

# The causal impact of school breakfast clubs on academic attainment

Evaluating the Magic Breakfast intervention

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10 April 2017

# Motivation

- ▶ 62% of UK school staff witness children arriving hungry at school on a weekly basis (Association for Public Service Excellence, 2014)
- ▶ Unhealthy or absent breakfasts associated with cognitive, behavioural, and health problems in children
- ▶ Policymakers seek to address this through school nutrition programmes
  - ▶ Welsh school breakfast programme (mandated 2013)
  - ▶ England's School Food Plan (2013)

# Research Questions

In the context of expanding provision, we examine:

- ▶ Whether school breakfast programmes have an impact on academic attainment
- ▶ How the effects are mediated
- ▶ For whom the intervention is most effective

Evaluating different models of provision is also a key question, but beyond the scope of our paper

# This paper

Our contribution:

- ▶ Provide evidence of effects on attainment from a large-scale RCT in disadvantaged English primary schools
  - ▶ Builds on recent quasi-experimental literature on school nutrition in developed countries
- ▶ Analysis of potential mechanisms and of programme costs

# This paper

## Our contribution:

- ▶ Provide evidence of effects on attainment from a large-scale RCT in disadvantaged English primary schools
  - ▶ Builds on recent quasi-experimental literature on school nutrition in developed countries
- ▶ Analysis of potential mechanisms and of programme costs

## Key results:

- ▶ Breakfast club provision increases academic attainment by around 0.13 standard deviations ( $\sim 2$  months' progress)
- ▶ Gains are driven by better behaviour and concentration, and possibly improved health
- ▶ Highly cost-effective - £24.01 per eligible pupil per year
- ▶ Evidence of spillovers between groups and peer effects in learning

# Outline

1. Existing evidence
2. Intervention and methodology
3. Results
4. Cost
5. Conclusion

# Nutrition and Human Capital

Nutrition is linked to human capital formation in several ways:

- ▶ Chronic malnutrition impedes the physical development of the brain, sometimes permanently (Brown and Pollitt, 1996)
- ▶ Acute hunger is detrimental to short-term outcomes
  - ▶ Cognitive outcomes such as memory or reaction time (Gold, 1995; Fischer et al., 2002)
  - ▶ Non-cognitive performance, including focus and behaviour (Murphy et al., 1998)
- ▶ Repeated episodes of hunger can have cumulative and acute effects on test scores

This suggests that interventions to reduce acute hunger and boost long-term nutrition might be effective in promoting human capital development.

## Existing Evidence

In developing countries, school breakfast improves health, attendance, and (some) academic outcomes

- ▶ Jacoby et al., 1996; Powell et al., 1998

Recent quasi-experimental literature based on U.S. focuses on non-academic outcomes

- ▶ Some exceptions, which emphasise effect of in-class delivery on attainment (Imberman and Kugler, 2014; Frisvold, 2015; Dotter, forthcoming)

Experimental evidence from other developed countries is less conclusive

- ▶ Some studies find improvements in health/reductions in hunger but little effect on attainment (Murphy et al., 2011; Ni Mhurchu et al., 2013; Schanzenbach and Zaki, forthcoming)
- ▶ Others find reduction in absence and improved concentration (Shemilt et al., 2004)



## Model

Model attainment of pupil  $i$  with classroom peers  $\bar{i}$  in year  $t$ :

$$Y_{it} = f(Y_{i,t-1}, Q_{it}, E_{\bar{i}t}, E_{it}, L_{it})$$

where  $Y_{i,t-1}$  is prior attainment;  $Q_{it}$  is teacher effectiveness;  $E_{it}$  and  $E_{\bar{i}t}$  are the efforts of the pupil and her classroom peers; and  $L_{it}$  is the pupil's learning time.

The inputs for  $Y_{it}$  also depend on the pupil's health ( $H_{it}$ ), the attendance of her peers ( $L_{\bar{i}t}$ ), and a fixed component of teacher quality  $\bar{Q}_i$ .

$$L_{it} = g(L_{\bar{i}t}, H_{it})$$

$$E_{it} = h(E_{\bar{i}t}, E_i, H_{it})$$

$$Q_{it} = q(E_{\bar{i}t}, \bar{Q}_i, L_{\bar{i}t})$$

# The Intervention

- ▶ Eligibility: relatively disadvantaged primary schools in England with limited existing breakfast club provision
- ▶ 106 schools randomised within strata
- ▶ Treatment: One year of support from the charity Magic Breakfast to establish a universal, free, before-school breakfast club (academic year 2014/15)
  - ▶ As much food as required, free of cost
  - ▶ £300 grant to defray capital costs
  - ▶ Support from dedicated school change leader to help with logistics, sustainability, ...
  - ▶ Schools were responsible for meeting other costs (e.g. staffing)
- ▶ Wait-list design: Control schools get two years' support starting 2015/16

## Fidelity and Take-up

- ▶ All treatment schools (that responded to follow-up survey) established breakfast provision
- ▶ But only a third of this was the agreed model of provision
- ▶ 40% of control schools also established new breakfast provision

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- ▶ 40% of control schools also established new breakfast provision

Pupil take-up is on the low end of estimates in the literature:

- ▶ Average take-up is just 13%
- ▶ Three-quarters of schools serve fewer than 50 students

## Data and Methodology

- ▶ Evaluation focuses on pupils at Year 2 (age 6/7) and Year 6 (age 10/11)
- ▶ Methodology: OLS/logistic regression, controlling for school and pupil characteristics and baseline measurements [More](#)
- ▶ Main academic outcome measures collected from administrative data (NPD)
- ▶ Absence and late arrival data and pupil demographics also from NPD
- ▶ Other mechanisms data comes from surveys designed by research team (collected at baseline and follow-up)
  - ▶ Pupil survey: hunger and breakfast consumption
  - ▶ Teacher survey: classroom behaviour and concentration questions
  - ▶ Head teacher survey: data on motivations and implementation
  - ▶ Magic Breakfast: food orders and take-up

# Evaluation Sample

- ▶ By design, schools are more disadvantaged than the average English school
  - ▶ 82% of participating schools in bottom 30% of neighbourhoods
- ▶ Well-balanced on observables, but treatment schools...
  - ▶ are significantly more urban
  - ▶ have a significantly higher proportion of students reporting hunger at baseline
  - ▶ have significantly fewer authorised absences in 2013/14

# Academic Outcomes

Table: Effect of treatment status on academic outcomes

	(1) KS1	(2) KS2
Treatment	0.137*** (0.050)	0.114 (0.074)
Observations	4,586	3,907
$R^2$	0.402	0.433
Control N	2,113	1,857
Treatment N	2,473	2,050
School N	102	98

Notes: \*\*\* denotes statistical significance at the 1% level, \*\* at the 5% level, \* at the 10% level. Outcome variables are standardised averages of point scores for reading and maths from teacher assessments (KS1) or test scores (KS2). All models estimated by Ordinary Least Squares. Standard errors clustered at the school level. Regressions control for randomisation strata; prior attainment; demographics (sex, ever FSM, ethnic group, SEN, EAL); pre-intervention school characteristics (Ofsted rating, IMD rank, urban status, number of students).

# Potential Mechanisms

Table: Effect of treatment status on potential mechanisms

	(1) Ate B'fast	(2) B'fast at School	(3) Total Absences	(4) Auth. Absences	(5) Unauth. Absences	(6) Late Arrivals	(7) Behaviour Index	(8) Concentration Index
Treatment	0.032** (0.016)	0.146*** (0.036)	-0.884* (0.533)	-1.367*** (0.461)	0.454 (0.347)	-0.147 (0.096)	0.476*** (0.157)	0.654*** (0.158)
Observations	3,373	3,323	8,085	8,085	8,085	8,085	234	234
R <sup>2</sup>	N/A	N/A	0.309	0.244	0.240	0.277	0.307	0.336
Pseudo R <sup>2</sup>	0.067	0.094	N/A	N/A	N/A	N/A	N/A	N/A
Control N	1,531	1,488	3,755	3,755	3,755	3,755	114	114
Treatment N	1,842	1,835	4,330	4,330	4,330	4,330	120	120
School N	71	70	106	106	106	106	86	86

Notes: \*\*\* denotes statistical significance at the 1% level, \*\* at the 5% level, \* at the 10% level. Outcomes for columns (1) and (2) are binary indicators; absence and late arrival variables are measured in half-days over the 2014/15 academic year; and outcomes for columns (7) and (8) are standardised indices derived from teacher survey responses using factor analysis. Standard errors clustered at the school level. Regressions control for randomisation strata; prior absence record (2013/14); demographics (sex, ever FSM, ethnic group, SEN, EAL); pre-intervention school characteristics (Ofsted rating, IMD rank, urban status, number of students). First two columns ("ate breakfast" and "ate breakfast at school") report average marginal effects following logistic regression; other outcomes are OLS coefficients.



# Subgroup Analysis

**Table:** Effect of treatment status on breakfast consumption and academic outcomes, by FSM status

	(1) Ate breakfast		(3) School breakfast		(5) KS1 Academic		(7) KS2 Academic	
	FSM	Not FSM	FSM	Not FSM	FSM	Not FSM	FSM	Not FSM
Treatment	-0.006 (0.021)	0.094*** (0.025)	0.180*** (0.039)	0.103** (0.040)	0.103* (0.058)	0.132** (0.060)	0.047 (0.080)	0.231*** (0.081)
Observations	1,842	1,439	1,808	1,437	2,295	2,050	2,364	1,543
R <sup>2</sup>	N/A	N/A	N/A	N/A	0.414	0.380	0.425	0.455
Pseudo R <sup>2</sup>	0.068	0.096	0.125	0.087	N/A	N/A	N/A	N/A
Control N	897	584	868	584	1,084	912	1,158	699
Treatment N	945	855	940	853	1,211	1,138	1,206	844
School N	71	69	70	69	101	102	98	98
Difference p-value	0.002 ***		0.030 **		0.559		0.004 ***	

Notes: \*\*\* denotes statistical significance at the 1% level, \*\* at the 5% level, \* at the 10% level. Models are estimated separately for each subgroup and tested for significant differences in the treatment effect. Standard errors clustered at the school level. Regressions control for randomisation strata; prior absence record (2013/14); demographics (sex, ever FSM, ethnic group, SEN, EAL); pre-intervention school characteristics (Ofsted rating, IMD rank, urban status, number of students). Columns (1)-(4) report average marginal effects following logistic regression; columns (5)-(8) report OLS coefficients on standardised outcome variables.

# Cost per Pupil

**Table:** Annual average cost, per eligible and per treated pupil

<b>Cost type</b>	<b>Average per eligible pupil</b>	<b>Average per treated pupil</b>
Upfront costs	£4.34	£33.30
Ongoing costs	£19.67	£119.46
Total costs	£24.01	£152.76

Notes: The first column reports costs per eligible pupil, i.e. all pupils in the school. The second column uses take-up figures from Magic Breakfast to calculate cost per student taking up the breakfast offer. "Upfront" costs include schools' reported spending on furniture, improvements to the physical environment, catering facilities, resources, staff training, and "other" costs. "Ongoing" costs include the retail cost of food provided by Magic Breakfast during the intervention, additional food purchased by the school, and imputed monetary costs of staff time. Staff time costs are imputed based on average hourly wages for different job titles (4-digit SOC codes) derived from the Annual Survey of Hours and Earnings. These figures are based on a subsample of 38 treated schools where both cost and take-up data are observed. [Hours](#)

## Conclusion

- ▶ Breakfast club provision in disadvantaged schools has a positive impact on pupil attainment (equivalent to about 2 months' progress)
- ▶ Distribution of the academic gains is uneven:
  - ▶ Larger at KS1 than KS2
  - ▶ Larger for non-FSM students
- ▶ Multiple mechanisms mediating this, but the most important appears to be behaviour and concentration
- ▶ Limited effect on overall breakfast consumption - suggests that the content/context of school breakfast are important
- ▶ Cost-effective intervention requiring just £24.01 and 3.1 hours per eligible pupil per year
- ▶ Given proven benefits and substantial policy interest, further research required to investigate optimal model of delivery in England

# Appendix

# Methodology

- ▶ Use OLS and logistic regression on standardised outcome variables to estimate effect sizes [More](#)
- ▶ Control for:
  - ▶ Randomisation strata
  - ▶ School characteristics (Ofsted rating, IMD rank, urban status, number of students)
  - ▶ Pupil characteristics (sex, ever FSM, ethnicity, SEN, EAL)
  - ▶ Relevant baseline measure of the outcome
- ▶ Standard errors clustered at school level

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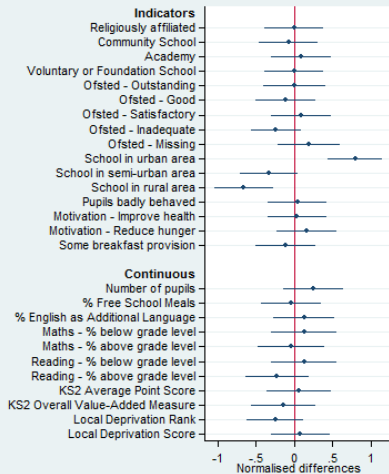
# Methodology

- ▶ For *academic outcomes*, use OLS regression on standardised scores
- ▶ For *hunger and breakfast consumption outcomes*, use logistic regression and report average marginal effects
- ▶ For *behaviour and concentration*, construct indices using factor analysis and analyse with OLS
- ▶ For *absence and late arrival outcomes*, use OLS on the number of half-days absent or late
- ▶ Standard errors clustered at school level

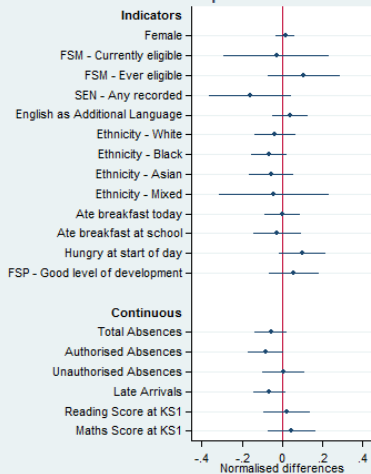
# Baseline Balance

## Baseline Balance Tests

### School characteristics



### Pupil characteristics



## Baseline Balance - school level

Table: Baseline balance on school-level discrete characteristics

Group:	Intervention		Control		
Variable	n/N (missing)	%	n/N (missing)	%	Difference
Religious	11/53(0)	20.8%	11/53(0)	20.8%	0.0
Community	30/53(0)	56.6%	32/53(0)	60.4%	-3.8
Academy	12/53(0)	22.6%	10/53(0)	18.9%	3.8
Voluntary	11/53(0)	20.8%	11/53(0)	20.8%	0.0
Outstanding	4/53(0)	7.5%	5/53(0)	7.5%	0.0
Good	30/53(0)	56.6%	33/53(0)	62.3%	-5.7
Satisfactory	12/53(0)	22.6%	10/53(0)	18.9%	3.8
Inadequate	0/53(0)	0%	2/53(0)	3.8%	-3.8
No Ofsted	7/53(0)	13.2%	4/53(0)	7.5%	5.7
Urban	40/53(0)	75.5%	19/53(0)	35.8%	39.6***
Semi-urban	10/53(0)	18.9%	18/53(0)	34.0%	-15.1*
Rural	3/53(0)	5.7%	16/53(0)	30.2%	-24.5***
Bad behaviour	17/53(0)	32.1%	16/53(0)	30.2%	1.9
Motive: health	26/53(0)	49.1%	25/53(0)	47.2%	1.9
Motive: hunger	18/53(0)	34.0%	14/53(0)	26.4%	7.5
B'fast provision	22/53(0)	41.5%	25/53(0)	47.2%	-5.7



## Baseline Balance - school level

Table: Baseline balance on school-level continuous characteristics

Group:	Intervention		Control		
Variable	n (missing)	Mean	n (missing)	Mean	Difference
number of pupils	53(0)	333.9	53(0)	291.5	42.4
%FSM	53(0)	43.8	53(0)	44.1	-0.3
%EAL	50(3)	35.5	47(6)	31.3	4.1
% above grade, maths	46(7)	34.1	46(7)	32.1	2.0
% below grade, maths	46(7)	17.3	46(7)	17.8	-0.5
% above grade, reading	46(7)	39.6	46(7)	37.5	2.1
% below grade, reading	46(7)	13.8	46(7)	16.2	-2.4
KS1 average points	4(49)	15.4	3(50)	13.6	1.8
KS2 average points	46(7)	27.5	48(5)	27.4	0.1
KS2 value-added	46(7)	100.2	48(5)	100.4	-0.2
IMD rank	53(0)	15.5	53(0)	19.6	-4.1
IMD score	53(0)	42.5	53(0)	41.3	1.2

# Baseline Balance - pupil level

Table: Baseline balance on pupil-level discrete characteristics

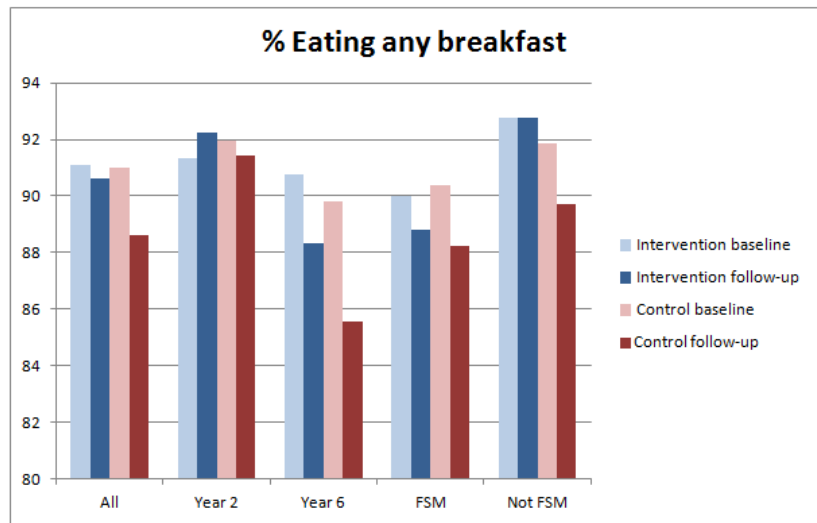
Group:	Intervention		Control		
Variable	n/N (missing)	%	n/N (missing)	%	Difference
Female	2283/4609 (528)	49.5	1969/4038 (405)	48.8	0.8
White	2505/5137 (0)	48.8	2228/4443 (0)	50.1	-1.4
Black	961/5137 (0)	18.7	653/4443 (0)	14.7	4.0
Asian	478/5137 (0)	9.3	640/4443 (0)	14.4	-5.1
Mixed	342/5137 (0)	6.7	252/4443 (0)	5.7	1.0
FSM current	1553/4574 (563)	34	1430/4009 (434)	35.7	-1.7
FSM ever	2478/4574 (563)	54.2	2300/4009 (434)	57.4	-3.2
SEN	983/4574 (563)	21.5	954/4009 (434)	23.8	-2.3
EAL	1786/4568 (569)	39.1	1645/4003 (440)	41.1	-2.0
B'fast today	3211/3526 (1611)	91.1	2326/2556 (1887)	91	0.1
School b'fast	346/3506 (1631)	9.9	269/2536 (1907)	10.6	-0.7
Hungry today	1230/3212 (1925)	38.3	786/2356 (2087)	33.4	4.9*
FSP good	1059/2376 (307)	44.6	838/2012 (253)	41.7	2.9

## Baseline Balance - pupil level

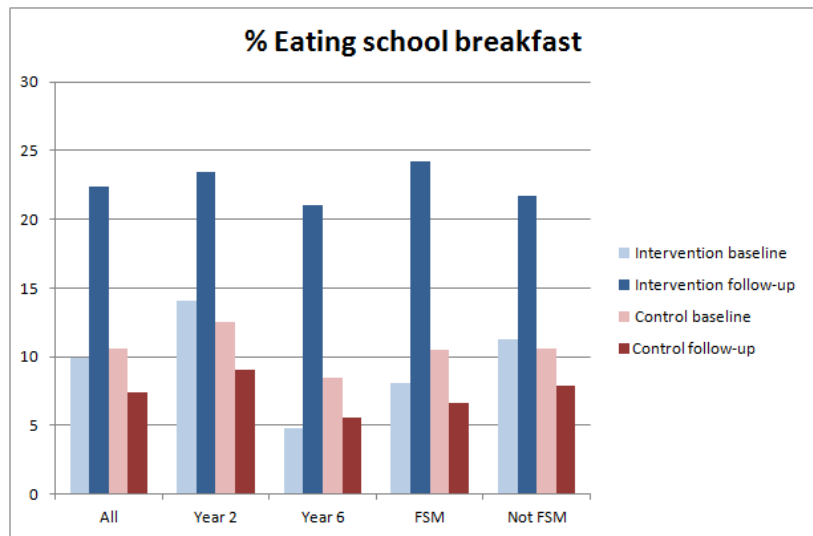
Table: Baseline balance on pupil-level discrete characteristics

Group:	Intervention		Control		
Variable	n (missing)	Mean	n (missing)	Mean	Difference
Absences	4376 (761)	13.05	3792 (651)	13.84	-0.79
Auth. absences	4376 (761)	9.46	3792 (651)	10.31	-0.86*
Unauth. absences	4376 (761)	3.59	3792 (651)	3.53	0.06
Late arrivals	4609 (528)	0.26	4038 (405)	0.37	-0.12
KS1 reading	1914 (540)	14.52	1698 (470)	14.42	0.10
KS1 writing	1914 (540)	13.30	1698 (470)	13.15	0.15
KS1 maths	1913 (541)	14.80	1697 (471)	14.63	0.17

# Proportion Eating Breakfast



# Proportion Eating School Breakfast



# Supervisory hours per pupil

**Table:** Annual average supervisory hours, per eligible and per treated pupil

<b>Supervisor type</b>	<b>Average per eligible pupil</b>	<b>Average per treated pupil</b>
Teaching staff	2.05	15.16
Support staff	0.45	4.36
Other staff/helpers	0.58	3.27
Total	3.08	22.79

Notes: The first column reports supervisory hours per eligible pupil, i.e. all pupils in the school. The second column uses take-up figures from Magic Breakfast to calculate hours per student taking up the breakfast offer. Teaching staff include teachers and teaching assistants; support staff include catering, caretaking, pastoral, and office staff; and 'Other' supervisors include volunteers and unspecified staff. [Back](#)