web/files/662.pdf
[7] According to the Georgia Department of Education's 2017 Fitness Assessment Program Report, in the 2016-17 school year, 1.1 million students in Georgia (71.3 percent of total student population) from 2,291 schools participate in the examination. The test must be conducted at least once a year. Schools may, however, choose to administer it more than once a year.
[8] For the state of Georgia, in the 2016-17 school year, 94.5 percent, 72.3 percent, and 63 percent of students in elementary, middle and high school, respectively, were enrolled in the physical education class.
[9] We use the reported BMI score to construct the standardized (Z) score for BMI. This is generated using the Z-anthro package in Stata that uses the 2006 WHO child growth standards to calculate the standardized BMI score.

percent) compared to non-CEP schools (38 percent), where this proportion goes to 100 percent for CEP adopters after 2016 by virtue of all students now being eligible for free meals. As we cannot observe FRL status in those schools post-2016, we use whether students were ever eligible for FRL pre-CEP as our pre-policy measure. Race is reported in non-mutually exclusive categories, which we code into those reporting Black and Hispanic ethnicity. Due to small cell sizes, we group those reporting other races or ethnicities into an "other" category. CEP-participating schools serve a much higher proportion of Black students (85 percent compared with 37 percent) but not Hispanic. They also have a smaller share of students reporting a race or ethnicity other than White, Black, or Hispanic—the majority of which is Asian. We also note that CEP schools are more likely to be elementary and middle schools than high schools.

The average BMI-Z score in non-CEP schools is about 0.5 (where the normalization is to the national average), with a slight decrease post-2016. In CEP schools, it is significantly higher (0.77), with a similar average decrease post-2016. This difference may be attributable to CEP schools serving slightly lower grades on average and therefore a younger population of students compared to non-CEP schools.

We plot our main outcome of interest over time to examine the trends before and after the implementation of CEP. Figure 3 shows the trend in BMI-Z score for students in CEP and non-CEP schools. First, we observe much higher BMI's in ever-CEP schools. This finding, in part, motivates our empirical models, which control for school fixed effects and take *within* student changes in weight and BMI outcomes as a result of exposure to CEP. We also observe spikes in BMI over time, which are unlikely due to random fluctuations in weight but rather who is tested—further motivating our empirical model and our specifications to test whether this variation is correlated with CEP participation or student characteristics.

3.1 School Participation in the CEP and FitnessGram Reporting

The CEP was introduced nationwide during the 2014-15 school year (reported as 2015 in our figures). In the first year, only 2 out of 103 schools in the district participated in the CEP. The following year in 2015-16, CEP participation jumped to 22 out of the 35 eligible schools in the district.[10] In the 2016-17 and 2017-18 school years, 27 out of the 107 schools in our district participated in the CEP. This is equivalent to 1 in every 4 schools in the district.

[10] The data for ISP and eligibility of schools is obtained from the FRAC database. This information is not publicly available for school years 2016-17 and 2017-18. Based on 2015-16 data, 2 out of 12 schools with ISP between 40 and 50 percent, 8 of 10 schools with ISP between 50 and 69 percent, and 12 out of 13 schools with ISP above 60 percent participated in the CEP.

In each year from 2012 to 2018, more than 90 percent of schools report administering the FitnessGram, with the exception of 2017, where 86 percent of schools administer it. There is, however, variation both in the proportion of students taking the FitnessGram across schools within the same school year, as well as in the average percentage of students in a school taking the test over the years. In particular, we see the participation rate drop to 25 percent in 2017, followed by an average participation rate of 64 percent in 2018.

We test whether this variation has any likely implications for our analysis in two ways. First, we model correlates of FitnessGram reporting at the school level as follows:

$$FG_{st} = \alpha_0 + \alpha_1 N_{st} + \alpha_2 FRL_{st} + \alpha_3 Gender_{st} + \alpha_4 RaceEth_{st} + \alpha_5 CEP_{st} + \gamma MaxGrade_s + \delta MinGrade_s + \theta_t + \varepsilon_{st} \quad (1)$$

Above, FG_{st} takes two forms: a binary indicator for whether or not school s administered the FitnessGram examination in year t and then the percent of students in the school who took the FitnessGram in that year. Note that a small number of schools reported very low numbers or proportions of students taking the FitnessGram, which are likely reporting errors or trial runs of the software. In our analyses, we eliminate school-year observations where fewer than 5 percent of students reportedly took the examination.[11] N_{st} is the number of students enrolled in the school in year t, FRL_{st} is the proportion of students in the school who were ever eligible for FRL in pre-CEP years, and $Gender_{st}$ is the proportion of female students in the school. $RaceEth_{st}$ is a set of variables measuring the proportion of students from different races and ethnicities.[12] CEP_{st} indicates whether school s participated in the CEP in year t or not. $\gamma MaxGrade_s$ and $\delta MinGrade_s$ are indicators for the minimum and maximum grade offered in the school, and θ_t is school-year fixed effects.

Columns 1 and 2 in Table 2 show results from Equation 1 for whether or not the school administered the FitnessGram. The size of the student body predicts school's participation in the FitnessGram with one hundred additional students increasing the probability that a school administers the FitnessGram by 3.5 percentage points. We find that the proportion of FRL students, gender composition of students, and race composition of students do not strongly predict the school's FitnessGram

[11] This has no effect on our results as it was a small number of observations. Results with these schools included are available upon request.

[12] The following groups are included in Race: Black, Hispanic, Indian, Asian, and Pacific Islander. White is the base category. Due to small sample sizes, we group Indian, Asian and Pacific Islander as "other".

participation. We do find that CEP schools (in the post period) are 16 percentage points more likely to administer the FitnessGram to any students. We note subsequent models control for this by comparing students within schools before and after CEP implementation, hence any fixed school attributes related to FitnessGram are removed.

We find analogous results in Columns 3 and 4 when we use proportion of students in the school taking the FitnessGram as our outcome. Again, school size predicts participation. We find no evidence of any of the other variables being strongly correlated with the proportion of students taking the FitnessGram, noting that our main empirical models compare students within schools. Moreover, CEP adoption does not predict the share of students taking FitnessGram *within* a school.

3.2 Student Participation in FitnessGram

A more relevant test is whether CEP adoption (or other characteristics) affects whether a student receives a FitnessGram test. For our analysis, we are specifically interested in testing whether certain subsets of students are more likely to take the FitnessGram than others, and within school, whether a transition to CEP affects *who* is tested (as our main analysis is within school). To test this, we estimate the following equation using student level data:

$$FG_{igst} = \alpha + \beta CEP_{st} + \Gamma X_i + \Delta CEP_{st} * X_i + \theta_t + \delta_g + \phi_s + \varepsilon_{igst} \quad (2)$$

The outcome variable FG_{igst} is a binary indicator for whether or not student *i*, enrolled in grade *g* at school *s* in year *t* takes the FitnessGram examination. *CEP* is an indicator for whether school, *s*, participated in the CEP program in year *t*, and *X* are student level covariates including race, gender, and whether the student was ever FRL-eligible. Finally, $\theta_t + \delta_g + \phi_s$ are year, grade, and school fixed effects, respectively.

Column 1 in Table 3 includes only year and grade fixed effects and an indicator for whether the school participated in the CEP that year. We observe no differential relationship within a school as suggested by the share taking FitnessGram in columns 3 and 4 of the previous table. In columns 2 and 3 of Table 3, we evaluate whether student characteristics predict FitnessGram participation, where in column 3 we include a school-level fixed effect. We find that within school-grade-year, females and students listing "other" race are slightly less likely to take a FitnessGram test. In columns 4 and 5, we include interactions between CEP adoption and student characteristics, where column 5 also includes a student fixed effect (hence the main effects for student characteristics drop out). This final column is analogous to our main outcome regressions. While the first columns show that on average exposure to CEP did not increase or decrease the likelihood of taking FitnessGram, this final column asks whether this is true across student characteristics. We find that female students were slightly less likely (1.9 percentage points) and Black students were more likely (4.8 percentage points) to take the FitnessGram after CEP adoption than before. We find no relationship between FitnessGram and CEP adoption across ever- and never-FRL-eligible students.

4. Effects of CEP on BMI, weight and attendance

Next, we turn to our main analysis by estimating the impact of attending a school that participates in the CEP on several outcomes of students, namely standardized BMI score (BMI-Z), BMI percentile, weight, height, likelihood of being underweight, normal weight, overweight or obese, and total days the child is absent from school in a school year. Estimating a simple regression of these outcomes on school CEP participation might produce estimates that are biased by factors common to students who attend CEP-participating schools that differ from those who attend non-participating schools. For example, children attending CEP schools are more likely to be from more disadvantaged backgrounds. Because ISP is partially determined through direct certification of participation in other federal assistance programs, these children are also more likely to participate in programs like SNAP or TANF. Moreover, other demographic and socioeconomic factors like race, parental education, and income are often associated with child BMI and are also likely to differ across CEP-eligible and ineligible schools. For the school district that we study, students in CEP-participating schools serve a much higher proportion of Black students compared to non-CEP schools.

We address these concerns by using a student-level fixed effects approach, which differences out any fixed attributes of individual students (and schools). For child i attending grade g at school s in year t, outcomes are modeled such that:

$$Y_{igst} = \delta CEP_{st} + \alpha_i + \phi_a + \lambda_g + \gamma_s + \theta_t + \epsilon_{igst} \quad (3)$$

where Y_{ist} is either continuous child BMI-Z score, BMI percentile, weight, height, binary indicators of whether a child is underweight, normal weight, overweight, or obese, or total days the child is absent from school in a school year. Race, gender, and our measure of having ever received FRL are time-invariant and therefore differenced out with the inclusion of our student fixed effect α_i. CEP_{st} is a binary indicator equal to 1 if the child's school, s, participated in the CEP during year t and 0 otherwise. λ_g are grade fixed effects, θ_t are school-year fixed effects, ϕ_a are indicators for age, and γ_s are school fixed effects that account for students changing schools over time (note that age, year and grade are not perfectly collinear as some students repeat grades or transition from one grade to another at different ages, where age is important for BMI calculations which are within age-gender; results are similar if we enter age linearly). ϵ_{isgt} is an error term containing all other information. The primary effect of interest in Equation (3) is δ, which shows the change in each outcome from attending a CEP-participating school.

We estimate the impact of a school's CEP participation across various child weight outcomes. Column 1 of Table 4 shows results from estimation of Equation 3. Panel A shows that student BMI increases by 0.065 standard deviations (in the national distribution) on average as a result of school CEP participation. Panel B shows a corresponding increase of 2 percentile points in the national distribution of BMI adjusted for age and gender. These results imply that students in schools that participate in the CEP have higher BMIs on average as a result of free meals being offered to all students in the school. A limitation of our study is that we cannot observe whether a student consumes school meals, home-packed meals, or some combination of both. We also cannot speak to the quality and calorie content of school meals versus home packed meals. Therefore, we estimate the total effect of program participation, which shows an increase in average BMI score.

We next estimate Equation (3) separately for non-FRL and FRL students in Columns 2 and 3, respectively. Column 2 shows that BMI-Z score for non-FRL students on average increases by 0.03 standard deviations and is not statistically different from zero. The corresponding increase for FRL students in Column 3 is 0.06 standard deviations. Taken together, these results suggest that the BMI increase we observe is driven by students who were previously eligible for free and reduced-price meals at some point prior to CEP adoption. This might be due to a stigma reducing effect or an increase in take-up for previously eligible students who did not opt to use the program.

We check for heterogeneous effects by gender in Columns 4 and 5. The average BMI-Z score for both male and female students increases by 0.07 and 0.06 standard deviations, respectively, suggesting similar effects across gender.

In Table 5, we analyze the CEP's effect on weight and height separately. This allows us to check whether or not the BMI increase we observe is driven by increased weight or some variation in height, which would not be consistent with a change caused by the CEP. While it is possible that greater access to food could increase height, it is a less direct and much slower path than weight. Furthermore, large changes in height measurements as a result of the CEP would raise concerns regarding who is being tested and the accuracy of testing. Moreover, height and weight are not scaled to national norms, so the transformation compared to BMI is not 1:1. We find that, indeed, CEP exposure leads to weight increases of about 2.8 pounds on average. We find that that weight gain for FRL and non-FRL students is similar, with a slight but not statistically meaningful difference of an additional one-half pound increase for the set of never-FRL students.

In Table 6, we examine where in the distribution of BMI these changes occur. If students are underweight due to limited food access or less nutritional food at home, the increase in BMI could prove beneficial. Alternatively, meals may lead to increased weight gain among those already in a "healthy weight" category. To answer this question, we use CDC BMI thresholds and estimate our main model for each weight category.[13,14] We find decreases in the share of students in the underweight and normal weight categories and increases in the percentage of students classified as overweight by about 2.6 percentage points. We find no evidence of an increase in obesity. Taken together, we observe some benefit (a reduction in underweight) and some potential harm (an increase in overweight), consistent with prior work at the school level.

Free provision of school meals is hypothesized to serve as an incentive to attend school. The guarantee of two free-of-cost meals during the day may encourage families and children to come to school. Further, better nutrition may lead to improved health, potentially leading to a reduction in absences. Some evidence (Ribar et al., 2013) suggests that the opposite may occur, as free meals may lead to students clustering in enclosed cafeteria spaces, leading to an increase in contagious illnesses such as the flu. We find, however, no evidence of such an effect. In Table 7, we estimate the impact of school's participation in the CEP on total days a student is absent from school in a school year. The estimates are statistically insignificant and small in magnitude.

5. Conclusion

Millions of children in the United States receive subsidized breakfast and lunch in schools. Evidence regarding the impact of school meal provisions on child BMI is mixed. Moreover, existing research on free school meal provision often faces specific limitations such as estimating effects of interest for children of specific ages or grades. In this paper, we estimate the impact of universal school meal provision under the CEP in a large metro-Atlanta school district. Using FitnessGram and administrative school records, we estimate a student fixed effects model exploiting variation before and after the implementation of the

[13] CDC thresholds define 0-5th percentile of BMI as underweight, 5th to less than 85th percentile as normal weight, 85th to less than the 95th percentile as overweight, and 95th percentile of greater as obese.
[14] An ordered logistic regression would be optimal here to observe transition rates, but these models are not ideal with large numbers of fixed effects. Here we estimate these as simple binary regressions.

CEP. We find that, on average, school participation in the CEP increases child BMI by 0.065 standard deviations—equivalent to an increase of around 3 pounds in weight. While an increase in BMI may represent a potential detriment or benefit to a child's health depending on where in the distribution of weight the change takes place, we find that attending a CEP school decreases the probability that a student will fall within the normal weight range while increasing the probability of overweight. Alternatively, we do find a modest decrease in the probability of underweight caused by CEP school attendance as well. We cannot observe whether a child actually consumes the school meal or not and estimate a total effect of the policy. Effects driven by students previously enrolled for free and reduced-price lunch suggest a stigma reducing effect might be playing a role, though we cannot confirm this. We find no evidence of impact on our placebo estimation on height. We also find no evidence of selection into taking the FitnessGram at the school or student level. Lastly, we find no evidence of free meal provision incentivizing children to attend school more often.

Our findings provide important information for policymakers and researchers interested in the effect of universal free school meals on child weight and school absences. In short, our finding that CEP participation leads to increased student weight highlights the possibility for negative weight effects caused by the program. While we show that attending a CEP school increases students weight on average, we do find some potential for a beneficial effect caused by the expected decrease in underweight percentage. A promising avenue for future research is the question of what mechanisms are driving these changes in weight. Depending on whether changes stem from quantity of food, quality of food, or some other factor or combination of factors is important for improvement of the CEP as well as for the design of future school meal policies.

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Tables

Table 1: School level Summary Statistics by CEP Status and Pre/Post 2016

	Never CEP Schools			CEP Adopters		
	Pre-2016 (sd)	Post-2016 (sd)	Difference (t)	Pre-2016 (sd)	Post-2016 (sd)	Difference (t)
Ever FRL eligible	0.38	0.38	0.00	0.92	1.00	0.079
	(0.29)	(0.28)	(0.03)	(0.05)	(0.00)	(17.43)
Female	0.49	0.50	0.00	0.49	0.49	0.001
	(0.03)	(0.05)	(1.10)	(0.02)	(0.02)	(0.54)
Black	0.37	0.38	0.01	0.85	0.84	-0.007
	(0.32)	(0.32)	(0.36)	(0.21)	(0.21)	(0.23)
Hispanic	0.14	0.15	0.01	0.14	0.16	0.016
	(0.13)	(0.14)	(1.11)	(0.19)	(0.20)	(0.54)
Other race	0.13	0.15	0.01	0.01	0.01	0.002
	(0.14)	(0.16)	(1.01)	(0.01)	(0.01)	(1.79)
No. of students	1007.19	998.36	-8.83	825.91	833.12	7.209
	(508.41)	(553.67)	(0.19)	(343.35)	(331.95)	(0.14)
Share taking FitnessGram	0.37	0.39	0.02	0.35	0.43	0.077
	(0.32)	(0.36)	(0.84)	(0.31)	(0.34)	(1.60)
School took FitnessGram	0.72	0.67	-0.05	0.78	0.79	0.019
	(0.45)	(0.47)	(1.13)	(0.42)	(0.41)	(0.31)
BMI Z-score	0.50	0.47	-0.03	0.77	0.75	-0.018
	(0.22)	(0.25)	(1.43)	(0.25)	(0.29)	(0.44)
BMI Percentile	64.29	63.32	-0.97	70.87	70.40	-0.466
	(5.73)	(6.86)	(1.75)	(5.87)	(7.54)	(0.45)
Underweight	0.05	0.06	0.01	0.05	0.05	0.007
	(0.03)	(0.03)	(2.95)	(0.05)	(0.04)	(1.05)
Healthy weight	0.64	0.63	-0.01	0.55	0.54	-0.017
	(0.07)	(0.08)	(1.67)	(0.07)	(0.11)	(1.21)
Overweight	0.20	0.20	0.00	0.23	0.24	0.013
	(0.04)	(0.05)	(0.37)	(0.05)	(0.08)	(1.26)
Obese	0.10	0.10	0.00	0.16	0.16	-0.003
	(0.05)	(0.05)	(0.21)	(0.06)	(0.07)	(0.28)
Height (in)	58.38	58.69	0.30	55.97	55.76	-0.211
	(6.18)	(6.25)	(0.57)	(5.52)	(5.65)	(0.25)
Weight (lbs)	104.37	106.68	2.31	95.50	96.15	0.654
	(32.69)	(32.62)	(0.82)	(28.58)	(29.31)	(0.15)
Days absent	5.65	6.23	0.58	7.61	8.80	1.190
	(1.63)	(2.12)	(3.46)	(3.04)	(2.36)	(3.00)
School x year		534			185	

Notes: Table shows student-weighted, school-level means and standard deviations. Differences are post-2016 - pre-2016.

Table 2: Participation in the FitnessGram (at the School level)

	Any FG		Share took FG	
	(1)	(2)	(3)	(4)
Students/100	0.035***	0.035***	0.011**	0.012**
	(0.010)	(0.010)	(0.005)	(0.005)
% FRL	0.003	0.128	-0.125	-0.090
	(0.143)	(0.160)	(0.103)	(0.121)
% Female	-0.474	-0.505	-0.419	-0.427
	(1.089)	(1.068)	(0.831)	(0.824)
% Black	-0.022	-0.161	0.038	-0.001
	(0.121)	(0.143)	(0.097)	(0.119)
% Hispanic	0.019	-0.122	0.121	0.082
	(0.214)	(0.225)	(0.165)	(0.170)
% Other race	-0.215	-0.218	0.022	0.021
	(0.249)	(0.248)	(0.243)	(0.243)
CEP		0.156**		0.043
		(0.076)		(0.055)
School min grade FE	X	X	X	X
School max grade FE	X	X	X	X
Year FE	X	X	X	X
Obs. (schools x year)	728	728	728	728

Notes: The outcome in Columns 1 and 2 is a binary indicator for whether the school administered the FitnessGram. The outcome in Columns 3 and 4 is the share of students in a school that participated in the FitnessGram. The sample is all schools in years 2012-2018. Standard errors in parentheses (* 0.10; ** 0.05; *** 0.01)

Table 3: Participation in the FitnessGram (at the Student Level)

	(1)	(2)	(3)	(4)	(5)
CEP school	0.014	0.030	0.009	-0.052	0.005
	(0.04)	(0.04)	(0.04)	(0.05)	(0.03)
Ever FRL eligible		-0.002	0.009	0.013***	
		(0.02)	(0.01)	(0.00)	
Female		-0.048***	-0.048***	-0.051***	
		(0.01)	(0.01)	(0.01)	
Black		-0.039	0.002	-0.002	
		(0.02)	(0.01)	(0.01)	
Hispanic		-0.002	0.005	0.009*	
		(0.02)	(0.01)	(0.01)	
Other race		-0.032	-0.042***	0.043**	
		(0.03)	(0.01)	(0.01)	
CEP*Ever FRL eligible				-0.025	-0.016
				(0.03)	(0.016)
CEP*Female				0.033*	-0.019***
				(0.02)	(0.007)
CEP*Black				0.073**	0.048**
				(0.03)	(0.023)
CEP*Hispanic				-0.009	0.007
				(0.02)	(0.023)
CEP*Other race				0.047*	0.024
				(0.03)	(0.039)
Student FE					X
School FE			X	X	
Grade FE	X	X	X	X	X
Year FE	X	X	X	X	X
Obs. (student x year)	698,183	698,183	698,183	698,183	698,183

Notes: The outcome of Columns 1, 2, and 3 is whether a student i in year t had FitnessGram results. The sample is all students with any FitnessGram observations in years 2012-2018. Standard errors are clustered at the school level (* 0.10; ** 0.05; *** 0.01).

Table 4: Effect of School's Participation in the CEP on BMI-Z and BMI Percentile

	(1) All	(2) Never FRL	(3) Ever FRL	(4) Male	(5) Female
			BMI Z-Score		
CEP	0.065***	0.028	0.059***	0.071***	0.062**
	(0.017)	(0.053)	(0.019)	(0.025)	(0.025)
			BMI Percentile		
CEP	1.985***	0.280	1.936***	1.987***	2.087***
	(0.457)	(1.415)	(0.493)	(0.650)	(0.643)
Grade FE	X	X	X	X	X
Year FE	X	X	X	X	X
School FE	X	X	X	X	X
Student FE	X	X	X	X	X
Observations	257067	152508	104559	138525	118542

Outcome is BMI Z-score in the national distribution (top panel) and BMI percentile in the national distribution (bottom panel). Columns are samples in each regression. Standard errors in parenthesis clustered at the school level. (* 0.10; ** 0.05; *** 0.01)

Table 5: Effect of School's Participation in the CEP on Child Weight and Height

	(1)	(2)	(3)	(4)	(5)
	All	Never FRL	Ever FRL	Male	Female
			Weight (lbs.)		
CEP	2.799***	1.999*	1.407***	2.568***	3.314***
	(0.408)	(1.079)	(0.461)	(0.554)	(0.581)
Obs.	258989	153574	105415	139577	119412
			Height (in.)		
CEP	0.026	-0.133	0.062	-0.071	0.125
	(0.055)	(0.163)	(0.061)	(0.074)	(0.076)
Obs.	260345	154120	106225	140232	120113
Grade FE	X	X	X	X	X
Year FE	X	X	X	X	X
School FE	X	X	X	X	X
Student FE	X	X	X	X	X

Outcome is weight (top panel) and height (bottom panel). Columns are samples in each regression. Standard errors in parenthesis clustered at the school level. (* 0.10; ** 0.05; *** 0.01)

Table 6: Effect of School's Participation in the CEP on Weight Categories

	(1) Underweight	(2) Normal	(3) Over-weight	(4) Obese
CEP	-0.013***	-0.018***	0.026***	0.004
	(0.002)	(0.006)	(0.005)	(0.004)
Grade FE	X	X	X	X
Year FE	X	X	X	X
School FE	X	X	X	X
Student FE	X	X	X	X
Obs.	236058	236058	236058	236058

Column headers are dependent variables in each regression. Standard errors in parenthesis. All standard errors are clustered at the school level. (* 0.10; ** 0.05; *** 0.01).

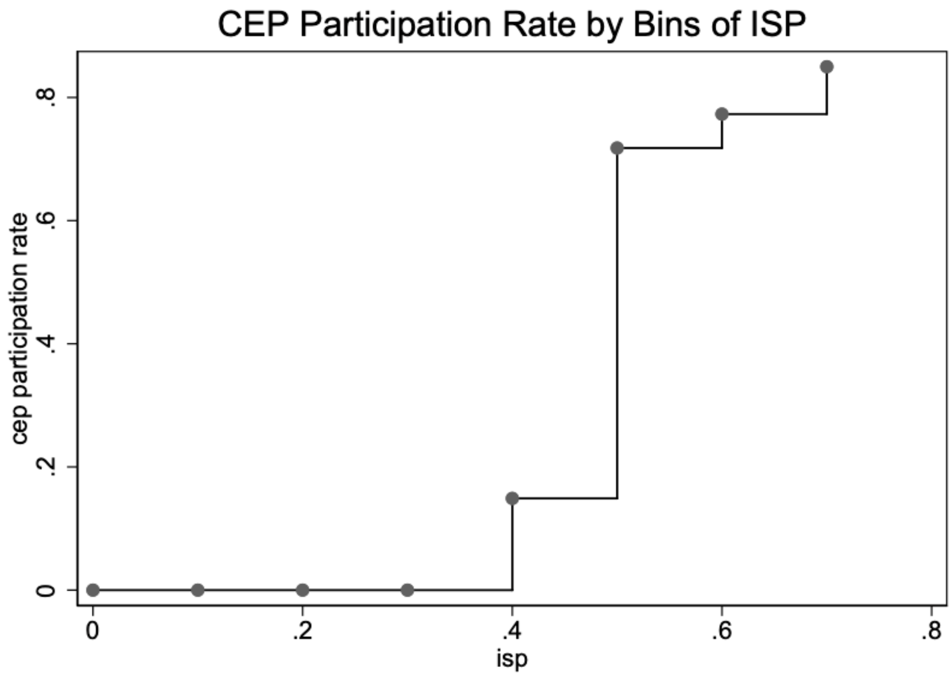
Table 7: Effect of School's Participation in the CEP on Absences

	(1) All	(2) Never FRL	(3) Ever FRL	(4) Male	(5) Female
CEP	0.160	-0.634	0.064	0.179	0.137
	(0.158)	(0.406)	(0.178)	(0.232)	(0.214)
Grade FE	X	X	X	X	X
Year FE	X	X	X	X	X
School FE	X	X	X	X	X
Student FE	X	X	X	X	X
Obs.	250167	149121	101046	134635	115532

Dependent variable is absences, columns are separate regression samples. Standard errors in parenthesis. All standard errors are clustered at the school level. (* 0.10; ** 0.05; *** 0.01).

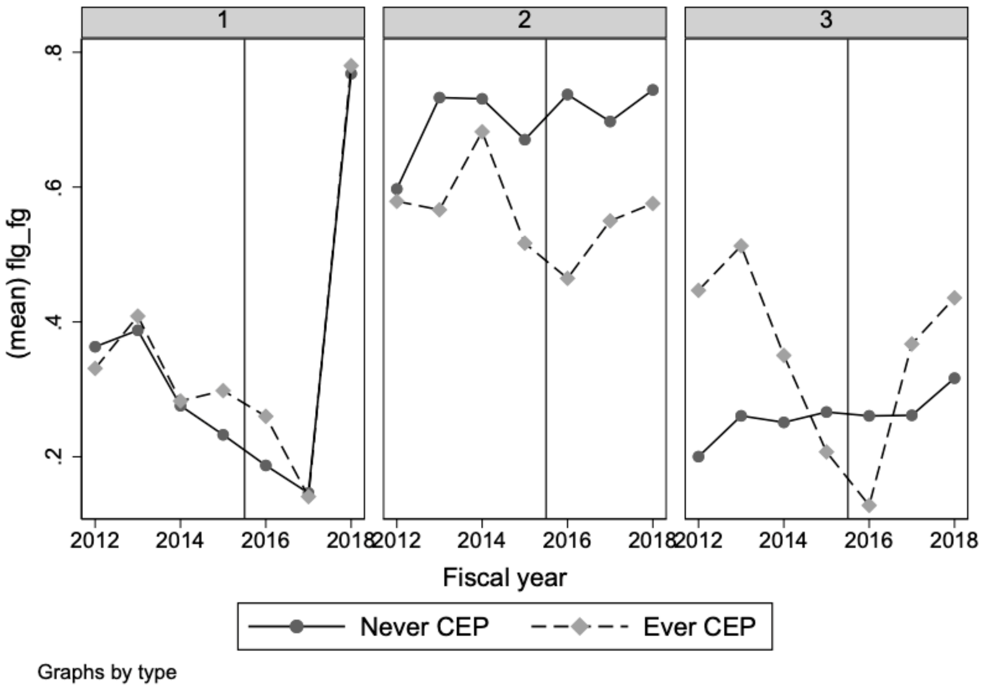
Figures

Figure 1: CEP Participation Rate of Schools by ISP



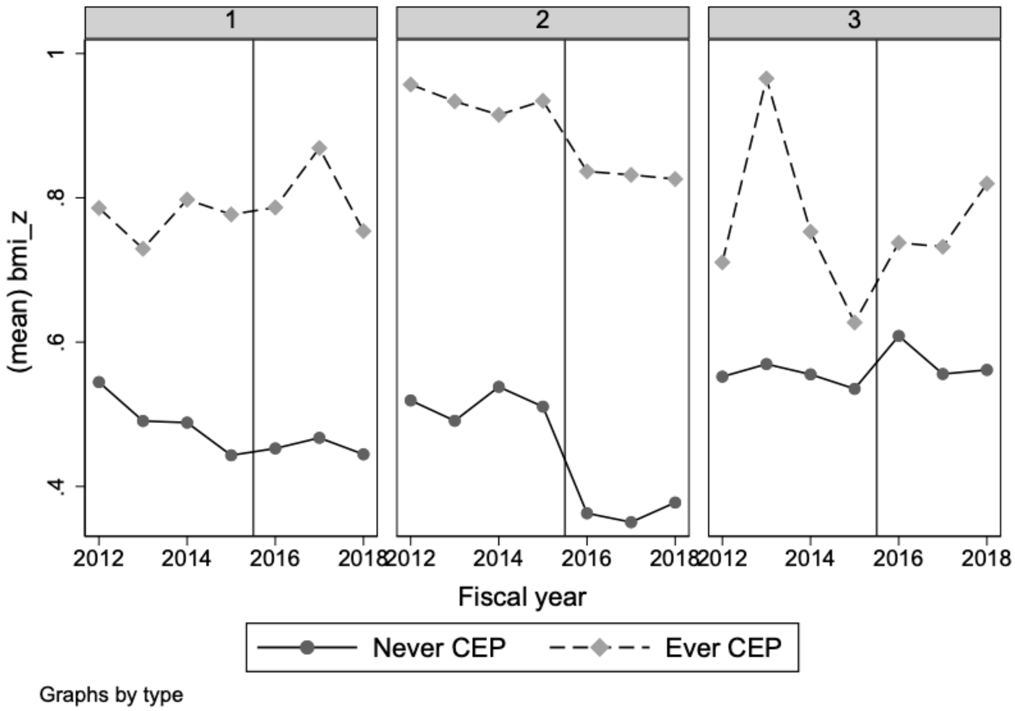
Notes: Figure shows proportion of schools in each bin of ISP (0.1) that participate in the CEP. The sample includes all schools for the years of 2015-2018.

Figure 2: Share of Students Taking FitnessGram, by CEP School Status and School Level



Note: The figures (from left to right) are for the following different school types: (1) Elementary Schools, Grades 1-5, (2) Middle Schools, Grades 6-8, (3) High School, Grades 9-12. Schools are defined as Never CEP if they do not participate in the CEP during any year. Schools are defined as Ever CEP if they participate in the CEP during one or more years.

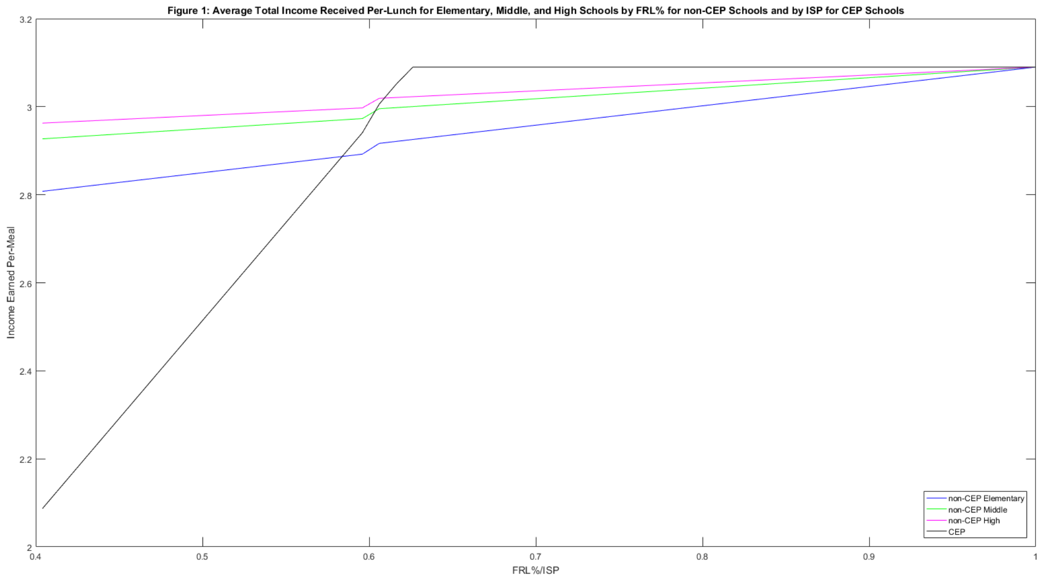
Figure 3: BMI by CEP school status and school level, pre and post the implementation of CEP



Note: The figures (from left to right) are for the following different school types: (1) Elementary Schools, Grades 1-5, (2) Middle Schools, Grades 6-8, (3) High School, Grades 9-12. The vertical line in all three figures shows the year of adoption of the CEP by schools in the district. Schools are defined as Never CEP if they do not participate in the CEP during any year. Schools are defined as Ever CEP if they participate in the CEP during one or more years.

Appendix

Figure A1: Average Total Income Received by Schools for a School Lunch Under the CEP and Traditional School Lunch Program



Note: Total income is defined as the amount paid by a student for a lunch plus the amount reimbursed for the lunch by the USDA. Average school lunch prices come from the School Nutrition Association's School Meal Trends & Stats (https://schoolnutrition.org/aboutschoolmeals/schoolmealtrendsstats/). Meal reimbursement rates come from the USDA (https://www.fns.usda.gov/school-meals/rates-reimbursement).

Acronyms

BMI	Body Mass Index
CEP	Community Eligibility Provision
FRL	Free and Reduced Price Lunch
HHFKA	Healthy Hunger Free Kids Act
ISP	Identified Student Percentage
MAPLE	Metro-Atlanta Policy Lab for Education
NSLP	National School Lunch Program
SBP	School Breakfast Program
SFP	School Feeding Programs

ABOUT THE AUTHORS

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ABOUT THE GEORGIA POLICY LABS

The Georgia Policy Labs (GPL) is a collaboration between Georgia State University and a variety of government agencies to promote evidence-based policy development and implementation. Housed in the Andrew Young School of Policy Studies, GPL works to create an environment where policymakers have the information and tools available to improve the effectiveness of existing government policies and programs, try out new ideas for addressing pressing issues, and decide what new initiatives to scale. The goal is to help government entities more effectively use scarce resources and make a positive difference in people's lives. GPL has three components: The Metro Atlanta Policy Lab for Education works to improve K-12 educational outcomes; the Career & Technical Education Policy Exchange focuses on high-school-based career and technical education in multiple U.S. states; and the Child & Family Policy Lab examines how Georgia's state agencies support the whole child and the whole family. In addition to conducting evidence-based policy research, GPL serves as a teaching and learning resource for state officials and policymakers, students, and other constituents. See more at gpl.gsu.edu.