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School Meals and Classroom Effort

Evidence from India

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PRELIMINARY DRAFT

School Meals and Classroom Effort: Evidence from India*

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Abstract

We use the exogenous policy shock of the extension of provision of school meals to upper primary grades in public schools in Delhi to study the effects of school meal intake on the cognitive effort of students within the classroom. Using individual level data on the performance of students in effort games both before and after the extension of the program, we find that the provision of meals significantly improved the classroom effort of students in grade seven. We conclude that school meals have the potential to increase educational attainment in the classroom.

JEL Classification: I21, I25, H52

Key words: school meals, effort, maze games, Delhi, India

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1. Introduction

Nutritionists and social scientists have widely recognized the causal relationship between nutritional status and the learning ability of children. Thus one of the policy initiatives undertaken by governments in several developing and developed countries to improve learning outcomes among children is the provision of free or subsidized school meals.

There are three possible mechanisms by which school meals can improve learning outcomes. First, school meals can act as an incentive for parents to send their children to school more regularly by implicitly reducing the cost of schooling (Schultz, 2004; Vermeersch and Kremer, 2004; and Afridi, 2011). Regular attendance at school can potentially lead to better educational outcomes. Second, school meals can improve the nutritional status of the child which, in turn, can affect her long-term cognitive ability (Behrman and Lavy, 1994; Glewwe, Jacoby and King, 1999). Third, school meals can impact learning outcomes by improving attention and classroom participation of children (Politt et al., 1981; Murphy et al., 1998, Gajre et al. 2008, Sigman et al., 1989; Kleinman et al., 1998), particularly in contexts where there is ‘classroom hunger’.

However, it is also possible that school meals adversely affect learning outcomes if the program creates additional pressures on limited school resources. For instance, Vermeersch and Kremer (2004) found that the introduction of school meals led to a considerable increase in class-size which in turn adversely affected learning-levels in Kenya. In addition, there could be a re-allocation of school resources away from teaching, if for instance, teachers’ spent more time in the daily administration and distribution of the school meals. Thus, the overall effect of such a program on students’ educational attainment is ambiguous.

In this paper we study a specific mechanism through which school meals could improve students’ learning in public schools in Delhi, India - by improving the effort and attention that a child puts to a task within the classroom. Studies have shown that undernourished children are more likely to have behavioural problems such as attention deficit, depression and aggression which in turn inhibit educational attainment (Sigman et al., 1989; Kleinman et al., 1998). School meals could provide immediate alleviation from hunger, reducing distraction and increasing concentration among students (Politt et al., 1981; Murphy et al., 1998). In the long-term, therefore, school meals could improve classroom effort and thereby the educational attainment of students by improving their nutritional status.

We use the exogenous policy shock of extension of the school meal program to upper primary grades (6 to 8) from 29th September 2009 onwards in the public schools of Delhi to identify the effect of the program on children's effort within the classroom. The paper utilizes student level data on performance in tests administered by the research investigators during multiple visits to randomly selected public schools both before and after the extension of the program. Schools whose randomly selected date of first visit fell before 29th September 2009 had not yet started the school meal scheme for upper primary grades, whereas those visited after 29th September were serving meals to upper primary grades. Sampled schools were re-visited between February and April, 2010 when all public schools were providing the meals in upper primary grades. We define schools that changed their meal implementation status in the upper grades between the two visits as treatment schools and those that did not as control schools. Thus, children in grades 6 to 8 in treatment schools received the meals only during the second survey round while those in control schools were getting meals during both survey rounds. This allows us to use a double difference, intention-to-treat estimation strategy.

We measure students' effort in terms of their performance in solving maze puzzles of increasing difficulty within a specified time. These tests were conducted in the classroom during regular school hours in both survey rounds. Thus, our main outcome of interest is the number of maze puzzles correctly solved by a student. Since the puzzles did not require either reading or writing skills but rather skills such as attention, perseverance and patience (Niederle and Vesterlund, 2007; Hoff and Pandey, 2006; Gneezy, Niederle, and Rustichini, 2003), we are able to focus on the immediate impact of the meal program on effort levels as opposed to standard tests of learning such as reading or math.

While there are numerous studies – experimental and survey – on the impact of school meals on cognition and learning through improvement in nutrition, the evidence from these studies is mixed. Adelman et al. (2008), Whaley et al. (2003) and Grantham-McGregor et al. (1998) find a significant impact of school meals on cognition whereas Kazianga et al. (2009) find no impact at all. Adelman et al. (2008), Ahmed (2004), Whaley et al. (2003), Powell et al.(1998) and Powell et al. (1983) find significant improvement in learning achievement or test scores, whereas Kazianga et al. (2009) and McEwan (2010) find no impact. However, in the case of experimental studies, the effect of meals on cognitive tests and learning achievement tests is context specific and depends on the baseline nutritional status of the subjects. Our study contributes to the literature on school achievement and nutrition by analyzing the effect of school meals on *effort* as opposed to reading or math skills.

Our results suggest that the provision of school meals improved the class room concentration and effort of students in grade 7. The findings also suggest that school quality influences the extent to which school meals improve effort levels. Students in schools that had higher average scores in curriculum related tests gained significantly more from the extension of the meal program.

The conclusions of this paper have immediate policy relevance – provision of subsidized or free meals can improve the performance of students within the classroom. This carries implications for the long term learning outcomes and educational attainment of children, particularly in the context of hungry and nutritionally deprived children.

The remainder of this paper is organized as follows – Section 2 gives the background of the school meal program in India, Section 3 describes the data and the methodology while Section 4 discussed the results. Conclusions and policy implications are discussed in Section 5.

2. Background: The Mid-Day Meal Scheme

The National Program of Nutritional Support to Primary Education or the Mid-day Meal (MDM) Scheme was initiated by the federal government of India in August 1995 (Government of India, 1995). It mandated provision of cooked meals during school hours to all children enrolled in public primary schools (grades 1 to 5). In November 2001, the Supreme Court of India issued further guidelines "to implement the Mid-Day Meal (MDM) Scheme by providing every child in every government and government assisted primary school with a prepared mid-day meal with a minimum content of 300 calories and 8-12 grams of protein each day of school for a minimum of 200 days" (Supreme Court of India judgment, PUCL vs. Union of India and Others, 2001).[1]

In 2007 the mandate of the program was extended to cover children in upper primary grades (grades 6 to 8) in public schools. The calorific value of a mid-day meal at upper primary stage was stipulated to be a minimum of 700 calories and 20 grams of protein per child per school day (as against the stipulation for grades 1 to 5). However, the vast majority of public schools in the country failed to implement this extended mandate until more recently. We take advantage of this extension of the program in the public schools of Delhi.

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[1]The average number of school days in a year is 200 (20 days per month for 10 months). The initial deadline for implementation of this order was February 2002 which was later extended to September 2004 by the Supreme Court.

In Delhi, public schools fall under the purview of three local administrative agencies- the Municipal Corporation of Delhi (MCD), the Directorate of Education (DoE) of the Government of Delhi and the New Delhi Municipal Corporation (NDMC). While the MCD runs only primary schools (grades from 1 to 5) the majority of middle, secondary and senior secondary schools are administered by the DoE. The DoE also runs composite schools that integrate all schooling levels into one, with grades from 1 to 12, known as Sarvodaya Vidyalayas.[2] The mid-day meals are provided to these schools by service providers contracted by the respective administrative agencies. In 2006-07 there were 40 school meal providers supplying meals to 2400 schools across Delhi. The estimated number of children who benefitted from the meal program was over 1 million.

We restrict our attention to the Sarvodaya Vidyalayas run by the DoE. In these schools, cooked meals were being served to children in grades 1 to 5 since 2003. The Government of Delhi extended the school meal program to upper primary grades (grades 6 to 8) from 29th September, 2009 onwards in keeping with the 2007 norms, mentioned above. Although the extension of the program was in the offing since 2007, the exact timing of the program's expansion was unanticipated in Delhi.

3. Data and Methodology

A. Data

[2]The NDMC is mainly concerned with primary education, but also runs a select number of middle, secondary and senior secondary schools in its areas. According to the Planning Department, Government of Delhi (2003) there are approximately 1820 MCD primary schools, 2186 DoE schools and 100 NDMC schools, at different levels, in the National Capital Territory of Delhi. (http://www.delhiplanning.nic.in/Write-up/2002-03/volume-I/General%20Education.pdf)

The data used in this study come from 18 randomly selected Sarvodaya Vidyalayas out of a total of 185 such schools managed by the Directorate of Education (DoE) in Delhi. We chose Sarvodaya schools for our study for three reasons: first, as pointed out above, Sarvodaya schools, as opposed to most other public schools in Delhi, contain primary (grades 1 to 5) and upper primary grades (grades 6 to 12). This allows us to compare and contrast the effect of the cooked meals on students in primary and upper primary grades holding the characteristics of the school constant. Second, admission into Sarvodaya schools in any grade is free of cost and on a first-come, first-served basis.[3] No screening in the form of admission tests or interviews is conducted for admission into these schools. This ensures that our sample of students is comparable to the average public school student in Delhi in terms of ability. Third, unlike the NDMC schools (some of which contain primary and upper primary grades), which are small in number and concentrated in the Central Municipality Zone of Delhi, Sarvodaya schools are spread across all municipality zones of Delhi. This makes our sample of students not only more representative but also allows us to assess any heterogeneity of effects of school meals.

The tests of effort (described in the following sub-section) were conducted in two phases – Phase 1 and Phase 2. The first phase of tests was conducted in grades 5 and 7 in the sampled schools between August and November 2009 while the second phase of tests were administered between February and April 2010 to the same grades (and students) in each of these schools.[4] While grade 5 students were receiving school meals since they enrolled in

[3]Under the provisions of the new Right to Education Act, government schools have to admit students all through the year. However, this provision was not applicable at the time of this study. Schools were admitting students until 30th September for the current academic year.

[4] We drop one school from our analysis due to incomplete data availability in Phase 1 which brings our total school sample to 17.

grade 1, grade 7 students would have received school meals till they were enrolled in grade 5.[5] Hence the latter would not have received school meals for over one year.

Data on socio-economic characteristics, food-intake by students on the day of the survey, heights and weights of students were also collected after the tests. The test scores of students were matched to their family and individual characteristics using unique student identification numbers which are assigned to students at the time of their admission into the school. We randomly interviewed 10 students in each grade for additional details of students' socio-economic characteristics such as parents' occupation, number of siblings and type of residence.

Table 1 shows the individual characteristics of the full sample of students. The table suggests that students in our sample are from lower-middle income families with the majority of students (more than 80 per cent) coming from families with a stay-at-home mother and father employed in occupations that require some skill. Academic achievement of students is poor with the average score of students in tests of language and math being 52 per cent. Using WHO norms we find that the nutritional status of students is 'adequately nourished'.[6]

We identify treatment and control group of schools on the basis of whether they changed their meal provision status for grades 6 to 8 between phases or not. The date of first visit to a school was randomly determined. Thus schools which were administered the tests *before* 29th September, 2009 in Phase 1 form our treatment group while schools visited *after* this date in Phase 1 were already receiving meals in grades 6 to 8. The latter form our control

[5] We also conducted the tests in grade 6. We drop grade 6 from this analysis because grade 6 students would have been without cooked meals for only 4 to 5 months, including 2 months of school holidays during May-June. We, therefore, neither expect nor observe any significant effects of program re-introduction for this grade.

[6] WHO standards categorize a child between -2S.D. and 1S.D. BMI-for-age as 'normal'.

group of schools. Note that the date of visit to a school in Phase 1 (and Phase 2) was randomly selected and the date of expansion of the program (29th September, 2009) was unanticipated. Thus whether a school falls in the treatment or control group is determined exogenously by the timing of the policy change.

B. Mazes

Our main outcome of interest is the performance of students on a test of effort conducted separately for grades 5 and 7 in the sampled schools.[7] The test of effort consisted of solving maze puzzles. Puzzles, such as mazes, have been used extensively to study effort as performance in these puzzles is not conditional on reading, writing or math skills. Instead they require skills such as attention, perseverance and patience (Niederle and Vesterlund, 2007; Hoff and Pandey, 2006; Gneezy, Niederle, and Rustichini, 2003).

The tests were conducted in the classroom during regular school hours. Two female experimenters were assigned to one randomly selected section each in grades 5 and 7. Test booklets, along with a pencil and an eraser, were distributed to all children present in the classroom. Before conducting the test a female experimenter explained the test to the students which consisted of the test booklet with five maze puzzles from Yahoo! Games. The test was to find a path through a field from one side to the other of a maze without crossing the solid lines (see Appendix for a sample maze). The experimenter demonstrated how to solve a simple maze to the students. Subjects were then given 8 minutes to solve all five mazes. The first two mazes were of the lowest difficulty level – level 1, while the next three mazes were increasing in difficulty level from 2 to 3 to 4, respectively. The difficulty levels of the first

[7] A typical academic year consists of 200 days (20 days per month for 10 months), from April to March of the following year. Since our earliest Phase 1 visit was in August, the grade 7 students had not received school meals for at least 15 months and at most 16 months.

two mazes were kept the same so that the first maze could be treated as a practice maze. The test booklets were identical for all grades.

The tests were conducted in two phases (Phase 1 and Phase 2), explained above. In each phase two sessions of the tests were conducted - before the lunch break (Session 1) and after the lunch break (Session 2). The average time gap between the two sessions was 1.7 hours. The same set of maze puzzles was given in each phase-session (i.e., the set of puzzles differed between sessions but not phases). Students were instructed to start with maze 1 and proceed forward. We analyze the impact of school meals on effort by studying the change, between phases, in maze-scores averaged over the pre-lunch and post-lunch sessions.

The maze puzzles were followed by a test booklet containing two questions each on language and math and one IQ question. The students had to select the correct answer from multiple choices for each question within a specified time. Following these tests, each student was weighed and her height recorded during both school visits (Phase 1 and 2).

Table 2 shows the average school characteristics of the treatment and control group at the baseline. Our small school level sample does not allow us to do tests of significance at that level. However, eyeballing the mean values, we see that control schools have higher enrolment levels and attendance rates than treatment schools. The average school score in curriculum related language and math was higher in the control schools. Scores in curriculum related questions are determined by both academic school level factors such as the quality of teaching as well as non-academic factors such as time spent by teachers in teaching, discipline and management of the school. However, we do not expect reading and writing skills to influence performance in mazes since these puzzles were unrelated to the curriculum. Students were also asked to solve one IQ based question to capture any difference in innate ability. Looking at the number of students who could correctly solve this question, we find no difference among treatment and control schools which suggests that students were of comparable ability in the two types of schools. We also find that control schools spent more time in the distribution of school meals than treatment schools. This could have been due to the additional time required to distribute meals to upper grades since the control schools had extended the program at the time of the first survey visit itself.

Following the same students over Phase 1 and 2, we construct a balanced individual-level panel dataset of 834 students of grades 5 and 7 in the sampled schools. We compare the individual characteristics of the students present in both phases of the survey in Table 3. The nutritional status, socio-economic characteristics and performance in IQ tests of students in the two school groups are comparable except that students in the control schools perform better in tests of language and counting than their counterparts in treatment schools, as indicated in the previous table. However, as suggested above, performance on curriculum related questions is not necessarily correlated with the ability to solve maze puzzles. This is also apparent from the fact that children in the two groups perform equally well (or poorly) on the IQ tests. The inherent abilities of the two groups should, therefore, be comparable.

Table 4 compares the changes in the mean maze scores between rounds for control and treatment students using the individual balanced panel described in the table above. Panel A shows the score of students in grade 7. We find that, at the baseline, the scores of control schools were not significantly different from treatment schools. There was an improvement in maze scores over phases for students of both treatment and control schools. This could be due to a learning effect and the impact on effort due to extension of the meal program between the two phases. While the learning effect would be valid for students in the control and treatment school the latter effect would exist only for the treatment group. The difference in difference (DID) in mean scores between the two groups of students could then be attributed to the school meal program. Panel A shows that the difference-in-difference was larger and significant for students in treatment schools than control schools (by 0.19). Panel B shows the maze score for Grade 5 in treatment and control schools. Grade 5 scores in control schools were higher than treatment school. However, the DID of means is insignificant for Grade 5 suggesting that the externalities generated due to the expansion of the school meal program had an insignificant impact on classroom effort.

Figure 1 shows the effect of program expansion for all students in grades 5 and 7, i.e. the unbalanced students' panel. We find that the trend of the mean scores of the unbalanced students' panel is similar to the balanced students' panel. Hence the two samples should be comparable to each other.

4. Empirical strategy

We exploit the exogeneity of the timing of the first visit to the randomly sampled schools and the extension of the cooked meal scheme to the upper grades to identify the treatment and control schools. The first phase of tests was conducted from 1st August to 3rd November, 2009. The cooked meals were introduced in all Sarvodaya schools on 29thSeptember, 2009. By this time we had conducted the tests in 10 of the sampled schools. The 7 schools that were surveyed between 8th October and 3rd November, 2009 were already providing mid-day meals to upper grades. During phase 2 of our tests, all schools had extended the mid-day meal scheme to cover upper grades. Thus, 10 schools which were visited before September 29th changed their treatment status between phase 1 and phase 2 and form the treatment group for our study. The 7 schools that did not change their status and offered meals to upper grades in both phases form the control group.

We measure student effort in terms of the total score of the student in mazes 2 to 5, averaged over sessions. The first maze was treated as a practice maze and is not included in the calculation of scores. Each maze carried equal points making the maximum score in each session four points. We compare the maze scores of students over the two rounds. By the time Phase 2 was initiated, all schools had been providing meals in the upper grades for at least five months. During Phase 1, grade 7 students in the control schools had been receiving meals for at least ten days. The effect of meals on behaviour and cognition manifests quickly and has been recognized in short-term evaluations.[8] This would suggest that scores of control group grade seven students should be higher than treatment schools in Phase 1. If the meal was effective in improving classroom behaviour and cognition, the gains made by grade seven students in the treatment schools should be higher than the gains made by grade seven students in the control schools between phases.

We estimate the effect of cooked meals on effort using a school-fixed effect, intention-to-treat estimation strategy. This accounts for all unobservable time-invariant school-characteristics that could influence effort in the classroom. The treatment status is assigned at the school-level and not by individual meal uptake status. Thus, our estimating equation is given by the following specification:

$$\text{MeanScore}_{ijp} = \beta_0 + \beta_1 \text{ Phase}_p + \beta_2(\text{Treat}_j{*}\text{Phase}_p) + \mathbf{X_i} + \mu_j + e_{ijp} \quad (1)$$

where $MeanScore_{ijp}$ is the maze score of student i, averaged over the two sessions, in school j in grade *7* in phase p. $Phase_p$ takes value 1 for all students if the observation is recorded for Phase 2 and 0 if recorded for Phase 1. $Treat_j$ takes value 1 for all students in both phases in schools that got meals in Phase 2 and not in Phase 1 and 0 in schools that got meals in both phases. $\mathbf{X_i}$ is a vector of individual characteristics such as nutritional status measured by the BMI category of the child, whether she could solve the IQ question, score of the child in math and language test and baseline score of the child in the maze puzzles. μ_j is the school-fixed effect and e_{ijp} is the idiosyncratic error term. The interaction $Treat_j{*}\ Phase_p$ estimates the difference-in-difference effect of cooked meals on Grade 7 students. In order to control

[8] Most studies on cognition and behavior have been conducted within two weeks to a month.

for individual time-invariant characteristics that could impact effort we also estimate equation 1 with child-fixed effects.

The introduction of meals may create additional pressures on limited school resources. For example, teachers need to be involved in the monitoring and distribution of meals which could reduce their time spent on teaching. In our sample, the extension of the program led to schools increasing recess duration including the time spent in meal distribution. We observed that although the distribution of meals took place grade-wise with lower grades receiving meals first, upper grades were dismissed for the lunch break before meals were distributed to them. Distribution of school meals was also not done in a systematic manner for upper grades in most schools. In 12 of the 17 schools, upper grades were served meals on a first-come, first-served basis. This caused considerable distraction among students and could confound any improvement in attention by students due to school meals. We attempt to get over this problem in two ways. First, we study the maze-scores averaged over sessions. Thus our outcome variable is inclusive of disturbance caused by the meal. Second, we use maze-scores of Grade 5 to study the externalities caused due to the distribution of school meals. Note that Grade 5 of all Sarvodaya Schools was entitled to school meals throughout the period under study. Thus, any difference in the test scores of Grade 5 students of treatment and control schools can be attributed to school-level changes due to the introduction of meals for upper grades which impact all grades equally. If this difference is insignificant, we can claim that the disturbance effect of the meal does not confound the effect on effort.

5. Results

We now discuss our results from estimating equation 1 above. Table 5 shows the effect of school meals on effort using the individual balanced panel for grade 5 and grade 7 students. Columns 1 and 2 report the results for the school-fixed specification while columns 3 and 4 show the results for the child-fixed effects specification. The coefficient of interest is the interaction term '*Treat x Phase2'* which is the DID estimate of the effect of school meals on Grade 7.

In column 1, the positive coefficient on the baseline maze score suggests that a high score at the baseline implies higher overall effort levels within the classroom. Performance improves in phase 2 as suggested by the coefficient on 'Phase 2'. This indicates, as expected, that there is a learning effect of playing the maze puzzles repeatedly. However the DID coefficient is insignificant for grade 5. Since grade 5 students were receiving school meals throughout the study (Phase 1 and 2) this indicates that program extension had an insignificant impact on the lower grades. There is no significant effect of the child's health status, gender, age or performance on other tests for grade 5 students.

In column 2 we analyze the school fixed effects results for students of grade 7. While there is a learning effect as indicated by the positive coefficient on 'phase 2', there is a positive effect of receiving school meals as well. The coefficient on the interaction term suggests that a grade 7 student solved an additional 0.19 mazes due to the extension of the program. This suggests that school meals had an overall impact on effort levels for the upper grades.

We do not find a significant impact of other individual characteristics on effort levels except age in column 2. The significantly negative coefficient on age suggests that older children in grade 7 perform worse than average in solving maze puzzles. Columns 3 and 4 show that our conclusions are unchanged when we account of heterogeneity in individual characteristics. To elaborate, the coefficient on the interaction term is insignificant for grade 5 but significant and remarkably similar in magnitude to the school fixed effects result for grade 7. While these results have been reported for the balanced panel, our conclusions are unchanged if we analyse the unbalanced panel of students.

We next analyze the heterogeneous effect of school meals for grade 7 students in Table 6. Column 1 shows the effect of the meal program on classroom effort by gender. We include the interaction terms 'girl x phase 2' and 'girl x treat x phase2'. The coefficient on both the interaction terms is insignificant, indicating that there is no differential affect by gender. However, the overall treatment effect, given by the coefficient on 'treat x phase2, is now insignificant. One possible explanation of this could be that there are only 6 co-educational schools in our sample (2 in control group and 4 in treatment group) which does not allow us to separate the school-effect from the gender-effect.

Column 2 looks at the effect by the average school level score in math and language tests. These are interacted with the dummy for phase 2 and with both phase 2 and treatment status dummy. We find that the coefficient on (school score x treat x phase2) is significant and positive. However, the overall effect of meals given by (Treat*Phase2) becomes negative and significant. This suggests that the average positive effect of school meals on classroom effort seen in the previous table was driven by schools with better performing students in math and language tests.

Column 3 looks at the effect of meals by children's nutritional status. Specifically, we interact the dummy variable for low BMI with the dummy for phase and for treatment. None of these interaction terms are significant. This suggests that the children with low BMI did not gain significantly due to the meals in terms of improvement in their classroom effort. Column 4 looks at the effect of meals on classroom effort by individual scores in math and language test. The interaction terms 'baseline math and language score x Phase 2' and 'baseline math and language score x Phase 2 x treat' are insignificant. However, the overall treatment effect, 'treat x phase 2' is positive and significant.

6. Conclusion

We study the effect of school meals on classroom effort of public school students in Delhi. Taking advantage of an extension of the meal program to upper grades of public schools in Delhi on an unanticipated date and the randomization in the date of first visit to the sampled schools, we find that school meals have a positive effect on classroom effort of students. We measure concentration and effort in terms of the performance of students on maze puzzles which were administered to them during regular school hours. We conclude that the provision of school meals can improve class room concentration and effort. It is important to highlight the fact that the sampled children in this study were better nourished than the average in India for that age group. Our results here, therefore, are likely to be lower than the effect of subsidized school meals on classroom effort in regions with more malnourished and hungry children. Our results also suggest that school quality influences the extent to which school meals improve effort levels. Students in schools that had higher average scores in curriculum related tests gained significantly more from the extension of the meal program.

The findings of this paper have policy relevance – provision of subsidized or free meals can improve the performance of students within the classroom. This carries implications for the long term learning outcomes and educational attainment of children.

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Table 1: Summary statistics of student characteristics

Individual child characteristics[a]	Mean	Std. Error	N
Age (years)	11.05	0.045	1164
Weight (kgs.)	29.88	0.246	1072
Height (cms.)	137.40	0.332	1077
Z-Score of BMI for age	-1.18	0.042	1059
Female	0.61	0.014	1213
Mean score in Language and Math test	2.5	0.008	1213
Students able to solve IQ question	0.20	0.011	1213
Household characteristics (sub-sample)			
Father is a regular salaried employee	0.27	0.028	246
Father is a mechanic	0.27	0.028	246
Father is a skilled worker	0.13	0.021	246
Father is a business man	0.13	0.021	246
Father is an unskilled worker	0.11	0.020	246
Mother is working	0.22	0.027	244

Notes: [a] Summary statistics of all 1213 students who took the test in Phase 1. Heights and weights not recorded for 2 grade-sections. Age is calculated from the date of birth record available from the Directorate of Education. Age is missing if date of birth is not recorded/ incorrectly recorded. Z-scores calculated using WHO standards.
[b] Family characteristics obtained for sub-sample of 246 randomly selected students.

Table 2: Summary statistics of school characteristics at baseline by treatment status

School characteristics	Control Schools (N=7)	Treatment School (N=10)
	(1)	(2)
Enrolment in grade 5	59.57	59.30
	(9.413)	(9.459)
Enrolment in grade 7	249.29	150.60
	(56.018)	(15.995)
Attendance rate in grade 5	0.89	0.82
	(0.023)	(0.040)
Attendance rate in grade 7	0.84	0.81
	(0.030)	(0.021)
Grade 5 score in math and language	3.13	2.88
	(0.223)	(0. 121)
Grade 7 score in math and language	4.19	3.93
	(0.131)	(0.341)
Proportion of students able to solve IQ question	0.20	0.18
	(0.019)	(0.018)
Time taken in distribution of MDM (in minutes)	56.42	29
	(9.923)	(6.741)
Recess duration (in minutes)	24.28	22.5
	(2.02)	(1.53)

Notes: Enrolment and attendance as of August 2009.

Table 3: Average student characteristics by treatment status (individual balanced panel)

	Control	Treatment	
Individual characteristics	**N=370**	**N=465**	**Difference**
	(1)	**(2)**	**(2)-(1)**
Weight (kgs.)	30.36	29.61	-0.75
	(0.423)	(0.375)	(0.566)
	[359]	[461]	
Height (cms.)	138.28	137.03	-1.25
	(0.587)	(0.503)	(0.770)
	[363]	[461]	
Z-score (BMI for age)	-1.19	-1.19	0.00
	(0.070)	(0.065)	(0.096)
	[359]	[459]	
Female	0.70	0.60	-0.10**
	(0.024)	(0.023)	(0.033)
Mean Score in language and math (maximum score=8)	3.85	3.49	-0.35**
	(0.086)	(0.080)	(0.011)
Proportion of students able to solve IQ question	0.19	0.20	0.01
	(0.020)	(0.018)	(0.028)
Father's occupation (sub-sample)	**N=97**	**N=146**	
Regular/salaried employee	0.29	0.26	-0.03
	(0.046)	(0.036)	(0.058)
Mechanic	0.24	0.28	0.04
	(0.043)	(0.037)	(0.058)
Skilled worker	0.12	0.14	0.01
	(0.034)	(0.029)	(0.044)
Businessman	0.14	0.12	-0.03
	(0.036)	(0.027)	(0.044)
Unskilled worker	0.11	0.11	0.00
	(0.032)	(0.026)	(0.041)

Notes: Summary statistics for students present in both phases of tests - 835 students. Any deviation from sample size is noted in square brackets. Heights and weights not recorded in two grade-sections of grade 5 which was assigned to random seating. Family characteristics obtained for sub-sample of 243 randomly selected students

Standard errors in parentheses. ** significant at 1% **significant at 5%

Table 4: Mean maze scores (individual balanced panel)

Treatment status	Grade 7		
	Phase 1	Phase 2	Difference
	(1)	(2)	(2) – (1)
Control	2.22	2.73	0.51
	(0.081)	(0.085)	(0.067)
Treatment	2.21	2.91	0.70
	(0.076)	(0.076)	(0.068)
Difference	-0.01	0.18	0.19**
	(0.112)	(0.114)	(0.096)
	Grade 5		
	(1)	(2)	(2) – (1)
Control	1.71	2.49	0.78
	(0.088)	(0.094)	(0.083)
Treatment	1.45	2.17	0.72
	(0.079)	(0.082)	(0.065)
Difference	-0.27**	-0.32**	-0.05
	0.118	0.125	(0.104)

Notes: Panel A shows the scores in mazes averaged over sessions for Grade 7 by treatment status. Panel B shows the same for Grade 5.
* significant at 5% ** significant at 1%.

Figure 1: Average maze scores (individual unbalanced panel)

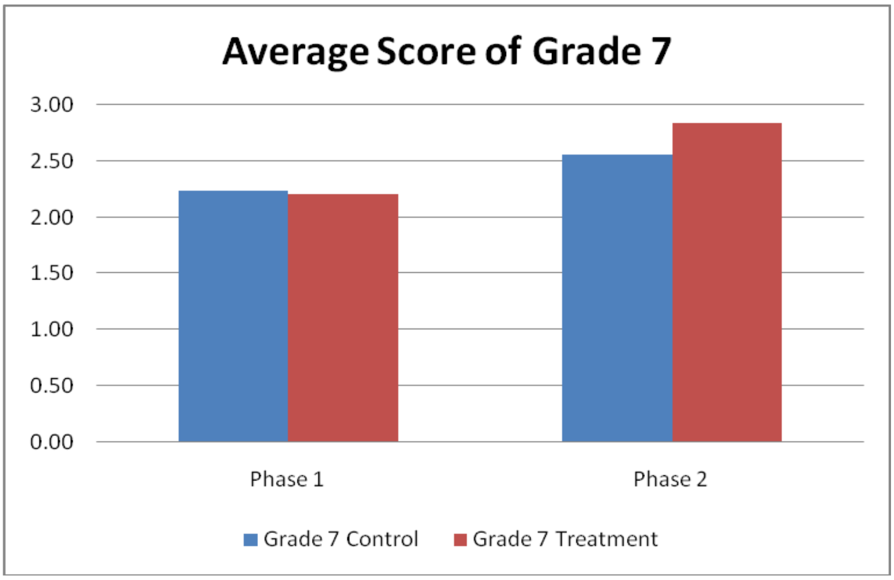


Table 5: Effect of school meals on class room effort

	School fixed effects		Child fixed effects	
	(1)	(2)	(3)	(4)
	Grade 5	Grade 7	Grade 5	Grade 7
Baseline Maze Score	0.82	0.79		
	(0.027)**	(0.025)**		
Phase 2	0.78	0.51	0.78	0.51
	(0.080)**	(0.064)**	(0.083)**	(0.067)**
Treat x Phase 2	-0.06	0.19	-0.06	0.19
	(0.101)	(0.090)*	(0.105)	(0.095)*
Child is overweight	-0.11	-0.10		
	(0.145)	(0.112)		
Child is thin	-0.10	-0.18		
	(0.178)	(0.136)		
Child is severely thin	-0.03	-0.06		
	(0.158)	(0.130)		
Girl	0.03	0.10		
	(0.068)	(0.070)		
Child's age	0.02	-0.04		
	(0.028)	(0.020)*		
Baseline IQ score	0.05	-0.03		
	(0.064)	(0.061)		
Baseline math & language score	0.03	0.01		
	(0.018)	(0.015)		
Constant	0.12	0.91	1.56	2.22
	(0.322)	(0.277)**	(0.036)**	(0.034)**
Observations	790	880	790	880
R-Square	0.700	0.700	0.672	0.659

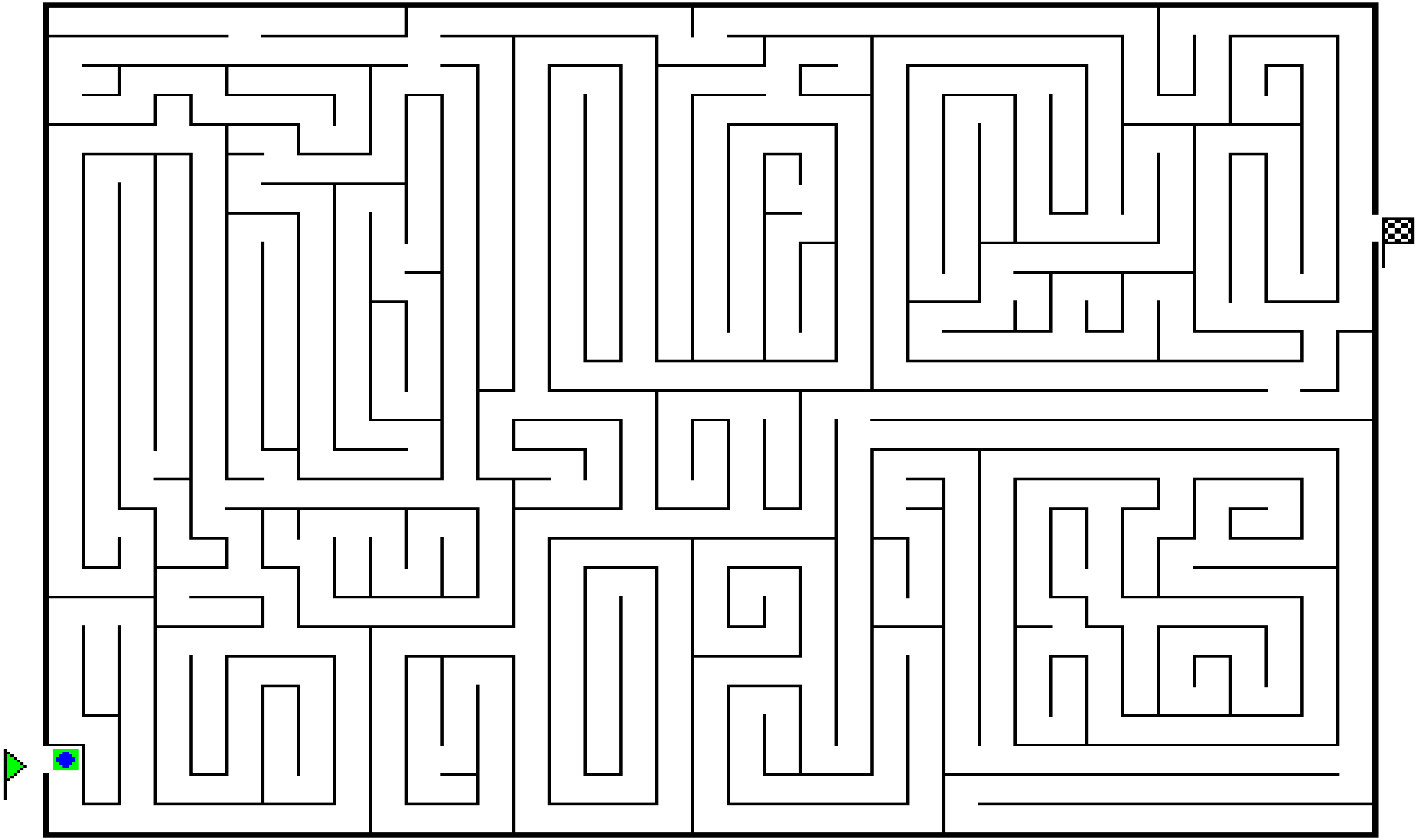
Notes: These results are for the sample of those students who were present in both rounds of tests. Results do not vary for the unbalanced panel of students.
Robust standard errors in parentheses. * significant at 5% ** significant at 1%.

Table 6: Heterogeneity of effect of school meals on classroom effort (school fixed effects)

	Specification			
	(1)	(2)	(3)	(4)
Baseline maze score	0.79	0.79	0.79	0.79
	(0.025)**	(0.025)**	(0.025)**	(0.025)**
Phase 2	0.46	1.93	0.51	0.38
	(0.119)**	(0.867)*	(0.074)**	(0.187)*
Treat x Phase 2	0.06	-1.91	0.22	0.42
	(0.15)	(0.947)*	(0.101)*	(0.240)*
Girl x Phase 2	0.07			
	(0.14)			
Girl x Treat x Phase 2	0.25			
	(0.18)			
School's math and language score x Phase 2		-0.37		
		(0.226)*		
School's math and language score x Treat x Phase 2		0.57		
		(0.249)*		
Low BMI			0.02	
			(0.04)	
Low BMI x Phase 2			0.00	
			(0.15)	
Low BMI x Phase2 x Treat			-0.11	
			(0.22)	
Baseline math and language score x Phase 2				0.03
				(0.04)
Baseline Math and Language Test Score x Phase2 x Treat				-0.06
				(0.05)
BMI 'normal'	-0.10	-0.10		-0.10
	(0.11)	(0.11)		(0.11)
BMI 'thin'	-0.18	-0.18		-0.18
	(0.14)	(0.14)		(0.14)
BMI 'severely thin'	-0.06	-0.06		-0.06
	(0.13)	(0.13)		(0.13)
Girl	-0.01	0.10	0.11	0.11
	(0.06)	(0.07)	(0.07)	(0.07)
Child's age	-0.03	-0.04	-0.03	-0.03
	(0.020)*	(0.020)*	(0.020)*	(0.020)*
Score in IQ test	-0.03	-0.03	-0.04	-0.04
	(0.06)	(0.06)	(0.06)	(0.06)
Baseline Score in math & language	0.00	0.01	0.01	0.01
	(0.02)	(0.02)	(0.02)	(0.01)
Constant	0.98	0.91	0.79	0.89
	(0.280)**	(0.276)**	(0.264)**	(0.275)**
Observations	880	880	880	880

Notes: The coefficient of Treat*Round 2 is the DD estimate of the effect of school meals on effort levels for the balanced panel of students.
Robust standard errors in parentheses. * significant at 5% ** significant at 1%.

Appendix 1: Sample maze puzzle



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